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necessary. Here is a sample; alter the names:

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library 'Frob' (a library for tweaking knobs) written by James Random Hacker.

<signature of Ty Coon>, 1 April 1990
Ty Coon, President of Vice

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Version 3, 29 June 2007

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GNU LIBICONV - character set conversion library

This library provides an iconv() implementation, for use on systems which
don't have one, or whose implementation cannot convert from/to Unicode.

It provides support for the encodings:

European languages
ASCII, ISO-8859-{1,2,3,4,5,7,9,10,13,14,15,16},
KOI8-R, KOI8-U, KOI8-RU,
CP{1250,1251,1252,1253,1254,1257}, CP{850,866,1131},
Mac{Roman,CentralEurope,Iceland,Croatian,Romania},
Mac{Cyrillic,Ukraine,Greek,Turkish},
Macintosh
Semitic languages
ISO-8859-{6,8}, CP{1255,1256}, CP862, Mac{Hebrew,Arabic}
Japanese
EUC-JP, SHIFT_JIS, CP932, ISO-2022-JP, ISO-2022-JP-2, ISO-2022-JP-1
Chinese
EUC-CN, HZ, GBK, CP936, GB18030, EUC-TW, BIG5, CP950, BIG5-HKSCS,
BIG5-HKSCS:2004, BIG5-HKSCS:2001, BIG5-HKSCS:1999, ISO-2022-CN,
ISO-2022-CN-EXT
Korean
EUC-KR, CP949, ISO-2022-KR, JOHAB
Armenian

ARMSCII-8
Georgian
Georgian-Academy, Georgian-PS
Tajik
KOI8-T
Kazakh
PT154, RK1048
Thai
ISO-8859-11, TIS-620, CP874, MacThai
Laotian
MuleLao-1, CP1133
Vietnamese
VISCII, TCVN, CP1258
Platform specifics
HP-ROMAN8, NEXTSTEP
Full Unicode
UTF-8
UCS-2, UCS-2BE, UCS-2LE
UCS-4, UCS-4BE, UCS-4LE
UTF-16, UTF-16BE, UTF-16LE
UTF-32, UTF-32BE, UTF-32LE
UTF-7
C99, JAVA
Full Unicode, in terms of 'uint16_t' or 'uint32_t'
(with machine dependent endianness and alignment)
UCS-2-INTERNAL, UCS-4-INTERNAL
Locale dependent, in terms of 'char' or 'wchar_t'
(with machine dependent endianness and alignment, and with OS and
locale dependent semantics)
char, wchar_t
The empty encoding name "" is equivalent to "char": it denotes the
locale
dependent character encoding.

When configured with the option --enable-extra-encodings, it also provides
support for a few extra encodings:

European languages
CP{437,737,775,852,853,855,857,858,860,861,863,865,869,1125}
Semitic languages
CP864
Japanese
EUC-JISX0213, Shift_JISX0213, ISO-2022-JP-3
Chinese
BIG5-2003 (experimental)
Turkmen
TDS565

Platform specifics
ATARIST, RISCOS-LATIN1

It can convert from any of these encodings to any other, through Unicode conversion.

It has also some limited support for transliteration, i.e. when a character cannot be represented in the target character set, it can be approximated through one or several similarly looking characters. Transliteration is activated when "//TRANSLIT" is appended to the target encoding name.

libiconv is for you if your application needs to support multiple character encodings, but that support
lacks from your system.

Installation

As usual for GNU packages:

```
$ ./configure --prefix=/usr/local
$ make
$ make install
```

After installing GNU libiconv for the first time, it is recommended to recompile and reinstall GNU gettext, so that it can take advantage of libiconv.

On systems other than GNU/Linux, the iconv program will be internationalized only if GNU gettext has been built and installed before GNU libiconv. This means that the first time GNU libiconv is installed, we have a circular dependency between the GNU libiconv and GNU gettext packages, which can be resolved by building and installing either
- first libiconv, then gettext, then libiconv again,
or (on systems supporting shared libraries, excluding AIX)
- first gettext, then libiconv, then gettext again.
Recall that before building a package for the second time, you need to erase the traces of the first build by running "make distclean".

This library can be built and installed in two variants:

- The library mode. This works on all systems, and uses a library 'libiconv.so' and a header file '<iconv.h>'. (Both are installed through "make install".)

  To use it, simply #include <iconv.h> and use the functions.

To use it in an autoconfiguring package:
- If you don't use automake, append m4/iconv.m4 to your aclocal.m4
  file.
- If you do use automake, add m4/iconv.m4 to your m4 macro repository.
- Add to the link command line of libraries and executables that use
  the functions the placeholder @LIBICONV@ (or, if using libtool for
  the link, @LTLIBICONV@). If you use automake, the right place for
  these additions are the *_LDADD variables.

Note that 'iconv.m4' is also part of the GNU gettext package, which
installs it in /usr/local/share/aclocal/iconv.m4.

- The libc plug/override mode. This works on GNU/Linux, Solaris and
OSF/1
systems only. It is a way to get good iconv support without having
glibc-2.1.
It installs a library 'preloadable_libiconv.so'. This library can be used
with LD_PRELOAD, to override the iconv* functions present in the C library.

On GNU/Linux and Solaris:
    $ export LD_PRELOAD=/usr/local/lib/preloadable_libiconv.so

On OSF/1:
    $ export _RLD_LIST=/usr/local/lib/preloadable_libiconv.so:DEFAULT

A program's source need not be modified, the program need not even be
recompiled. Just set the LD_PRELOAD environment variable, that's it!

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The libiconv and libcharset _libraries_ and their header files are under LGPL,
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The iconv _program_ and the documentation are under GPL, see file COPYING.

Download
----

http://ftp.gnu.org/gnu/libiconv/libiconv-1.14.tar.gz

Homepage
----

http://www.gnu.org/software/libiconv/

Bug
reports to

<bug-gnu-libiconv@gnu.org>

Bruno Haible <bruno@clisp.org>

1.3 lua 5.1.5

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1.4 libpcap 1.2.1

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1.5 freefont-ttf 20100919

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1.9 lua 5.1.4

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1.11 iptables 1.4.20

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1.12 ncurses 5.9

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This script is compatible with the BSD install script, but was written
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1.13 libpcap 1.7.4

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1.14 libmnl 1.0.3

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30 atime=1337191922.583566431
30 ctime=1338052482.808834269

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<one line to give the
program's name and a brief idea of what it does.>
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```
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under certain conditions; type `show c' for details.
```

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necessary. Here is a sample; alter the names:

```
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 `Gnomovision' (which makes passes at compilers) written by James Hacker.

 <signature of Ty Coon>, 1 April 1989
 Ty Coon, President of Vice
```

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1.16 libxml2 2.9.4

1.16.1 Available under license :

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```
/*
* hash.c: chained hash tables
*
* Reference: Your favorite introductory book on algorithms
*
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*
* $Id$
*
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************************************************************************
*
```

1.17 glib 2.48.1

1.17.1 Available under license :

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Ty Coon, President of Vice

That's all there is to it!
/* This is the public header file for the PCRE library, to be #included by
applications that call the PCRE functions.

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include/freetype/internal/fthash.h
#
src/base/fthash.c
src/base/md5.c
src/base/md5.h
#
src/bdf/bdf.c
src/bdf/bdf.h
src/bdf/bdfdrivr.c
src/bdf/bdfdrivr.h
src/bdf/bdferror.h
src/bdf/bdflib.c
src/bdf/module.mk
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#
src/pcf/module.mk
src/pcf/pcf.c
src/pcf/pcf.h
src/pcf/pcfdrivr.c
src/pcf/pcfdrivr.h
src/pcf/pcferror.h
src/pcf/pcfread.c
src/pcf/pcfread.h
src/pcf/pcfutil.c
src/pcf/pcfutil.h
src/pcf/README
src/pcf/rules.mk
#
src/gzip/adler32.c
src/gzip/infblock.c
src/gzip/infblock.h
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src/gzip/inffixed.h
src/gzip/inflate.c
src/gzip/inftrees.c
src/gzip/inftrees.h
src/gzip/infutil.c
src/gzip/infutil.h
src/gzip/zconf.h
src/gzip/zlib.h
src/gzip/zutil.c

src/gzip/zutil.h
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src/tools/apinames.c
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1.21 e2fsprogs 1.43.7

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Index: tdbsa/tdb.c
===
--- tdbsa.orig/tdb.c
+++ tdbsa/tdb.c
@@ -4,11 +4,11 @@ Rev: 23371
Last Changed Date: 2007-06-06 20:14:06 -0400 (Wed, 06 Jun 2007)
*/
 /*

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-
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This package was added to the e2fsprogs debian source package by
Theodore Ts'o <tytso@mit.edu> on Sat Mar 15 15:33:37 EST 2003

It is part of the main e2fsprogs distribution, which can be found at:

http://sourceforge.net/projects/e2fsprogs

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#
# This is a Makefile stub which handles the creation of BSD shared
# libraries.
#
# In order to use this stub, the following makefile variables must be defined.
#
# BSDLIB_VERSION = 1.0
# BSDLIB_IMAGE = libce
# BSDLIB_MYDIR = et
# BSDLIB_INSTALL_DIR = $(SHLIBDIR)
#

all:: image

real-subdirs:: Makefile
 @echo " MKDIR pic"
 @mkdir -p pic

BSD_LIB = $(BSDLIB_IMAGE).so.$(BSDLIB_VERSION)
BSDLIB_PIC_FLAG = -fpic

image:  $(BSD_LIB)

$(BSD_LIB): $(OBJS)
 (cd pic; ld -Bshareable -o $(BSD_LIB) $(LDFLAGS_SHLIB) $(OBJS))
 $(MV) pic/$(BSD_LIB) .
 $(RM) -f ../$(BSD_LIB)
 (cd ..; $(LN) $(LINK_BUILD_FLAGS) \
  `echo $(my_dir) | sed -e 's;lib/;;'`/$(BSD_LIB) $(BSD_LIB))

install-shlibs install:: $(BSD_LIB)
 @echo " INSTALL_PROGRAM $(BSDLIB_INSTALL_DIR)/$(BSD_LIB)"
 @$(INSTALL_PROGRAM) $(BSD_LIB) \
  $(DESTDIR)$(BSDLIB_INSTALL_DIR)/$(BSD_LIB)
 @-$(LDCONFIG)

install-strip: install
```

install-shlibs-strip: install-shlibs

uninstall-shlibs uninstall::
 $(RM) -f $(DESTDIR)$(BSDLIB_INSTALL_DIR)/$(BSD_LIB)

clean::
 $(RM)
 -rf pic
 $(RM) -f $(BSD_LIB)
 $(RM) -f ../$(BSD_LIB)
This is the Debian GNU/Linux prepackaged version of the ss
command-line interface parsing library. It is currently
distributed together with the EXT2 file system utilities, which are
otherwise packaged as "e2fsprogs".

This package was put together by Yann Dirson <dirson@debian.org>,
from sources obtained from a mirror of:
tsx-11.mit.edu:/pub/linux/packages/ext2fs/

From the original distribution:

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libet and libss libraries for more information.

The most recent officially distributed version can be found at
http://e2fsprogs.sourceforge.net. If you need to make a distribution,

that's the one you should use. If there is some reason why you'd like
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using the "WIP" test distributions or one from the hg or git
repository from the development branch, please contact me
(tytso@mit.edu)
before you ship. The release schedules for this
package are flexible, if you give me enough lead time.

Theodore Ts'o
23-June-2007

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Description library. It is currently distributed together with the EXT2 file
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This package was put together by Yann Dirson <dirson@debian.org>,
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1.22 protobuf 3.5.1

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Alek Storm <alek.storm@gmail.com>

  * Slicing support for repeated scalar fields for the Python API.
Oleg Smolsky <oleg.smolsky@gmail.com>
  * MS Visual Studio error format option.
  * Detect unordered_map in stl_hash.m4.
Brian Olson <brianolson@google.com>
  * gzip/zlib I/O support.
Michael Poole <mdpoole@troilus.org>
  * Fixed warnings about generated constructors not explicitly initializing
    all fields (only present with certain compiler settings).
  * Added generation of field number constants.
Wink Saville <wink@google.com>
  * Fixed initialization ordering problem in logging code.
Will Pierce <willp@nuclei.com>
  * Small patch improving performance of in Python serialization.
Alexandre Vassalotti <alexandre@peadrop.com>
  * Emacs mode for Protocol Buffers (editors/protobuf-mode.el).
Scott Stafford <scott.stafford@gmail.com>
  * Added Swap(), SwapElements(), and RemoveLast() to Reflection interface.
Alexander Melnikov <alm@sibmail.ru>
  * HPUX support.
Oliver Jowett <oliver.jowett@gmail.com>
   * Detect whether zlib is new enough in configure script.
  * Fixes for Solaris 10 32/64-bit confusion.
Evan Jones <evanj@mit.edu>
  * Optimize Java serialization code when writing a small message to a stream.
  * Optimize Java serialization of strings so that UTF-8 encoding happens only
    once per string per serialization call.
  * Clean up some Java warnings.
  * Fix bug with permanent callbacks that delete themselves when run.
Michael Kucharski <m.kucharski@gmail.com>
  * Added CodedInputStream.getTotalBytesRead().
Kacper Kowalik <xarthisius.kk@gmail.com>
  * Fixed m4/acx_pthread.m4 problem for some Linux distributions.
William Orr <will@worrbase.com>
  * Fixed detection of sched_yield on Solaris.
  * Added atomicops for Solaris
Andrew Paprocki <andrew@ishiboo.com>
  * Fixed minor IBM xlC compiler build issues
  * Added atomicops for AIX (POWER)
This file contains a list of people who've made non-trivial
contribution to the Google C++ Testing Framework project. People
who commit code to the project are encouraged to add their names
here. Please keep the list sorted by first names.

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1.23 curl 7.62.0

1.23.1 Available under license :

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==========

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 was addressed when the [Modified BSD
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libssh2

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1.24 bzip2 1.0.8

1.25 ldns 1.7.1

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libtool (GNU libtool) 2.4.6
Provide generalized library-building support services.
Written by Gordon Matzigkeit <gord@gnu.ai.mit.edu>, 1996

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/*
* FILE: sha2.c
* AUTHOR: Aaron D. Gifford - http://www.aarongifford.com/
*
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*
* Modified by Jelte Jansen to fit in ldns, and not clash with any
* system-defined SHA code.
* Changes:
* - Renamed (external) functions and constants to fit ldns style

* - Removed _End and _Data functions
* - Added ldns_shaX(data, len, digest) convenience functions
* - Removed prototypes of _Transform functions and made those static
*
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*
* $Id:
 sha2.c,v 1.1 2001/11/08 00:01:51 adg Exp adg $
*/

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/* from openssh 4.3p2 compat/strlcpy.c */

/*

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/* From openssh4.3p2 compat/inet_aton.c */

/*

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1.26 dmidecode 3.5

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1.32 ethtool 4.6

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1.33 json-c 0.12.99

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1.34 json-c 0.12.1

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1.35 glibc 2.23

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@center Version 2.1, February 1999

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To protect each distributor, we want to make it very clear that there is no warranty for the free library. Also, if the library is modified by someone else and passed on, the recipients should know that what they have is not the original version, so that the original author's reputation
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introduced by others.

Finally, software patents pose a constant threat to the existence of any free program. We wish to make sure that a company cannot effectively restrict the users of a free program by obtaining a restrictive license from a patent holder. Therefore, we insist that any patent license obtained for a version of the library must be consistent with the full freedom of use specified in this license.

Most GNU software, including some libraries, is covered by the ordinary GNU General Public License. This license, the GNU Lesser General Public License, applies to certain designated libraries, and is quite different from the ordinary General Public License. We use this license for certain libraries in order to permit linking those libraries into non-free programs.

When a program is linked with a library, whether statically or using a shared library, the combination of the two is legally speaking a combined work, a derivative
of the original library. The ordinary
General Public License therefore permits such linking only if the entire combination fits its criteria of freedom. The Lesser General Public License permits more lax criteria for linking other code with the library.

We call this license the @dfn{Lesser} General Public License because it does @emph{Less} to protect the user's freedom than the ordinary General Public License. It also provides other free software developers Less of an advantage over competing non-free programs. These disadvantages are the reason we use the ordinary General Public License for many libraries. However, the Lesser license provides advantages in certain special circumstances.

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 In other cases, permission to use a particular library in non-free programs enables a greater number of people to use a large body of free software. For example, permission to use the GNU C Library in non-free programs enables many more people to use the whole GNU operating system, as well as its variant, the GNU/Linux operating system.

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 contains code derived from the library, whereas the latter must be combined with the library in order to run.

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 either verbatim or with modifications and/or translated straightforwardly into another language. (Hereinafter, translation is included without limitation in the term ``modification''.)

``Source code'' for a work means the preferred form of the work for making modifications to it. For a library, complete source code means all the source code for all modules it contains, plus any associated interface definition files, plus the scripts used to control compilation and installation of the library.

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cause the whole of the work to be licensed at no
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If a facility in the modified Library refers to a function or a
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is invoked, then you must make a good faith effort to ensure that,
in the event an application does not supply such function or
table, the facility still operates, and performs whatever part of
its purpose remains meaningful.

(For example, a function in a library to compute square roots has
a purpose that is entirely well-defined independent of the
application. Therefore, Subsection 2d requires that any
application-supplied function or table used by this function must
be optional: if the application does not supply it, the square
root function must still compute square roots.)
@end enumerate

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 of that work are not derived from the Library,
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medium customarily used for software interchange.

If distribution of object code is made by offering access to copy
from a designated place, then offering equivalent access to copy the
source code from the same place satisfies the requirement to
distribute the source code, even though third parties are not
compelled to copy the source along with the object code.

@item
A program that contains no derivative of any portion of the
Library, but is designed to work with the Library by being compiled or
linked with it, is called a ``work that uses the Library''. Such a
work, in isolation, is not a derivative work of the Library, and
therefore falls outside the scope of this License.

However, linking a ``work that uses the Library'' with the Library
creates an executable that is a derivative of the Library (because
it
contains portions of the Library), rather than a ``work that uses the
library''. The executable is therefore covered by this License.
Section 6 states terms for distribution of such executables.

When a ``work that uses the Library'' uses material from a header file
that is part of the Library, the object code for the work may be a
derivative work of the Library even though the source code is not.
Whether this is true is especially significant if the work can be
linked without the Library, or if the work is itself a library. The
threshold for this to be true is not precisely defined by law.

If such an object file uses only numerical parameters, data
structure layouts and accessors, and small macros and small inline
functions (ten lines or less in length), then the use of the object

file is unrestricted, regardless of whether it is legally a derivative
work. (Executables containing this object code plus portions of the
Library will still fall under Section 6.)

 Otherwise,
 if the work is a derivative of the Library, you may
distribute the object code for the work under the terms of Section 6.
Any executables containing that work also fall under Section 6,
whether or not they are linked directly with the Library itself.

@item
As an exception to the Sections above, you may also combine or
link a ``work that uses the Library'' with the Library to produce a
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modification of the work for the customer's own use and reverse
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copyright notice for the Library among them, as well as a reference
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@enumerate a
@item
Accompany the work with the complete corresponding
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Sections 1 and 2 above); and, if the work is an executable linked
with the Library, with the complete machine-readable ``work that
uses the Library'', as object code and/or source code, so that the
user can modify the Library and then relink to produce a modified
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that the user who changes the contents of definitions files in the
Library will not necessarily be able to recompile the application
to use the modified definitions.)

@item
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library already present on the user's computer system, rather than
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@subheading END OF TERMS AND CONDITIONS

@page
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In other cases, permission to use a particular library in non-free programs enables a greater number of people to use a large body of free software. For example, permission to use the GNU C Library in non-free programs enables many more people to use the whole GNU operating system, as well as its variant, the GNU/Linux operating system.

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1.43 glibc 2.25

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same job as widely used non-free libraries. In this
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contains code derived from the library, whereas the latter must be combined with the library in order to run.

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The modified work must itself be a software library.

@item
You must cause the files modified to carry prominent notices
stating that you changed the files and the date of any change.

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You must
 cause the whole of the work to be licensed at no
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table of data to be supplied by an application program that uses
the facility, other than as an argument passed when the facility
is invoked, then you must make a good faith effort to ensure that,
in the event an application does not supply such function or
table, the facility still operates, and performs whatever part of
its purpose remains meaningful.

(For example, a function in a library to compute square roots has
a purpose that is entirely well-defined independent of the
application. Therefore, Subsection 2d requires that any
application-supplied function or table used by this function must
be optional: if the application does not supply it, the square
root function must still compute square roots.)
@end enumerate

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 of that work are not derived from the Library,
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under the terms of Sections 1 and
2 above provided that you accompany
it with the complete corresponding machine-readable source code, which
must be distributed under the terms of Sections 1 and 2 above on a
medium customarily used for software interchange.

If distribution of object code is made by offering access to copy
from a designated place, then offering equivalent access to copy the
source code from the same place satisfies the requirement to
distribute the source code, even though third parties are not
compelled to copy the source along with the object code.

@item
A program that contains no derivative of any portion of the
Library, but is designed to work with the Library by being compiled or
linked with it, is called a ``work that uses the Library''. Such a

work, in isolation, is not a derivative work of the Library, and
therefore falls outside the scope of this License.

However, linking a ``work that uses the Library'' with the Library
creates an executable that is a derivative of the Library (because
it
contains portions of the Library), rather than a ``work that uses the
library''. The executable is therefore covered by this License.
Section 6 states terms for distribution of such executables.

When a ``work that uses the Library'' uses material from a header file
that is part of the Library, the object code for the work may be a
derivative work of the Library even though the source code is not.
Whether this is true is especially significant if the work can be
linked without the Library, or if the work is itself a library. The
threshold for this to be true is not precisely defined by law.

If such an object file uses only numerical parameters, data
structure layouts and accessors, and small macros and small inline
functions (ten lines or less in length), then the use of the object
file is unrestricted, regardless of whether it is legally a derivative
work. (Executables containing this object code plus portions of the
Library will still fall under Section 6.)

Otherwise,
if the work is a derivative of the Library, you may
distribute the object code for the work under the terms of Section 6.
Any executables containing that work also fall under Section 6,
whether or not they are linked directly with the Library itself.

@item
As an exception to the Sections above, you may also combine or
link a ``work that uses the Library'' with the Library to produce a
work containing portions of the Library, and distribute that work
under terms of your choice, provided that the terms permit
modification of the work for the customer's own use and reverse
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during execution displays copyright notices, you must include the
copyright notice for the Library among them, as well as a reference
directing the user to the copy of
this License. Also, you must do one
of these things:

@enumerate a

@item
Accompany the work with the complete corresponding
machine-readable source code for the Library including whatever
changes were used in the work (which must be distributed under
Sections 1 and 2 above); and, if the work is an executable linked
with the Library, with the complete machine-readable ``work that
uses the Library'', as object code and/or source code, so that the
user can modify the Library and then relink to produce a modified
executable containing the modified Library. (It is understood
that the user who changes the contents of definitions files in the
Library will not necessarily be able to recompile the application
to use the modified definitions.)

@item
Use a suitable shared library mechanism for linking with the Library. A
suitable mechanism is one that (1) uses at run time a copy of the
library already present on the user's computer system, rather than
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 and (2) will operate
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one, as long as the modified version is interface-compatible with the
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@item
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@item
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reproducing the executable from it. However, as a special exception,
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which the executable runs, unless that component itself accompanies the
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@enumerate a
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facilities. This must be distributed under the terms of the
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@item
Give prominent notice with the combined library of the fact
that part of it is a work based on the Library, and explaining
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@subheading END OF TERMS AND CONDITIONS

@page
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1.44 ipmi-tool 1.8.18

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1.45 libdnet 1.11

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1.46 rsyslog 7.6.7

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1.50 popt 1.16

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Fri, 22 Aug 2003 01:33:34 -0500.

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1.52 cryptsetup 2.1.0

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1.53 libunwind 1.1

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1.54 inotify-tools 3.14

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1.58 tcpdump 4.9.2

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1.59 json-c 0.12

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1.60 acpid 2.0.11

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1.61 grpc 1.9.1

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* Frodo Looijaard
Original author of libsensors, sensors-detect, sensors and isadump.
* Merlin Hughes
Original author of sensord.
* Bob Schlaermann
Dynamic chip feature detection (a.k.a. generic chip support) in
libsensors and sensors.
* Mark M. Hoffman
Many improvements to the libsensors configuration file scanner.
* Jean Delvare
New libsensors API, and migration of sensors and sensord thereto.
Many optimizations in libsensors and sensors.
Configuration file converter.
Rewrite of sensors-detect.
Support for multiple configuration files in libsensors.

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The
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The initial developer of the original code is Rainer Budde (http://www.speed-soft.de).

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1.78 icu 65

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## Commands to generate dependency files
GEN_DEPS.c= $(CC) -E -MM $(DEFS) $(CPPFLAGS)
GEN_DEPS.cc= $(CXX) -E -MM $(DEFS) $(CPPFLAGS)

## Flags for position independent code
SHAREDLIBCFLAGS = -fPIC
SHAREDLIBCXXFLAGS = -fPIC
SHAREDLIBCPPFLAGS = -DPIC

## Additional flags when building libraries and with threads
THREADSCPPFLAGS = -D_REENTRANT
LIBCPPFLAGS =

## Compiler switch to embed a runtime search path
LD_RPATH=
LD_RPATH_PRE= -Wl,-rpath,

## Compiler switch to embed a library name
LD_SONAME = -Wl,-soname -Wl,$(notdir $(MIDDLE_SO_TARGET))

## Shared library options
LD_SOOPTIONS= -Wl,-Bsymbolic

## Shared object suffix
SO = so
## Non-shared intermediate object suffix
STATIC_O = ao
```

```
## Compilation
 rules
%.$(STATIC_O): $(srcdir)/%.c
 $(COMPILE.c) $(STATICCPPFLAGS) $(STATICCFLAGS) -o $@ $<
%.o: $(srcdir)/%.c
 $(COMPILE.c) $(DYNAMICCPPFLAGS) $(DYNAMICCFLAGS) -o $@ $<

%.$(STATIC_O): $(srcdir)/%.cpp
 $(COMPILE.cc) $(STATICCPPFLAGS) $(STATICCXXFLAGS) -o $@ $<
%.o: $(srcdir)/%.cpp
 $(COMPILE.cc) $(DYNAMICCPPFLAGS) $(DYNAMICCXXFLAGS) -o $@ $<


## Dependency rules
%.d: $(srcdir)/%.c
 @echo "generating dependency information for $<"
 @$(SHELL) -ec '$(GEN_DEPS.c) $< \
  | sed '\"s/\($*\)\.o[ :]*/\1.o $@ : /g'\" > $@; \
  [ -s $@ ] || rm -f $@'

%.d: $(srcdir)/%.cpp
 @echo "generating dependency information for $<"
 @$(SHELL) -ec '$(GEN_DEPS.cc) $< \
  | sed '\"s/\($*\)\.o[ :]*/\1.o $@ : /g'\" > $@; \
  [ -s $@ ] || rm -f $@'

## Versioned libraries rules

%.$(SO).$(SO_TARGET_VERSION_MAJOR): %.$(SO).$(SO_TARGET_VERSION)
 $(RM) $@ && ln -s ${<F} $@
%.$(SO): %.$(SO).$(SO_TARGET_VERSION_MAJOR)
 $(RM) $@ && ln -s ${*F}.$(SO).$(SO_TARGET_VERSION) $@

##  Bind internal references

# LDflags that pkgdata will use
BIR_LDFLAGS= -Wl,-Bsymbolic

# Dependencies [i.e. map files] for the final library
BIR_DEPS=

## Remove shared library 's'
STATIC_PREFIX_WHEN_USED =
STATIC_PREFIX =

## End BSD-specific setup
```

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1.79 glibc 2.31

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users' freedom, it does ensure that the user of a program that is
linked with the Library has the freedom and the wherewithal to run
that program using a modified version of the Library.

The precise terms and conditions for copying, distribution and
modification follow. Pay close attention to the difference between a
``work based on the library'' and a ``work that uses the library''. The
former
contains code derived from the library, whereas the latter must
be combined with the library in order to run.

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prepared so as to be conveniently linked with application programs
(which use some of those functions and data) to form executables.

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``Source code'' for a work means the preferred form of the work for making modifications to it. For a library, complete source code means all the source code for all modules it contains, plus any associated interface definition files, plus the scripts used to control compilation and installation of the library.

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@item
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@item
You must
cause the whole of the work to be licensed at no
charge to all third parties under the terms of this License.

@item
If a facility in the modified Library refers to a function or a
table of data to be supplied by an application program that uses
the facility, other than as an argument passed when the facility
is invoked, then you must make a good faith effort to ensure that,
in the event an application does not supply such function or
table, the facility still operates, and performs whatever part of
its purpose remains meaningful.

(For example, a function in a library to compute square roots has
a purpose that is entirely well-defined independent of the
application. Therefore, Subsection 2d requires that any
application-supplied function or table used by this function must
be optional: if the application does not supply it, the square
root function must still compute square roots.)
@end enumerate

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of that work are not derived from the Library,
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Thus, it is not the intent of this section to claim rights or contest
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In addition, mere aggregation of another work not based on the Library
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This option is useful when you wish to copy part of the code of
the Library into a program that is not a library.

@item
You may copy and distribute the Library (or a portion or
derivative of it, under Section 2) in object code or executable form
under the terms of Sections 1 and
2 above provided that you accompany
it with the complete corresponding machine-readable source code, which
must be distributed under the terms of Sections 1 and 2 above on a
medium customarily used for software interchange.

If distribution of object code is made by offering access to copy
from a designated place, then offering equivalent access to copy the
source code from the same place satisfies the requirement to
distribute the source code, even though third parties are not
compelled to copy the source along with the object code.

@item
A program that contains no derivative of any portion of the
Library, but is designed to work with the Library by being compiled or
linked with it, is called a ``work that uses the Library''. Such a
work, in isolation, is not a derivative work of the Library, and
therefore falls outside the scope of this License.

However, linking a ``work that uses the Library'' with the Library
creates an executable that is a derivative of the Library (because
it
contains portions of the Library), rather than a ``work that uses the
library''. The executable is therefore covered by this License.
Section 6 states terms for distribution of such executables.

When a ``work that uses the Library'' uses material from a header file
that is part of the Library, the object code for the work may be a
derivative work of the Library even though the source code is not.
Whether this is true is especially significant if the work can be
linked without the Library, or if the work is itself a library. The
threshold for this to be true is not precisely defined by law.

If such an object file uses only numerical parameters, data
structure layouts and accessors, and small macros and small inline
functions (ten lines or less in length), then the use of the object
file is unrestricted, regardless of whether it is legally a derivative
work. (Executables containing this object code plus portions of the
Library will still fall under Section 6.)

Otherwise,
if the work is a derivative of the Library, you may
distribute the object code for the work under the terms of Section 6.
Any executables containing that work also fall under Section 6,
whether or not they are linked directly with the Library itself.

@item
As an exception to the Sections above, you may also combine or
link a ``work that uses the Library'' with the Library to produce a
work containing portions of the Library, and distribute that work
under terms of your choice, provided that the terms permit
modification of the work for the customer's own use and reverse
engineering for debugging such modifications.

You must give prominent notice with each copy of the work that the
Library is used in it and that the Library and its use are covered by
this License. You must supply a copy of this License. If the work
during execution displays copyright notices, you must include the
copyright notice for the Library among them, as well as a reference
directing the user to the copy of
this License. Also, you must do one
of these things:

@enumerate a
@item
Accompany the work with the complete corresponding
machine-readable source code for the Library including whatever
changes were used in the work (which must be distributed under
Sections 1 and 2 above); and, if the work is an executable linked
with the Library, with the complete machine-readable ``work that
uses the Library'', as object code and/or source code, so that the
user can modify the Library and then relink to produce a modified
executable containing the modified Library. (It is understood
that the user who changes the contents of definitions files in the

Library will not necessarily be able to recompile the application
to use the modified definitions.)

@item
Use a suitable shared library mechanism for linking with the Library. A
suitable mechanism is one that (1) uses at run time a copy of the
library already present on the user's computer system, rather than
copying library functions into the executable,
and (2) will operate
properly with a modified version of the library, if the user installs
one, as long as the modified version is interface-compatible with the
version that the work was made with.

@item
Accompany the work with a written offer, valid for at
least three years, to give the same user the materials
specified in Subsection 6a, above, for a charge no more
than the cost of performing this distribution.

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specified materials from the same place.

@item
Verify that the user has already received a copy of these
materials or that you have already sent this user a copy.
@end enumerate

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Library'' must include any data and utility programs needed for
reproducing the executable from it. However, as a special exception,
the materials to be distributed need not include anything that
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normally distributed (in either source or binary form) with the major
components (compiler, kernel, and so on) of the operating system on
which the executable runs, unless that component itself accompanies the
executable.

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library, provided that the separate distribution of the work based on
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@end enumerate

@subheading END OF TERMS AND CONDITIONS

@page
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smallexample

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@var{signature of Ty Coon}, 1 April 1990
Ty Coon, President of Vice
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Thus, it is not the intent of this section to claim rights or contest your rights to work written entirely by you; rather, the intent is to exercise the right to control the distribution of derivative or collective works based on the Program.

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and only if you
received the program in object code or executable form with such an offer, in accord with Subsection b above.)

The source code for a work means the preferred form of the work for making modifications to it. For an executable work, complete source code means all the source code for all modules it contains, plus any associated interface definition files, plus the scripts used to control compilation and installation of the executable. However, as a special exception, the source code distributed need not include

anything that is normally distributed (in either source or binary form) with the major components (compiler, kernel, and so on) of the operating system on which the executable runs, unless that component itself accompanies the executable.

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34. [37]Louis A. Mamakos <louie@ni.umd.edu> MD5-based authentication
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```

1.86 ffmpeg 4.3.1

1.86.1 Available under license :

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Specifically, the GPL parts of FFmpeg are:

- libpostproc
- optional x86 optimization in the files
  - `libavcodec/x86/flac_dsp_gpl.asm`
  - `libavcodec/x86/idct_mmx.c`
  - `libavfilter/x86/vf_removegrain.asm`
- the following building and testing tools
  - `compat/solaris/make_sunver.pl`
  - `doc/t2h.pm`
  - `doc/texi2pod.pl`
  - `libswresample/tests/swresample.c`
  - `tests/checkasm/*`
  - `tests/tiny_ssim.c`
-
 the following filters in libavfilter:
  - `signature_lookup.c`
  - `vf_blackframe.c`
  - `vf_boxblur.c`
  - `vf_colormatrix.c`
  - `vf_cover_rect.c`
  - `vf_cropdetect.c`
  - `vf_delogo.c`
  - `vf_eq.c`
  - `vf_find_rect.c`
  - `vf_fspp.c`
  - `vf_histeq.c`
  - `vf_hqdn3d.c`
  - `vf_kerndeint.c`
  - `vf_lensfun.c` (GPL version 3 or later)
  - `vf_mcdeint.c`
  - `vf_mpdecimate.c`
  - `vf_nnedi.c`
  - `vf_owdenoise.c`
  - `vf_perspective.c`

- `vf_phase.c`
- `vf_pp.c`
- `vf_pp7.c`
- `vf_pullup.c`
- `vf_repeatfields.c`
- `vf_sab.c`
- `vf_signature.c`
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- `vf_spp.c`
- `vf_stereo3d.c`
- `vf_super2xsai.c`
- `vf_tinterlace.c`
- `vf_uspp.c`
- `vf_vaguedenoiser.c`
- `vsrc_mptestsrc.c`

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There are a handful of files under other licensing terms, namely:

* The files `libavcodec/jfdctfst.c`, `libavcodec/jfdctint_template.c` and
`libavcodec/jrevdct.c` are taken from libjpeg, see the top of the files for
licensing details. Specifically note that you must credit the IJG in the
documentation accompanying your program if you only distribute executables.
You must also indicate any changes including additions and deletions to
those three files in the documentation.
* `tests/reference.pnm` is under the expat license.

External libraries

FFmpeg can be combined with a number of external libraries, which sometimes
affect the licensing of binaries resulting from the combination.

Compatible libraries

The following libraries are under GPL version 2:
- avisynth
- frei0r
- libcdio
- libdavs2
- librubberband
- libvidstab
- libx264

- libx265
- libxavs
-
libxavs2
- libxvid

When combining them with FFmpeg, FFmpeg needs to be licensed as GPL as well by
passing `--enable-gpl` to configure.

The following libraries are under LGPL version 3:
- gmp
- libaribb24
- liblensfun

When combining them with FFmpeg, use the configure option `--enable-version3` to
upgrade FFmpeg to the LGPL v3.

The VMAF, mbedTLS, RK MPI, OpenCORE and VisualOn libraries are under the Apache License
2.0. That license is incompatible with the LGPL v2.1 and the GPL v2, but not with
version 3 of those licenses. So to combine these libraries with FFmpeg, the
license version needs to be upgraded by passing `--enable-version3` to configure.

The smbclient library is under the GPL v3, to combine it with FFmpeg,
the options `--enable-gpl` and `--enable-version3` have to be passed to
configure to upgrade FFmpeg to the GPL v3.

Incompatible libraries

There are certain libraries you can combine with FFmpeg whose licenses are not
compatible with the GPL and/or the LGPL. If
you wish to enable these
libraries, even in circumstances that their license may be incompatible, pass
`--enable-nonfree` to configure. This will cause the resulting binary to be
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Version 3, 29 June 2007

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1.87 spring-security-web 5.3.4.RELEASE

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* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/server/util/matcher/ServerWebExchangeMatcher.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/server/authentication/logout/SecurityContextServerLogoutHandler.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/server/authentication/RedirectServerAuthenticationEntryPoint.java
* /spring-security-web-5-3-4-release-sources-

jar/org/springframework/security/web/server/authentication/ServerAuthenticationSuccessHandler.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/server/WebFilterChainProxy.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/server/authentication/logout/ServerLogoutHandler.java
*
/spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/server/authentication/WebFilterChainServerAuthenticationSuccessHandler.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/server/csrf/CsrfException.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/server/authentication/HttpBasicServerAuthenticationEntryPoint.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/server/context/SecurityContextServerWebExchange.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/server/util/matcher/OrServerWebExchangeMatcher.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/server/csrf/ServerCsrfTokenRepository.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/server/authentication/RedirectServerAuthenticationFailureHandler.java
*
/spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/server/ServerRedirectStrategy.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/server/ui/LogoutPageGeneratingWebFilter.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/server/authorization/DelegatingReactiveAuthorizationManager.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/server/header/ServerHttpHeadersWriter.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/server/authorization/ExceptionTranslationWebFilter.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/server/header/HttpHeaderWriterWebFilter.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/server/authentication/ServerAuthenticationEntryPointFailureHandler.java
*
/spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/server/authorization/HttpStatusServerAccessDeniedHandler.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/server/authentication/RedirectServerAuthenticationSuccessHandler.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/server/savedrequest/NoOpServerRequestCache.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/server/WebFilterExchange.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/server/csrf/CsrfToken.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/server/context/SecurityContextServerWebExchangeWebFilter.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/server/authorization/ServerAccessDeniedHandler.java

* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/server/savedrequest/ServerRequestCache.java
*
/spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/server/savedrequest/WebSessionServerRequestCache.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/server/authentication/logout/LogoutWebFilter.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/server/context/ReactorContextWebFilter.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/server/SecurityWebFilterChain.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/server/header/CompositeServerHttpHeadersWriter.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/server/authentication/logout/ServerLogoutSuccessHandler.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/server/context/NoOpServerSecurityContextRepository.java
*
/spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/authentication/rememberme/PersistentTokenBasedRememberMeServices.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/server/header/CacheControlServerHttpHeadersWriter.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/server/context/ServerSecurityContextRepository.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/server/ServerAuthenticationEntryPoint.java
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* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/authentication/DelegatingAuthenticationFailureHandler.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/access/expression/EvaluationContextPostProcessor.java
*
 /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/access/expression/AbstractVariableEvaluationContextPostProcessor.java
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jar/org/springframework/security/web/session/InvalidSessionAccessDeniedHandler.java
* /spring-security-web-5-3-4-release-sources-
jar/org/springframework/security/web/csrf/HttpSessionCsrfTokenRepository.java
*
/spring-security-web-5-3-4-release-sources-
jar/org/springframework/security/web/csrf/CsrfAuthenticationStrategy.java
* /spring-security-web-5-3-4-release-sources-
jar/org/springframework/security/web/util/matcher/AnyRequestMatcher.java
* /spring-security-web-5-3-4-release-sources-
jar/org/springframework/security/web/csrf/InvalidCsrfTokenException.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/csrf/DefaultCsrfToken.java
* /spring-security-web-5-3-4-release-sources-
jar/org/springframework/security/web/authentication/session/AbstractSessionFixationProtectionStrategy.java
* /spring-security-web-5-3-4-release-sources-
jar/org/springframework/security/web/authentication/session/ChangeSessionIdAuthenticationStrategy.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/csrf/CsrfException.java
* /spring-security-web-5-3-4-release-sources-
jar/org/springframework/security/web/csrf/MissingCsrfTokenException.java
*
/spring-security-web-5-3-4-release-sources-
jar/org/springframework/security/web/bind/support/AuthenticationPrincipalArgumentResolver.java
* /spring-security-web-5-3-4-release-sources-
jar/org/springframework/security/web/servlet/support/csrf/CsrfRequestDataValueProcessor.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/csrf/CsrfFilter.java
* /spring-security-web-5-3-4-release-sources-
jar/org/springframework/security/web/context/AbstractSecurityWebApplicationInitializer.java
* /spring-security-web-5-3-4-release-sources-
jar/org/springframework/security/web/authentication/session/SessionFixationProtectionStrategy.java
* /spring-security-web-5-3-4-release-sources-
jar/org/springframework/security/web/authentication/session/CompositeSessionAuthenticationStrategy.java
* /spring-security-web-5-3-4-release-sources-
jar/org/springframework/security/web/header/writers/XContentTypeOptionsHeaderWriter.java
*
/spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/csrf/CsrfTokenRepository.java
* /spring-security-web-5-3-4-release-sources-
jar/org/springframework/security/web/method/annotation/AuthenticationPrincipalArgumentResolver.java
* /spring-security-web-5-3-4-release-sources-
jar/org/springframework/security/web/bind/annotation/AuthenticationPrincipal.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/csrf/CsrfToken.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/header/HeaderWriter.java
* /spring-security-web-5-3-4-release-sources-
jar/org/springframework/security/web/authentication/session/SessionFixationProtectionEvent.java
* /spring-security-web-5-3-4-release-sources-
jar/org/springframework/security/web/method/annotation/CsrfTokenArgumentResolver.java
* /spring-security-web-5-3-4-release-sources-

jar/org/springframework/security/web/header/writers/DelegatingRequestMatcherHeaderWriter.java
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* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/authentication/DelegatingAuthenticationEntryPoint.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/util/matcher/ELRequestMatcher.java
*
/spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/util/matcher/RequestMatcherEditor.java
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* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/firewall/StrictHttpFirewall.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/servlet/util/matcher/MvcRequestMatcher.java
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* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/server/authentication/logout/HttpStatusReturningServerLogoutSuccessHandler.java
*
 /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/server/authentication/ServerAuthenticationConverter.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/server/DefaultServerRedirectStrategy.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/server/util/matcher/PathPatternParserServerWebExchangeMatcher.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/server/authentication/HttpStatusServerEntryPoint.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/reactive/result/method/annotation/AuthenticationPrincipalArgumentResolver.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/server/authorization/ServerWebExchangeDelegatingServerAccessDeniedHandler.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/server/ServerHttpBasicAuthenticationConverter.java
*
 /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/authentication/logout/ForwardLogoutSuccessHandler.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/context/request/async/SecurityContextCallableProcessingInterceptor.java
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* /spring-security-web-5-3-4-release-sources-
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* /spring-security-web-5-3-4-release-sources-
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* /spring-security-web-5-3-4-release-sources-
jar/org/springframework/security/web/authentication/ui/DefaultLogoutPageGeneratingFilter.java
*
/spring-security-web-5-3-4-release-sources-
jar/org/springframework/security/web/authentication/SimpleUrlAuthenticationFailureHandler.java
* /spring-security-web-5-3-4-release-sources-
jar/org/springframework/security/web/server/header/ContentSecurityPolicyServerHttpHeadersWriter.java
* /spring-security-web-5-3-4-release-sources-
jar/org/springframework/security/web/reactive/result/view/CsrfRequestDataValueProcessor.java
* /spring-security-web-5-3-4-release-sources-
jar/org/springframework/security/web/authentication/ForwardAuthenticationFailureHandler.java
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jar/org/springframework/security/web/firewall/FirewalledResponse.java
*
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* /spring-security-web-5-3-4-release-sources-
jar/org/springframework/security/web/authentication/ExceptionMappingAuthenticationFailureHandler.java
* /spring-security-web-5-3-4-release-sources-
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* /spring-security-web-5-3-4-release-sources-
jar/org/springframework/security/web/server/authentication/ServerX509AuthenticationConverter.java
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jar/org/springframework/security/web/server/util/matcher/NegatedServerWebExchangeMatcher.java
* /spring-security-web-5-3-4-release-sources-
jar/org/springframework/security/web/header/writers/CacheControlHeadersWriter.java
* /spring-security-web-5-3-4-release-sources-
jar/org/springframework/security/web/authentication/preauth/AbstractPreAuthenticatedProcessingFilter.java
*
/spring-security-web-5-3-4-release-sources-
jar/org/springframework/security/web/server/header/StaticServerHttpHeadersWriter.java
* /spring-security-web-5-3-4-release-sources-
jar/org/springframework/security/web/access/RequestMatcherDelegatingAccessDeniedHandler.java
* /spring-security-web-5-3-4-release-sources-
jar/org/springframework/security/web/server/authentication/AnonymousAuthenticationWebFilter.java
* /spring-security-web-5-3-4-release-sources-
jar/org/springframework/security/web/server/MatcherSecurityWebFilterChain.java

* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/server/authentication/logout/DelegatingServerLogoutHandler.java
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* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/authentication/AbstractAuthenticationTargetUrlRequestHandler.java
*
 /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/session/ConcurrentSessionFilter.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/authentication/AuthenticationFilter.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/server/authentication/ReactivePreAuthenticatedAuthenticationManager.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/access/intercept/RequestKey.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/header/writers/ReferrerPolicyHeaderWriter.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/server/header/ClearSiteDataServerHttpHeadersWriter.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/reactive/result/method/annotation/CurrentSecurityContextArgumentResolver.java
*
 /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/util/matcher/IpAddressMatcher.java

* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/header/HeaderWriterFilter.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/util/matcher/MediaTypeRequestMatcher.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/authentication/AuthenticationEntryPointFailureHandler.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/authentication/session/ConcurrentSessionControlAuthenticationStrategy.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/method/annotation/CurrentSecurityContextArgumentResolver.java
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*
/spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/header/writers/frameoptions/XFrameOptionsHeaderWriter.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/header/writers/FeaturePolicyHeaderWriter.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/server/authentication/logout/HeaderWriterServerLogoutHandler.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/header/writers/HstsHeaderWriter.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/authentication/www/BasicAuthenticationConverter.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/server/csrf/CookieServerCsrfTokenRepository.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/authentication/AuthenticationConverter.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/util/matcher/AntPathRequestMatcher.java
*
/spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/header/writers/StaticHeadersWriter.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/authentication/logout/CookieClearingLogoutHandler.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/header/writers/HpkpHeaderWriter.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/header/writers/XXssProtectionHeaderWriter.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/header/writers/ClearSiteDataHeaderWriter.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/header/writers/CompositeHeaderWriter.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/authentication/logout/HeaderWriterLogoutHandler.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/access/expression/ExpressionBasedFilterInvocationSecurityMetadataSource.java
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```

Found in path(s):
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/authentication/logout/LogoutHandler.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/savedrequest/Enumerator.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/util/UrlUtils.java
*
/spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/access/DefaultWebInvocationPrivilegeEvaluator.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/savedrequest/FastHttpDateFormat.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/authentication/rememberme/TokenBasedRememberMeServices.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/session/HttpSessionEventPublisher.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/access/AccessDeniedHandlerImpl.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/savedrequest/SavedRequestAwareWrapper.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/access/channel/ChannelProcessingFilter.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/access/channel/RetryWithHttpEntryPoint.java
*
/spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/authentication/WebAuthenticationDetails.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/authentication/switchuser/SwitchUserFilter.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/PortMapperImpl.java

* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/authentication/www/DigestAuthenticationEntryPoint.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/PortResolver.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/authentication/RememberMeServices.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/savedrequest/SimpleSavedRequest.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/authentication/switchuser/AuthenticationSwitchUserEvent.java
*
 /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/authentication/UsernamePasswordAuthenticationFilter.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/authentication/WebAuthenticationDetailsSource.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/authentication/LoginUrlAuthenticationEntryPoint.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/authentication/logout/SecurityContextLogoutHandler.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/access/channel/ChannelDecisionManagerImpl.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/access/intercept/FilterSecurityInterceptor.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/access/channel/ChannelEntryPoint.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/access/AccessDeniedHandler.java
*
 /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/authentication/www/BasicAuthenticationFilter.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/AuthenticationEntryPoint.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/access/WebInvocationPrivilegeEvaluator.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/access/intercept/FilterInvocationSecurityMetadataSource.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/access/channel/SecureChannelProcessor.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/authentication/NullRememberMeServices.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/access/intercept/DefaultFilterInvocationSecurityMetadataSource.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/authentication/AnonymousAuthenticationFilter.java
*
 /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/authentication/www/NonceExpiredException.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/access/channel/ChannelDecisionManager.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/PortResolverImpl.java

* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/authentication/www/BasicAuthenticationEntryPoint.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/authentication/AbstractAuthenticationProcessingFilter.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/access/channel/RetryWithHttpsEntryPoint.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/savedrequest/DefaultSavedRequest.java
*
 /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/session/HttpSessionCreatedEvent.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/servletapi/SecurityContextHolderAwareRequestFilter.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/session/HttpSessionDestroyedEvent.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/PortMapper.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/servletapi/SecurityContextHolderAwareRequestWrapper.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/access/channel/InsecureChannelProcessor.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/authentication/switchuser/SwitchUserGrantedAuthority.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/FilterChainProxy.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/FilterInvocation.java
*
 /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/access/channel/ChannelProcessor.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/authentication/logout/LogoutFilter.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/authentication/rememberme/RememberMeAuthenticationFilter.java
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* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/server/jackson2/DefaultCsrfServerTokenMixin.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/jackson2/PreAuthenticatedAuthenticationTokenDeserializer.java
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* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/jackson2/DefaultSavedRequestMixin.java
* /spring-security-web-5-3-4-release-sources-

jar/org/springframework/security/web/session/SessionInformationExpiredStrategy.java
*
/spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/jackson2/CookieDeserializer.java
* /spring-security-web-5-3-4-release-sources-
jar/org/springframework/security/web/jackson2/WebAuthenticationDetailsMixin.java
* /spring-security-web-5-3-4-release-sources-
jar/org/springframework/security/web/jackson2/SavedCookieMixin.java
* /spring-security-web-5-3-4-release-sources-
jar/org/springframework/security/web/jackson2/WebServletJackson2Module.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/jackson2/CookieMixin.java
* /spring-security-web-5-3-4-release-sources-
jar/org/springframework/security/web/jackson2/PreAuthenticatedAuthenticationTokenMixin.java
* /spring-security-web-5-3-4-release-sources-
jar/org/springframework/security/web/jackson2/WebJackson2Module.java
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* /spring-security-web-5-3-4-release-sources-
jar/org/springframework/security/web/access/expression/WebExpressionConfigAttribute.java
* /spring-security-web-5-3-4-release-sources-
jar/org/springframework/security/web/authentication/logout/SimpleUrlLogoutSuccessHandler.java
*
/spring-security-web-5-3-4-release-sources-
jar/org/springframework/security/web/authentication/rememberme/CookieTheftException.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/authentication/package-
info.java
* /spring-security-web-5-3-4-release-sources-
jar/org/springframework/security/web/authentication/SimpleUrlAuthenticationSuccessHandler.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/package-info.java
* /spring-security-web-5-3-4-release-sources-
jar/org/springframework/security/web/authentication/session/SessionAuthenticationException.java

* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/savedrequest/SavedRequest.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/savedrequest/SavedCookie.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/authentication/preauth/websphere/package-info.java
*
/spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/authentication/AuthenticationSuccessHandler.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/context/SecurityContextPersistenceFilter.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/util/TextEscapeUtils.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/savedrequest/HttpSessionRequestCache.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/access/intercept/package-info.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/debug/DebugFilter.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/RedirectStrategy.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/context/HttpRequestResponseHolder.java
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/spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/authentication/SavedRequestAwareAuthenticationSuccessHandler.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/access/expression/WebSecurityExpressionRoot.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/servletapi/HttpServletRequestFactory.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/context/SecurityContextRepository.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/util/matcher/AndRequestMatcher.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/util/matcher/OrRequestMatcher.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/authentication/switchuser/package-info.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/authentication/session/SessionAuthenticationStrategy.java
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/spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/authentication/Http403ForbiddenEntryPoint.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/authentication/preauth/j2ee/J2eeBasedPreAuthenticatedWebAuthenticationDetailsSource.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/session/SessionManagementFilter.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/authentication/rememberme/PersistentTokenRepository.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/authentication/HttpStatusEntryPoint.java

* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/servletapi/package-info.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/authentication/preauth/PreAuthenticatedAuthenticationToken.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/authentication/rememberme/InMemoryTokenRepositoryImpl.java
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/spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/authentication/preauth/PreAuthenticatedGrantedAuthoritiesUserDetailsService.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/jackson2/package-info.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/WebAttributes.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/authentication/preauth/websphere/WASUsernameAndGroupsExtractor.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/DefaultRedirectStrategy.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/header/writers/frameoptions/AbstractRequestParameterAllowFromStrategy.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/util/matcher/NegatedRequestMatcher.java
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* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/authentication/session/NullAuthenticatedSessionStrategy.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/authentication/preauth/PreAuthenticatedAuthenticationProvider.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/authentication/logout/package-info.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/authentication/www/DigestAuthUtils.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/firewall/RequestRejectedException.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/util/package-info.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/authentication/logout/LogoutSuccessHandler.java
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/spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/firewall/FirewalledRequest.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/authentication/ui/package-info.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/context/HttpSessionSecurityContextRepository.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/authentication/session/package-info.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/access/package-info.java
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* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/util/OnCommittedResponseWrapper.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/authentication/session/RegisterSessionAuthenticationStrategy.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/authentication/switchuser/SwitchUserAuthorityChanger.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/SecurityFilterChain.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/util/RedirectUrlBuilder.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/authentication/preauth/websphere/DefaultWASUsernameAndGroupsExtractor.java
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* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/savedrequest/RequestCacheAwareFilter.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/util/ThrowableAnalyzer.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/authentication/preauth/PreAuthenticatedCredentialsNotFoundException.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/authentication/preauth/x509/X509AuthenticationFilter.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/header/Header.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/session/package-info.java
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* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/context/SaveContextOnUpdateOrErrorResponseWrapper.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/DefaultSecurityFilterChain.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/session/SimpleRedirectSessionInformationExpiredStrategy.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/authentication/rememberme/PersistentRememberMeToken.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/util/matcher/RegexRequestMatcher.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/firewall/HttpFirewall.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/access/channel/package-info.java
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jar/org/springframework/security/web/authentication/preauth/j2ee/package-info.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/firewall/RequestWrapper.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/authentication/preauth/package-info.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/savedrequest/RequestCache.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/authentication/preauth/websphere/WebSpherePreAuthenticatedWebAuthenticationDetailsSource.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/servletapi/HttpServlet3RequestFactory.java
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/spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/authentication/preauth/RequestHeaderAuthenticationFilter.java
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* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/context/NullSecurityContextRepository.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/authentication/rememberme/InvalidCookieException.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/savedrequest/NullRequestCache.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/session/SimpleRedirectInvalidSessionStrategy.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/header/writers/frameoptions/StaticAllowFromStrategy.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/context/request/async/WebAsyncManagerIntegrationFilter.java
*
/spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/authentication/logout/HttpStatusReturningLogoutSuccessHandler.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/authentication/preauth/PreAuthenticatedGrantedAuthoritiesWebAuthenticationDetails.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/authentication/preauth/RequestAttributeAuthenticationFilter.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/debug/Logger.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/header/writers/frameoptions/RegExpAllowFromStrategy.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/authentication/logout/DelegatingLogoutSuccessHandler.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/authentication/preauth/websphere/WebSpherePreAuthenticatedProcessingFilter.java
*

/spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/header/writers/frameoptions/AllowFromStrategy.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/access/expression/package-info.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/authentication/preauth/x509/package-info.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/jaasapi/package-info.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/authentication/www/package-info.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/session/InvalidSessionStrategy.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/access/channel/AbstractRetryEntryPoint.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/authentication/rememberme/RememberMeAuthenticationException.java
*
/spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/context/package-info.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/access/expression/WebExpressionVoter.java
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* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/session/SessionInformationExpiredEvent.java
* /spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/csrf/CookieCsrfTokenRepository.java
*
/spring-security-web-5-3-4-release-sources-jar/org/springframework/security/web/csrf/LazyCsrfTokenRepository.java

1.88 spring-security-core 5.3.4.RELEASE

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*/
/**
* Base64 encoder which is a reduced version of Robert Harder's public domain
* implementation (version 2.3.7). See <a
* href="http://iharder.sourceforge.net/current/java/base64/">http://iharder.sourceforge.net/current/java/base64/
for more information.
* <p>
* For internal use only.
*
* @author
 Luke Taylor
* @since 3.0
* @deprecated Use java.util.Base64
*/

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*/
/**
* Reviews the <code>Object</code> returned from a secure object invocation, being able to
* modify the <code>Object</code> or throw an {@link AccessDeniedException}.
* <p>
* Typically used to ensure the principal is permitted to access the domain object
* instance returned by a service layer bean.
 Can also be used to mutate the domain object
* instance so the principal is only able to access authorised bean properties or
* <code>Collection</code> elements.
* <p>
```

```
* Special consideration should be given to using an <code>AfterInvocationManager</code>
* on bean methods that modify a database. Typically an
* <code>AfterInvocationManager</code> is used with read-only methods, such as
* <code>public DomainObject getById(id)</code>. If used with methods that modify a
* database, a transaction manager should be used to ensure any
* <code>AccessDeniedException</code> will cause a rollback of the changes made by the
* transaction.
* </p>
*
* @author Ben Alex
*/
```

Found in path(s):
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/access/intercept/AfterInvocationManager.java
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* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/converter/RsaKeyConverters.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/core/userdetails/UserDetailsPasswordService.java
*
 /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/crypto/argon2/Argon2PasswordEncoder.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/authentication/ReactiveAuthenticationManagerResolver.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/authentication/AbstractUserDetailsReactiveAuthenticationManager.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/crypto/argon2/Argon2EncodingUtils.java

* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/core/token/SecureRandomFactoryBean.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/access/expression/method/ExpressionBasedPreInvocationAdvice.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/authentication/event/LogoutSuccessEvent.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/authentication/UserDetailsRepositoryReactiveAuthenticationManager.java
*
 /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/core/annotation/CurrentSecurityContext.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/access/hierarchicalroles/RoleHierarchyImpl.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/authentication/ReactiveAuthenticationManagerAdapter.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/authentication/AuthenticationManagerResolver.java
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* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/crypto/keygen/SecureRandomBytesKeyGenerator.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/crypto/util/EncodingUtils.java
*
 /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/crypto/encrypt/HexEncodingTextEncryptor.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/crypto/encrypt/TextEncryptor.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/crypto/keygen/HexEncodingStringKeyGenerator.java
* /spring-security-core-5-3-4-release-sources-

jar/org/springframework/security/crypto/password/StandardPasswordEncoder.java
* /spring-security-core-5-3-4-release-sources-
jar/org/springframework/security/crypto/password/NoOpPasswordEncoder.java
* /spring-security-core-5-3-4-release-sources-
jar/org/springframework/security/crypto/encrypt/BouncyCastleAesCbcBytesEncryptor.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/crypto/encrypt/CipherUtils.java
* /spring-security-core-5-3-4-release-sources-
jar/org/springframework/security/crypto/keygen/SharedKeyGenerator.java
*
/spring-security-core-5-3-4-release-sources-
jar/org/springframework/security/crypto/encrypt/BouncyCastleAesBytesEncryptor.java
* /spring-security-core-5-3-4-release-sources-
jar/org/springframework/security/crypto/keygen/StringKeyGenerator.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/crypto/keygen/KeyGenerators.java
* /spring-security-core-5-3-4-release-sources-
jar/org/springframework/security/crypto/encrypt/AesBytesEncryptor.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/crypto/encrypt/BytesEncryptor.java
* /spring-security-core-5-3-4-release-sources-
jar/org/springframework/security/crypto/encrypt/BouncyCastleAesGcmBytesEncryptor.java
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* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/core/authority/SimpleGrantedAuthority.java
*
 /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/authentication/jaas/event/package-info.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/access/expression/method/MethodSecurityExpressionRoot.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/access/method/P.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/access/expression/SecurityExpressionRoot.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/access/package-info.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/authentication/InternalAuthenticationServiceException.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/access/prepost/PostInvocationAttribute.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/access/prepost/PostFilter.java
*
 /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/access/intercept/package-info.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/access/prepost/PreInvocationAuthorizationAdviceVoter.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/core/authority/mapping/GrantedAuthoritiesMapper.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/authentication/jaas/package-info.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/access/intercept/aspectj/AspectJMethodSecurityInterceptor.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/access/annotation/AnnotationMetadataExtractor.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/authentication/AccountStatusException.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/provisioning/MutableUser.java

*
/spring-security-core-5-3-4-release-sources-
jar/org/springframework/security/core/session/SessionDestroyedEvent.java
* /spring-security-core-5-3-4-release-sources-
jar/org/springframework/security/concurrent/DelegatingSecurityContextScheduledExecutorService.java
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jar/org/springframework/security/access/intercept/aspectj/MethodInvocationAdapter.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/jackson2/package-info.java
* /spring-security-core-5-3-4-release-sources-
jar/org/springframework/security/core/authority/mapping/MappableAttributesRetriever.java
* /spring-security-core-5-3-4-release-sources-
jar/org/springframework/security/access/expression/method/MethodSecurityExpressionOperations.java
* /spring-security-core-5-3-4-release-sources-
jar/org/springframework/security/access/expression/method/AbstractExpressionBasedMethodConfigAttribute.java
*
/spring-security-core-5-3-4-release-sources-
jar/org/springframework/security/core/authority/mapping/MapBasedAttributes2GrantedAuthoritiesMapper.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/core/context/package-info.java
* /spring-security-core-5-3-4-release-sources-
jar/org/springframework/security/provisioning/UserDetailsManager.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/access/prepost/PostAuthorize.java
* /spring-security-core-5-3-4-release-sources-
jar/org/springframework/security/core/authority/GrantedAuthoritiesContainer.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/core/authority/package-info.java
* /spring-security-core-5-3-4-release-sources-
jar/org/springframework/security/core/authority/mapping/SimpleMappableAttributesRetriever.java
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* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/core/authority/AuthorityUtils.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/core/session/package-info.java
* /spring-security-core-5-3-4-release-sources-
jar/org/springframework/security/access/expression/ExpressionUtils.java
* /spring-security-core-5-3-4-release-sources-
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* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/access/prepost/PreFilter.java
* /spring-security-core-5-3-4-release-sources-
jar/org/springframework/security/core/userdetails/UserDetailsByNameServiceWrapper.java
* /spring-security-core-5-3-4-release-sources-
jar/org/springframework/security/access/prepost/PrePostInvocationAttributeFactory.java
* /spring-security-core-5-3-4-release-sources-
jar/org/springframework/security/concurrent/DelegatingSecurityContextExecutor.java
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jar/org/springframework/security/core/authority/mapping/SimpleAttributes2GrantedAuthoritiesMapper.java
* /spring-security-core-5-3-4-release-sources-

jar/org/springframework/security/core/userdetails/UserDetailsChecker.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/task/DelegatingSecurityContextAsyncTaskExecutor.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/crypto/codec/Utf8.java
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* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/core/userdetails/jdbc/package-info.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/access/prepost/PrePostAnnotationSecurityMetadataSource.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/access/PermissionCacheOptimizer.java
*
/spring-security-core-5-3-4-release-sources-jar/org/springframework/security/concurrent/AbstractDelegatingSecurityContextSupport.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/access/vote/package-info.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/core/package-info.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/provisioning/package-info.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/crypto/password/AbstractPasswordEncoder.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/access/prepost/PostInvocationAdviceProvider.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/access/prepost/PreInvocationAuthorizationAdvice.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/provisioning/GroupManager.java
*
/spring-security-core-5-3-4-release-sources-jar/org/springframework/security/util/package-info.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/core/userdetails/cache/package-info.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/core/userdetails/package-info.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/access/expression/SecurityExpressionHandler.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/core/userdetails/cache/SpringCacheBasedUserCache.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/task/DelegatingSecurityContextTaskExecutor.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/access/expression/method/package-info.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/access/expression/DenyAllPermissionEvaluator.java
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/spring-security-core-5-3-4-release-sources-jar/org/springframework/security/access/method/DelegatingMethodSecurityMetadataSource.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/core/token/Sha512DigestUtils.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/core/session/SessionCreationEvent.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/access/annotation/package-info.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/authentication/rcp/package-info.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/access/hierarchicalroles/package-

info.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/provisioning/InMemoryUserDetailsManager.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/core/userdetails/AuthenticationUserDetailsService.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/core/userdetails/memory/package-info.java
*
/spring-security-core-5-3-4-release-sources-jar/org/springframework/security/access/hierarchicalroles/RoleHierarchyAuthoritiesMapper.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/core/authority/mapping/Attributes2GrantedAuthoritiesMapper.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/scheduling/DelegatingSecurityContextSchedulingTaskExecutor.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/access/expression/method/ExpressionBasedAnnotationAttributeFactory.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/crypto/codec/Hex.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/access/hierarchicalroles/CycleInRoleHierarchyException.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/core/CredentialsContainer.java
*
/spring-security-core-5-3-4-release-sources-jar/org/springframework/security/authentication/AccountStatusUserDetailsChecker.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/core/token/DefaultToken.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/access/intercept/aspectj/package-info.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/access/method/package-info.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/authentication/package-info.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/access/prepost/PreAuthorize.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/authentication/jaas/memory/package-info.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/core/parameters/DefaultSecurityParameterNameDiscoverer.java
*
/spring-security-core-5-3-4-release-sources-jar/org/springframework/security/access/expression/AbstractSecurityExpressionHandler.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/authentication/dao/package-info.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/access/prepost/PostInvocationAuthorizationAdvice.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/authentication/AuthenticationEventPublisher.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/crypto/codec/package-info.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/core/authority/mapping/SimpleAuthorityMapper.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/access/expression/package-info.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/access/expression/method/PostInvocationExpressionAttribute.java
*

/spring-security-core-5-3-4-release-sources-jar/org/springframework/security/access/annotation/Jsr250Voter.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/concurrent/DelegatingSecurityContextExecutorService.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/core/token/package-info.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/provisioning/MutableUserDetails.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/access/annotation/Jsr250SecurityConfig.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/access/intercept/aopalliance/package-info.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/access/hierarchicalroles/RoleHierarchy.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/access/hierarchicalroles/NullRoleHierarchy.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/core/authority/mapping/package-info.java
*
/spring-security-core-5-3-4-release-sources-jar/org/springframework/security/access/expression/method/MethodSecurityExpressionHandler.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/authentication/event/package-info.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/access/prepost/package-info.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/access/prepost/PreInvocationAttribute.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/access/expression/method/ExpressionBasedPostInvocationAdvice.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/core/token/TokenService.java
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* limitations under the License.
*/
/**
* A token issued by {@link TokenService}.
*
* <p>
```

* It is important that the keys assigned to tokens are sufficiently randomised and
* secured that they can serve as identifying a unique user session. Implementations of
* {@link TokenService} are free to use encryption or encoding strategies of their
 choice.
* It is strongly recommended that keys are of sufficient length to balance safety against
* persistence cost. In relation to persistence cost, it is strongly recommended that
* returned keys are small enough for encoding in a cookie.
* </p>
*
* @author Ben Alex
* @since 2.0.1
*/

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* /spring-security-core-5-3-4-release-sources-
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* /spring-security-core-5-3-4-release-sources-
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* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/access/annotation/Secured.java
* /spring-security-core-5-3-4-release-sources-
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* /spring-security-core-5-3-4-release-sources-
jar/org/springframework/security/authentication/AuthenticationTrustResolver.java
* /spring-security-core-5-3-4-release-sources-
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* /spring-security-core-5-3-4-release-sources-
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* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/access/vote/UnanimousBased.java
* /spring-security-core-5-3-4-release-sources-
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* /spring-security-core-5-3-4-release-sources-
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* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/core/userdetails/UserCache.java
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* /spring-security-core-5-3-4-release-sources-
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* /spring-security-core-5-3-4-release-sources-
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* /spring-security-core-5-3-4-release-sources-
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/spring-security-core-5-3-4-release-sources-
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* /spring-security-core-5-3-4-release-sources-
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* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/access/event/LoggerListener.java
* /spring-security-core-5-3-4-release-sources-
jar/org/springframework/security/access/intercept/aopalliance/MethodSecurityMetadataSourceAdvisor.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/access/AccessDeniedException.java
* /spring-security-core-5-3-4-release-sources-
jar/org/springframework/security/core/userdetails/memory/UserAttribute.java

* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/authentication/event/AuthenticationFailureDisabledEvent.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/access/method/MapBasedMethodSecurityMetadataSource.java
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/spring-security-core-5-3-4-release-sources-jar/org/springframework/security/authentication/DisabledException.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/core/userdetails/UserDetails.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/util/SimpleMethodInvocation.java
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* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/authentication/AuthenticationManager.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/authentication/jaas/event/JaasAuthenticationSuccessEvent.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/authentication/jaas/JaasAuthenticationCallbackHandler.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/authentication/jaas/JaasAuthenticationToken.java
*
/spring-security-core-5-3-4-release-sources-jar/org/springframework/security/authentication/ProviderNotFoundException.java
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* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/authentication/AuthenticationTrustResolverImpl.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/authentication/AnonymousAuthenticationToken.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/access/intercept/aspectj/AspectJCallback.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/core/userdetails/User.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/authentication/BadCredentialsException.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/access/event/AuthorizationFailureEvent.java
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/spring-security-core-5-3-4-release-sources-jar/org/springframework/security/core/AuthenticationException.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/core/context/ThreadLocalSecurityContextHolderStrategy.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/authentication/AuthenticationDetailsSource.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/core/userdetails/cache/NullUserCache.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/access/vote/AffirmativeBased.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/access/method/AbstractMethodSecurityMetadataSource.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/access/AccessDecisionManager.java
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/spring-security-core-5-3-4-release-sources-jar/org/springframework/security/authentication/AbstractAuthenticationToken.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/access/vote/RoleVoter.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/authentication/dao/AbstractUserDetailsAuthenticationProvider.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/authentication/RememberMeAuthenticationToken.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/authentication/jaas/JaasPasswordCallbackHandler.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/access/intercept/RunAsManager.java
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jar/org/springframework/security/core/context/ReactiveSecurityContextHolder.java
* /spring-security-core-5-3-4-release-sources-
jar/org/springframework/security/authorization/AuthorizationDecision.java
* /spring-security-core-5-3-4-release-sources-
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*
 /spring-security-core-5-3-4-release-sources-
jar/org/springframework/security/authentication/ReactiveAuthenticationManager.java
* /spring-security-core-5-3-4-release-sources-
jar/org/springframework/security/core/userdetails/ReactiveUserDetailsService.java
* /spring-security-core-5-3-4-release-sources-
jar/org/springframework/security/authorization/AuthenticatedReactiveAuthorizationManager.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/crypto/password/Md4.java
* /spring-security-core-5-3-4-release-sources-
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* /spring-security-core-5-3-4-release-sources-
jar/org/springframework/security/core/SpringSecurityCoreVersion.java
* /spring-security-core-5-3-4-release-sources-
jar/org/springframework/security/authorization/ReactiveAuthorizationManager.java

* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/core/AuthenticatedPrincipal.java
*
/spring-security-core-5-3-4-release-sources-jar/org/springframework/security/core/parameters/P.java
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jar/org/springframework/security/authentication/jaas/DefaultJaasAuthenticationProvider.java
* /spring-security-core-5-3-4-release-sources-
jar/org/springframework/security/authentication/jaas/AbstractJaasAuthenticationProvider.java
* /spring-security-core-5-3-4-release-sources-
jar/org/springframework/security/authentication/jaas/memory/InMemoryConfiguration.java
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* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/jackson2/UsernamePasswordAuthenticationTokenDeserializer.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/jackson2/UserDeserializer.java
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* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/crypto/keygen/Base64StringKeyGenerator.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/authentication/DelegatingReactiveAuthenticationManager.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/core/Transient.java
*
 /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/core/userdetails/ReactiveUserDetailsPasswordService.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/crypto/password/MessageDigestPasswordEncoder.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/scheduling/DelegatingSecurityContextTaskScheduler.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/authorization/AuthorityReactiveAuthorizationManager.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/jackson2/UnmodifiableListDeserializer.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/provisioning/JdbcUserDetailsManager.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/access/expression/method/DefaultMethodSecurityExpressionHandler.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/core/token/KeyBasedPersistenceTokenService.java
*
 /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/crypto/password/LdapShaPasswordEncoder.java

* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/jackson2/UnmodifiableListMixin.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/concurrent/DelegatingSecurityContextCallable.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/concurrent/DelegatingSecurityContextRunnable.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/access/prepost/PrePostAdviceReactiveMethodInterceptor.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/authentication/CachingUserDetailsService.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/crypto/password/Md4PasswordEncoder.java
*
/spring-security-core-5-3-4-release-sources-jar/org/springframework/security/crypto/password/DelegatingPasswordEncoder.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/jackson2/BadCredentialsExceptionMixin.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/crypto/password/Pbkdf2PasswordEncoder.java
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*/
/**
  * Determines if the {@link #getAuthentication()} has permission to access the target
  * given the permission
  * @param target the target domain object to check permission on
  * @param permission the permission to check on the domain object (i.e. "read",
  * "write", etc).
  * @return true if permission
 is granted to the {@link #getAuthentication()}, else
  * false
  */
```

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* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/jackson2/CoreJackson2Module.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/jackson2/UserMixin.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/jackson2/UnmodifiableSetDeserializer.java
*
 /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/jackson2/UnmodifiableSetMixin.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/jackson2/RememberMeAuthenticationTokenMixin.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/jackson2/SimpleGrantedAuthorityMixin.java
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/jackson2/UsernamePasswordAuthenticationTokenMixin.java
* /spring-security-core-5-3-4-release-sources-

jar/org/springframework/security/jackson2/AnonymousAuthenticationTokenMixin.java
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*/
/**
 *
 * @param authentication represents the user in question. Should not be null.
 * @param targetDomainObject the domain object for which permissions should be
 * checked. May be null in which case implementations should return false, as the null
 * condition can be checked explicitly in the expression.

* @param permission a representation of the permission object as supplied by the
 * expression system. Not null.
 * @return true if the permission is granted, false otherwise
 */
```

Found in path(s):
* /spring-security-core-5-3-4-release-sources-jar/org/springframework/security/access/PermissionEvaluator.java

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metrics from the pseudo-filesystem proc.

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*
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*
* Author: Adam Dunkels <adam@sics.se>
*
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1.95 gnulib 2019-09-23

1.95.1 Available under license :

Please email the following information to fsf-records@gnu.org, and we
will send you the assignment form that covers your program.

Please use your full legal name (in ASCII characters) as the subject
line of the message.

[What is the name of the program or package you're contributing?]

[Will this become part of a larger GNU package? If so, what package?]

[Did you copy any files or text written by someone else into the
program? Even if that material is free software, we need to know
about it.]

[Do you have an employer who might have a basis to claim to own
your changes? Do you attend a school which might make such a claim?]

[What country are you a citizen of?]

[What year were you born?]

[Please write your email address here.]

[Please write your postal address here.]
Files:
tests/test-update-copyright.sh

Depends-on:

configure.ac:
abs_aux_dir=`cd "$ac_aux_dir"; pwd`
AC_SUBST([abs_aux_dir])

Makefile.am:
TESTS += test-update-copyright.sh
TESTS_ENVIRONMENT += abs_aux_dir='$(abs_aux_dir)'
@c The GNU Lesser General Public License.
@center Version 2.1, February 1999

@c This file is intended to be included within another document,
@c hence no sectioning command or @node.

@display
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[This is the first released version of the Lesser GPL. It also counts
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@end display

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We protect your rights with a two-step method: (1) we copyright the library, and (2) we offer you this license, which gives you legal permission to copy, distribute and/or modify the library.

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When a program is linked with a library, whether statically or using a shared library, the combination of the two is legally speaking a combined work, a derivative of the original library. The ordinary General Public License therefore permits such linking only if the entire combination fits its criteria of freedom. The Lesser General

Public License permits more lax criteria for linking other code with
the library.

We call this license the @dfn{Lesser} General Public License because it
does @emph{Less} to protect the user's freedom than the ordinary General
Public License. It also provides other free software developers Less
of an advantage over competing non-free programs. These disadvantages
are the reason we use the ordinary General Public License for many
libraries. However, the Lesser license provides advantages in certain
special circumstances.

For example, on rare occasions, there may be a special need to
encourage the widest possible use of a certain library, so that it becomes
a de-facto standard. To achieve this, non-free programs must be
allowed to use the library. A more frequent case is that a free
library does the
same job as widely used non-free libraries. In this
case, there is little to gain by limiting the free library to free
software only, so we use the Lesser General Public License.

In other cases, permission to use a particular library in non-free
programs enables a greater number of people to use a large body of
free software. For example, permission to use the GNU C Library in
non-free programs enables many more people to use the whole GNU
operating system, as well as its variant, the GNU/Linux operating
system.

Although the Lesser General Public License is Less protective of the
users' freedom, it does ensure that the user of a program that is
linked with the Library has the freedom and the wherewithal to run
that program using a modified version of the Library.

The precise terms and conditions for copying, distribution and
modification follow. Pay close attention to the difference between a
``work based on the library'' and a ``work that uses the library''. The
former
contains code derived from the library, whereas the latter must
be combined with the library in order to run.

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@enumerate 0
@item
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A ``library'' means a collection of software functions and/or data prepared so as to be conveniently linked with application programs (which use some of those functions and data) to form executables.

The ``Library'', below, refers to any such software library or work which has been distributed under these terms. A ``work based on the Library'' means either the Library or any derivative work under copyright law: that is to say, a work containing the Library or a portion of it,
either verbatim or with modifications and/or translated straightforwardly into another language. (Hereinafter, translation is included without limitation in the term ``modification''.)

``Source code'' for a work means the preferred form of the work for making modifications to it. For a library, complete source code means all the source code for all modules it contains, plus any associated interface definition files, plus the scripts used to control compilation and installation of the library.

Activities other than copying, distribution and modification are not covered by this License; they are outside its scope. The act of running a program using the Library is not restricted, and output from such a program is covered only if its contents constitute a work based on the Library (independent of the use of the Library in a tool for writing it). Whether that is true depends on what the Library does and what the program that uses the Library does.

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You may copy and distribute
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You may modify your copy or copies of the Library or any portion of it, thus forming a work based on the Library, and copy and distribute such modifications or work under the terms of Section 1 above, provided that you also meet all of these conditions:

@enumerate a
@item
The modified work must itself be a software library.

@item
You must cause the files modified to carry prominent notices
stating that you changed the files and the date of any change.

@item
You must
 cause the whole of the work to be licensed at no
charge to all third parties under the terms of this License.

@item
If a facility in the modified Library refers to a function or a
table of data to be supplied by an application program that uses
the facility, other than as an argument passed when the facility
is invoked, then you must make a good faith effort to ensure that,
in the event an application does not supply such function or
table, the facility still operates, and performs whatever part of
its purpose remains meaningful.

(For example, a function in a library to compute square roots has
a purpose that is entirely well-defined independent of the
application. Therefore, Subsection 2d requires that any
application-supplied function or table used by this function must
be optional: if the application does not supply it, the square
root function must still compute square roots.)
@end enumerate

These requirements apply to the modified work as a whole. If
identifiable sections
 of that work are not derived from the Library,
and can be reasonably considered independent and separate works in
themselves, then this License, and its terms, do not apply to those
sections when you distribute them as separate works. But when you
distribute the same sections as part of a whole which is a work based
on the Library, the distribution of the whole must be on the terms of
this License, whose permissions for other licensees extend to the
entire whole, and thus to each and every part regardless of who wrote
it.

Thus, it is not the intent of this section to claim rights or contest
your rights to work written entirely by you; rather, the intent is to
exercise the right to control the distribution of derivative or
collective works based on the Library.

In addition, mere aggregation of another work not based on the Library

with the Library (or with a work based on the Library) on a volume of
a storage or distribution medium does not bring the other work under
the scope of this
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You may opt to apply the terms of the ordinary GNU General Public
License instead of this License to a given copy of the Library. To do
this, you must alter all the notices that refer to this License, so
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instead of to this License. (If a newer version than version 2 of the
ordinary GNU General Public License has appeared, then you can specify
that version instead if you wish.) Do not make any other change in
these notices.

Once this change is made in a given copy, it is irreversible for
that copy, so the ordinary GNU General Public License applies to all
subsequent copies and derivative works made from that copy.

This option is useful when you wish to copy part of the code of
the Library into a program that is not a library.

@item
You may copy and distribute the Library (or a portion or
derivative of it, under Section 2) in object code or executable form
under the terms of Sections 1 and
2 above provided that you accompany
it with the complete corresponding machine-readable source code, which
must be distributed under the terms of Sections 1 and 2 above on a
medium customarily used for software interchange.

If distribution of object code is made by offering access to copy
from a designated place, then offering equivalent access to copy the
source code from the same place satisfies the requirement to
distribute the source code, even though third parties are not
compelled to copy the source along with the object code.

@item
A program that contains no derivative of any portion of the
Library, but is designed to work with the Library by being compiled or
linked with it, is called a ``work that uses the Library''. Such a
work, in isolation, is not a derivative work of the Library, and
therefore falls outside the scope of this License.

However, linking a ``work that uses the Library'' with the Library
creates an executable that is a derivative of the Library (because
it
contains portions of the Library), rather than a ``work that uses the

library". The executable is therefore covered by this License.
Section 6 states terms for distribution of such executables.

When a ``work that uses the Library'' uses material from a header file
that is part of the Library, the object code for the work may be a
derivative work of the Library even though the source code is not.
Whether this is true is especially significant if the work can be
linked without the Library, or if the work is itself a library. The
threshold for this to be true is not precisely defined by law.

If such an object file uses only numerical parameters, data
structure layouts and accessors, and small macros and small inline
functions (ten lines or less in length), then the use of the object
file is unrestricted, regardless of whether it is legally a derivative
work. (Executables containing this object code plus portions of the
Library will still fall under Section 6.)

Otherwise,
if the work is a derivative of the Library, you may
distribute the object code for the work under the terms of Section 6.
Any executables containing that work also fall under Section 6,
whether or not they are linked directly with the Library itself.

@item
As an exception to the Sections above, you may also combine or
link a ``work that uses the Library'' with the Library to produce a
work containing portions of the Library, and distribute that work
under terms of your choice, provided that the terms permit
modification of the work for the customer's own use and reverse
engineering for debugging such modifications.

You must give prominent notice with each copy of the work that the
Library is used in it and that the Library and its use are covered by
this License. You must supply a copy of this License. If the work
during execution displays copyright notices, you must include the
copyright notice for the Library among them, as well as a reference
directing the user to the copy of
this License. Also, you must do one
of these things:

@enumerate a
@item
Accompany the work with the complete corresponding
machine-readable source code for the Library including whatever
changes were used in the work (which must be distributed under
Sections 1 and 2 above); and, if the work is an executable linked
with the Library, with the complete machine-readable ``work that
uses the Library'', as object code and/or source code, so that the

user can modify the Library and then relink to produce a modified
executable containing the modified Library. (It is understood
that the user who changes the contents of definitions files in the
Library will not necessarily be able to recompile the application
to use the modified definitions.)

@item
Use a suitable shared library mechanism for linking with the Library. A
suitable mechanism is one that (1) uses at run time a copy of the
library already present on the user's computer system, rather than
copying library functions into the executable,
 and (2) will operate
properly with a modified version of the library, if the user installs
one, as long as the modified version is interface-compatible with the
version that the work was made with.

@item
Accompany the work with a written offer, valid for at
least three years, to give the same user the materials
specified in Subsection 6a, above, for a charge no more
than the cost of performing this distribution.

@item
If distribution of the work is made by offering access to copy
from a designated place, offer equivalent access to copy the above
specified materials from the same place.

@item
Verify that the user has already received a copy of these
materials or that you have already sent this user a copy.
@end enumerate

 For an executable, the required form of the ``work that uses the
Library" must include any data and utility programs needed for
reproducing the executable from it. However, as a special exception,
the materials to be distributed need not include anything that
 is
normally distributed (in either source or binary form) with the major
components (compiler, kernel, and so on) of the operating system on
which the executable runs, unless that component itself accompanies the
executable.

 It may happen that this requirement contradicts the license
restrictions of other proprietary libraries that do not normally
accompany the operating system. Such a contradiction means you cannot
use both them and the Library together in an executable that you
distribute.

@item
You may place library facilities that are a work based on the
Library side-by-side in a single library together with other library
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library, provided that the separate distribution of the work based on
the Library and of the other library facilities is otherwise
permitted, and provided that you do these two things:

@enumerate a
@item
Accompany the combined library with a copy of the same work
based on the Library,
 uncombined with any other library
facilities. This must be distributed under the terms of the
Sections above.

@item
Give prominent notice with the combined library of the fact
that part of it is a work based on the Library, and explaining
where to find the accompanying uncombined form of the same work.
@end enumerate

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@end enumerate

@subheading END OF TERMS AND CONDITIONS

@page
@subheading How to Apply These Terms to Your New Libraries

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To apply these terms, attach the following notices to the library. It is
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``copyright'' line and a pointer to where the full notice is found.

@smallexample
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USA.
@end
smallexample

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@smallexample

Yoyodyne, Inc., hereby disclaims all copyright interest in the library
`Frob' (a library for tweaking knobs) written by James Random Hacker.

@var{signature of Ty Coon}, 1 April 1990
Ty Coon, President of Vice
@end smallexample

That's all there is to it!

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Version 3, 29 June 2007

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other than an Application or a Combined Work as defined below.

An "Application" is any work that makes use of an interface provided
by the Library, but which is not otherwise based on the Library.
Defining a subclass of a class defined by
the Library is deemed a mode
of using an interface provided by the Library.

A "Combined Work" is a work produced by combining or linking an
Application with the Library. The particular version of the Library
with which the Combined Work was made is also called the "Linked
Version".

The "Minimal Corresponding Source" for a Combined Work means the
Corresponding Source for the Combined Work, excluding any source code
for portions of the Combined Work that, considered in isolation, are
based on the Application, and not on the Linked Version.

The "Corresponding Application Code" for a Combined Work means the
object code and/or source code for the Application, including any data
and utility programs needed for reproducing the Combined Work from the

Application, but excluding the System Libraries of the Combined Work.

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2. Conveying Modified Versions.

If you modify a copy of the Library, and, in your modifications, a facility refers to a function or data to be supplied by an Application that uses the facility (other than as an argument passed when the facility is invoked), then you may convey a copy of the modified version:

a) under this License, provided that you make a good faith effort to ensure that, in the event an Application does not supply the function or data, the facility still operates, and performs whatever part of its purpose remains meaningful, or

b) under the GNU GPL, with none of the additional permissions of this License applicable to that copy.

3. Object Code Incorporating Material from Library Header Files.

The object code form of an Application may incorporate material from a header file that is part of the Library. You may convey such object code under terms of your choice, provided that, if the incorporated material is not limited to numerical parameters,
data structure
layouts and accessors, or small macros, inline functions and templates (ten or fewer lines in length), you do both of the following:

a) Give prominent notice with each copy of the object code that the Library is used in it and that the Library and its use are covered by this License.

b) Accompany the object code with a copy of the GNU GPL and this license document.

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You may convey a Combined Work under terms of your choice that, taken together, effectively do not restrict modification of the portions of the Library contained in the Combined Work and reverse engineering for debugging such modifications, if you also do each of the following:

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b) Accompany the Combined Work with a copy of the GNU GPL and this license document.

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d) Do one of the following:

0) Convey the Minimal Corresponding Source under the terms of this License, and the Corresponding Application Code in a form suitable for, and under terms that permit, the user to recombine or relink the Application with a modified version of the Linked Version to produce a modified Combined Work, in the manner specified by section 6 of the GNU GPL for conveying Corresponding Source.

1) Use a suitable shared library mechanism for linking with the Library. A suitable mechanism is one that (a) uses at run time a copy of the Library already present on the user's computer system, and (b) will operate properly with a modified version of the Library that is interface-compatible with the Linked Version.

e) Provide Installation Information, but only if you would otherwise be required to provide such information under section 6 of the GNU GPL, and only to the extent that such information is necessary to install and execute a modified version of the Combined Work produced by recombining or relinking the Application with a modified version of the Linked Version. (If you use option 4d0, the Installation Information must accompany the Minimal Corresponding Source and Corresponding Application Code. If you use option 4d1, you must provide the Installation Information in the manner specified by section 6 of the GNU GPL for conveying Corresponding Source.)

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You may place library facilities that are a work based on the Library side by side in a single library together with other library facilities that are not Applications and are not covered by this

License, and convey such a combined
library under terms of your
choice, if you do both of the following:

a) Accompany the combined library with a copy of the same work based
on the Library, uncombined with any other library facilities,
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b) Give prominent notice with the combined library that part of it
is a work based on the Library, and explaining where to find the
accompanying uncombined form of the same work.

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versions will be similar in spirit to the present version, but may
differ in detail to address new problems or concerns.

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Library.
Description:
Concatenate two arbitrary file names.

Files:
lib/filenamecat.h
lib/filenamecat-lgpl.c
m4/filenamecat.m4

Depends-on:
dirname-lgpl

configure.ac:
gl_FILE_NAME_CONCAT_LGPL

Makefile.am:
lib_SOURCES += filenamecat-lgpl.c

Include:
"filenamecat.h"

License:
LGPLv2+

Maintainer:
Jim Meyering
$Id: COPYING,v 1.3 2006-10-26 16:20:28 eggert Exp $
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@iftex
@heading END OF TERMS AND CONDITIONS
@end iftex
@ifinfo
@center END OF TERMS AND CONDITIONS

@end ifinfo

@page
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possible use to the public, the best way to achieve this is to make it
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to attach them to the start of each source file to most effectively
convey the exclusion of warranty; and each file should have at least
the ``copyright'' line and a pointer to where the full notice is found.

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and a brief idea of what it does.}
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@end smallexample

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when it starts in an interactive mode:

@smallexample
Gnomovision version
 69, Copyright (C) @var{year} @var{name of author}
Gnomovision comes with ABSOLUTELY NO WARRANTY; for details type `show w'.
This is free software, and you are welcome to redistribute it
under certain conditions; type `show c' for details.
@end smallexample

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@example
Yoyodyne, Inc., hereby disclaims all copyright interest in the program
`Gnomovision' (which makes passes at compilers) written by James Hacker.

@var{signature of Ty Coon}, 1 April 1989
Ty Coon, President of Vice
@end example

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Files:
tests/test-canonicalize-lgpl.c
tests/signature.h
tests/null-ptr.h

tests/macros.h

Depends-on:
ignore-value
same-inode
symlink

configure.ac:

Makefile.am:
TESTS += test-canonicalize-lgpl
check_PROGRAMS += test-canonicalize-lgpl
Description:
Provide the GNU Free Documentation License in Texinfo format.

Files:
doc/fdl.texi

Depends-on:

configure.ac:

Makefile.am:

Include:

License:
unmodifiable license text

Maintainer:
all
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* Assign the copyright to the Free Software Foundation.
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* Keep the copyright and release the program yourself under the GNU

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* Put the code in the public domain. Then there is nothing to stop hoarding of modified versions, but we can still use the program in GNU.

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If you are employed to do programming, or have made an agreement with your employer that says it owns programs you write, we need a signed piece of paper from your employer disclaiming rights to the program. It should be signed by a vice president or general manager of the company. If you can't get at them, it is almost as good to find someone who signs licenses for software that is purchased. Here is a sample wording:

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<signature of Mo Ghoul>, 1 April 1987
Mo Ghoul, President of Vice, Digital Simulation Corp.

The description of what the program does is just to make it clearer what the disclaimer covers.

If
what you did was change an existing program, it should say this:

...in the changes and enhancements made by Hugh Hacker to the

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REQUEST: SEND FORM FOR PAST AND FUTURE CHANGES

[What is the name of the program or package you're contributing to?]

[Did you copy any files or text written by someone else in these changes? Even if that material is free software, we need to know about it.]

[Do you have an employer who might have a basis to claim to own your changes? Do you attend a school which might make such a claim?]

[For the copyright registration, what country are you a citizen of?]

[What year were you born?]

[Please write your email address here.]

[Please write your postal address here.]

[Which files have you changed so far, and which new files have you written so far?]
Description:
Help make libraries relocatable, that is, to allow them to function properly when copied to an arbitrary directory.

Files:
doc/relocatable.texi
lib/relocatable.h
lib/relocatable.c
lib/relocatable.valgrind
m4/relocatable-lib.m4

Depends-on:
strdup

configure.ac:
gl_RELOCATABLE_LIBRARY
if test $RELOCATABLE = yes; then
 AC_LIBOBJ([relocatable])
fi

Makefile.am:
DEFS += -DNO_XMALLOC

Include:
"relocatable.h"

License:
LGPLv2+

Maintainer:
Ben Pfaff

Description:
Ensure getcwd(NULL, 0) returns a buffer allocated by the malloc() function.

Files:
lib/getcwd-lgpl.c
m4/getcwd.m4

Depends-on:
unistd
strdup [test $REPLACE_GETCWD = 1]

configure.ac:
gl_FUNC_GETCWD_LGPL
if test $REPLACE_GETCWD = 1; then
AC_LIBOBJ([getcwd-lgpl])
fi
gl_UNISTD_MODULE_INDICATOR([getcwd])

Makefile.am:

Include:
<unistd.h>

License:
LGPLv2+

Maintainer:
Eric Blake

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<signature of Ty Coon>, 1 April 1990
Ty Coon, President of Vice

That's all there is to it!

Description:
Locating a program in PATH (LGPLed version).

Files:
lib/findprog.h
lib/findprog.c
lib/findprog-lgpl.c
m4/findprog.m4
m4/eaccess.m4

Depends-on:
stdbool
strdup
concat-filename
access
unistd

configure.ac:
gl_FINDPROG
gl_MODULE_INDICATOR([findprog-lgpl])

Makefile.am:
lib_SOURCES += findprog.h findprog.c

Include:
"findprog.h"

License:
LGPLv2+

Maintainer:
all
The files in this directory describe the gnulib modules.
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changes, but it will not cover other unrelated future changes to the
same program.

Please use your full legal name (in ASCII characters) as the subject line of the message.

REQUEST: SEND FORM FOR CHANGES ALREADY MADE

[What is the name of the program or package you're contributing to?]

[Did you copy any files or text written by someone else in these changes?
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[Do you have an employer who might have a basis to claim to own
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[What year were you born?]

[Please write your email address here.]

[Please write your
 postal address here.]

[Which files have you changed so far, and which new files have you written
so far?]
Files:
tests/test-getcwd-lgpl.c
tests/signature.h
tests/macros.h

Depends-on:

configure.ac:

Makefile.am:
TESTS += test-getcwd-lgpl
check_PROGRAMS += test-getcwd-lgpl
test_getcwd_lgpl_LDADD = $(LDADD) $(LIBINTL)
Please email the following information to assign@gnu.org, and we will
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Description:
realpath, canonicalize_file_name: Provide canonical absolute file name

Files:
lib/canonicalize-lgpl.c
m4/canonicalize.m4
m4/double-slash-root.m4

Depends-on:
extensions

stdlib
nocrash
alloca-opt [test $HAVE_CANONICALIZE_FILE_NAME = 0 || test $REPLACE_CANONICALIZE_FILE_NAME = 1]
errno [test $HAVE_CANONICALIZE_FILE_NAME = 0 || test $REPLACE_CANONICALIZE_FILE_NAME = 1]
lstat [test $HAVE_CANONICALIZE_FILE_NAME = 0 || test $REPLACE_CANONICALIZE_FILE_NAME = 1]
malloca [test $HAVE_CANONICALIZE_FILE_NAME = 0 || test $REPLACE_CANONICALIZE_FILE_NAME = 1]
memmove [test $HAVE_CANONICALIZE_FILE_NAME = 0 || test $REPLACE_CANONICALIZE_FILE_NAME = 1]
pathmax [test $HAVE_CANONICALIZE_FILE_NAME = 0 || test $REPLACE_CANONICALIZE_FILE_NAME = 1]
readlink [test $HAVE_CANONICALIZE_FILE_NAME = 0 || test $REPLACE_CANONICALIZE_FILE_NAME = 1]
sys_stat [test $HAVE_CANONICALIZE_FILE_NAME = 0 || test $REPLACE_CANONICALIZE_FILE_NAME = 1]

configure.ac:
gl_CANONICALIZE_LGPL
if
 test $HAVE_CANONICALIZE_FILE_NAME = 0 || test $REPLACE_CANONICALIZE_FILE_NAME = 1; then
 AC_LIBOBJ([canonicalize-lgpl])
fi
gl_MODULE_INDICATOR([canonicalize-lgpl])
gl_STDLIB_MODULE_INDICATOR([canonicalize_file_name])
gl_STDLIB_MODULE_INDICATOR([realpath])

Makefile.am:

Include:
<stdlib.h>

License:
LGPLv2+

Maintainer:
all
Description:
Extract specific portions of filenames.

Files:
lib/dirname.h
lib/dirname-lgpl.c
lib/basename-lgpl.c
lib/stripslash.c
m4/dirname.m4

Depends-on:
dosname
double-slash-root
malloc-posix
stdbool

configure.ac:
gl_DIRNAME_LGPL

Makefile.am:
lib_SOURCES += dirname-lgpl.c basename-lgpl.c stripslash.c

Include:
"dirname.h"

License:
LGPLv2+

Maintainer:
Jim Meyering, Eric Blake

1.96 hd-parm 9.38

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1.97 lcms 2.7

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1.98 libjpeg 9b

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*
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*
* These routines may need modification for non-Unix environments or
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* an ordinary stdio stream.
*
* Based on code contributed by Lee Daniel Crocker.
*/
```

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/wrtarga.c
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```
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*
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*
* This file contains inverse-DCT routines that produce reduced-size output:
* either 4x4, 2x2, or 1x1 pixels from an 8x8 DCT block.
*
* The implementation is based on the Loeffler, Ligtenberg and Moschytz (LL&M)
* algorithm used in jidctint.c.  We simply replace each 8-to-8 1-D IDCT step
* with an 8-to-4 step that produces the four averages of two adjacent outputs
* (or an 8-to-2 step producing two averages of four outputs, for 2x2 output).
* These steps were derived by computing the corresponding values at the end
* of the normal LL&M code, then simplifying as much as possible.
*
* 1x1 is trivial: just take the DC coefficient divided by 8.
*
* See jidctint.c for additional comments.
*/
```

Found in path(s):

*

/libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/jidctred.c

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```
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*
* This file contains routines to write output images in GIF format.
*
*************************************************************************
* NOTE: to avoid entanglements with Unisys' patent on LZW compression,   *
* this code has been modified to output "uncompressed GIF" files.        *
* There is no trace of the LZW algorithm in this file.                   *
*************************************************************************
*
* These routines may need modification for non-Unix environments or
* specialized applications.  As they stand, they assume output to
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*/
/*
```

```
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 contains the following copyright notice:
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```

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/wrgif.c
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```
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*
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*
* This file contains application interface code for the compression half
* of the JPEG library.  These are the "standard" API routines that are
* used in the normal full-compression case.  They are not used by a
* transcoding-only application.  Note that if an application links in
* jpeg_start_compress, it will end up linking in the entire compressor.
* We thus must separate this file from jcapimin.c to avoid linking the
* whole compression library into a transcoder.
*/
```

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/jcapistd.c
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```
/*
* jidctfst.c
*
```

```
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*
* This file contains a fast, not so accurate integer implementation of the
* inverse DCT (Discrete Cosine Transform).  In the IJG code, this routine
* must also perform dequantization of the input coefficients.
*
* A 2-D IDCT can be done by 1-D IDCT on each column followed by 1-D IDCT
* on each row (or vice versa, but it's more convenient to emit a row at
* a time).  Direct algorithms are also available, but they are much more
* complex and seem not to be any faster when reduced to code.
*
* This implementation is based on Arai, Agui, and Nakajima's algorithm for
* scaled DCT.  Their original paper (Trans. IEICE E-71(11):1095) is in
* Japanese, but the algorithm is described in the Pennebaker & Mitchell
 * JPEG textbook (see REFERENCES section in file README).  The following code
* is based directly on figure 4-8 in P&M.
* While an 8-point DCT cannot be done in less than 11 multiplies, it is
* possible to arrange the computation so that many of the multiplies are
* simple scalings of the final outputs.  These multiplies can then be
* folded into the multiplications or divisions by the JPEG quantization
* table entries.  The AA&N method leaves only 5 multiplies and 29 adds
* to be done in the DCT itself.
* The primary disadvantage of this method is that with fixed-point math,
* accuracy is lost due to imprecise representation of the scaled
* quantization values.  The smaller the quantization table entry, the less
* precise the scaled value, so this implementation does worse with high-
* quality-setting files than with low-quality ones.
*/
```

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/jidctfst.c
No license file was found, but licenses were detected in source scan.

```
/*
* jccolor.c
*
* This file was part of the Independent JPEG Group's software:
* Copyright (C) 1991-1996, Thomas G. Lane.
* Modifications:
* Copyright 2009 Pierre Ossman <ossman@cendio.se> for Cendio AB
* Copyright (C) 2009-2012, D. R. Commander.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains input colorspace conversion routines.
*/
```

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/jccolor.c
No license file was found, but licenses were detected in source scan.

```
/*
* jdmainct.c
*
* This file was part of the Independent JPEG Group's software:
* Copyright (C) 1994-1996, Thomas G. Lane.
* Modifications:
* Copyright (C) 2010, D. R. Commander.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains the main buffer controller for decompression.
* The main buffer lies between the JPEG decompressor proper and the
* post-processor; it holds downsampled data in the JPEG colorspace.
*
* Note that this code is bypassed in raw-data mode, since the application
* supplies the equivalent of the main buffer in that case.
*/
```

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/jdmainct.c
No license file was found, but licenses were detected in source scan.

```
/*
* jdhuff.c
*
* This file was part of the Independent JPEG Group's software:
* Copyright (C) 1991-1997, Thomas G. Lane.
* Modifications:
* Copyright (C) 2009-2011, D. R. Commander.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains Huffman entropy decoding routines.
*
* Much of the complexity here has to do with supporting input suspension.
* If the data source module demands suspension, we want to be able to back
* up to the start of the current MCU.  To do this, we copy state variables
* into local working storage, and update them back to the permanent
* storage only upon successful completion of an MCU.
*/
```

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-

archive-C8ga4kAj/libjpeg-turbo-1.2.90/jdhuff.c
No license file was found, but licenses were detected in source scan.

```
/*
* jpegint.h
*
* Copyright (C) 1991-1997, Thomas G. Lane.
* Modified 1997-2009 by Guido Vollbeding.
* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.
*
* This file provides common declarations for the various JPEG modules.
* These declarations are considered internal to the JPEG library; most
* applications using the library shouldn't need to include this file.
*/
```

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/jpegint.h
No license file was found, but licenses were detected in source scan.

```
********************************************************************************
**     Background
********************************************************************************

libjpeg-turbo is a JPEG image codec that uses SIMD instructions (MMX, SSE2,
NEON) to accelerate baseline JPEG compression and decompression on x86, x86-64,
and ARM systems.  On such systems, libjpeg-turbo is generally 2-4x as fast as
libjpeg, all else being equal.  On other types of systems, libjpeg-turbo can
still outperform libjpeg by a significant amount, by virtue of its
highly-optimized Huffman coding routines.  In many cases, the performance of
libjpeg-turbo rivals that of proprietary high-speed JPEG codecs.

libjpeg-turbo implements both the traditional libjpeg API as well as the less
powerful but more straightforward TurboJPEG API.  libjpeg-turbo also features
colorspace extensions that allow it to compress from/decompress to 32-bit
 and
big-endian pixel buffers (RGBX, XBGR, etc.), as well as a full-featured Java
interface.

libjpeg-turbo was originally based on libjpeg/SIMD, an MMX-accelerated
derivative of libjpeg v6b developed by Miyasaka Masaru.  The TigerVNC and
VirtualGL projects made numerous enhancements to the codec in 2009, and in
early 2010, libjpeg-turbo spun off into an independent project, with the goal
of making high-speed JPEG compression/decompression technology available to a
broader range of users and developers.
```

```
================================================================================
**  License
================================================================================
```

Most of libjpeg-turbo inherits the non-restrictive, BSD-style license used by
libjpeg (see README.) The TurboJPEG wrapper (both C and Java versions) and
associated test programs bear a similar license, which is reproduced below:

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 this list of conditions and the following disclaimer.
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 this list of conditions and the following disclaimer in the documentation
 and/or other materials provided with the distribution.
- Neither the name of the libjpeg-turbo Project nor the names of its
 contributors may be used to endorse or promote products derived from this
 software without specific prior written permission.

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CONSEQUENTIAL DAMAGES (INCLUDING,
 BUT NOT LIMITED TO, PROCUREMENT OF
SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS
INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN
CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE)
ARISING IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE
POSSIBILITY OF SUCH DAMAGE.

```
================================================================================
**  Using libjpeg-turbo
================================================================================
```

libjpeg-turbo includes two APIs that can be used to compress and decompress
JPEG images:

 TurboJPEG API: This API provides an easy-to-use interface for compressing
 and decompressing JPEG images in memory. It also provides some functionality
 that would not be straightforward to achieve using the underlying libjpeg
 API, such as generating planar YUV images and performing multiple
 simultaneous lossless transforms on an image. The Java interface

for
libjpeg-turbo is written on top of the TurboJPEG API.

libjpeg API: This is the de facto industry-standard API for compressing and decompressing JPEG images. It is more difficult to use than the TurboJPEG API but also more powerful. The libjpeg API implementation in libjpeg-turbo is both API/ABI-compatible and mathematically compatible with libjpeg v6b. It can also optionally be configured to be API/ABI-compatible with libjpeg v7 and v8 (see below.)

There is no significant performance advantage to either API when both are used to perform similar operations.

==========
Installation Directory
==========

This document assumes that libjpeg-turbo will be installed in the default directory (/opt/libjpeg-turbo on Un*x and Mac systems and c:\libjpeg-turbo[-gcc][64] on Windows systems. If your installation of libjpeg-turbo resides in a different directory, then adjust the instructions accordingly.

==========
Replacing libjpeg
 at Run Time
==========

Un*x

If a Un*x application is dynamically linked with libjpeg, then you can replace libjpeg with libjpeg-turbo at run time by manipulating LD_LIBRARY_PATH. For instance:

```
[Using libjpeg]
> time cjpeg <vgl_5674_0098.ppm >vgl_5674_0098.jpg
real  0m0.392s
user  0m0.074s
sys   0m0.020s

[Using libjpeg-turbo]
> export LD_LIBRARY_PATH=/opt/libjpeg-turbo/{lib}:$LD_LIBRARY_PATH
> time cjpeg <vgl_5674_0098.ppm >vgl_5674_0098.jpg
real  0m0.109s
user  0m0.029s
sys   0m0.010s
```

({lib} = lib32 or lib64, depending on whether you wish to use the 32-bit or the 64-bit version of libjpeg-turbo.)

System administrators can also replace the libjpeg symlinks in /usr/lib* with links to the libjpeg-turbo dynamic library located in /opt/libjpeg-turbo/{lib}. This will effectively accelerate every application that uses the libjpeg dynamic library on the system.

Windows

If a Windows application is dynamically linked with libjpeg, then you can replace libjpeg with libjpeg-turbo at run time by backing up the application's copy of jpeg62.dll, jpeg7.dll, or jpeg8.dll (assuming the application has its own local copy of this library) and copying the corresponding DLL from libjpeg-turbo into the application's install directory. The official libjpeg-turbo binary packages only provide jpeg62.dll. If the application uses jpeg7.dll or jpeg8.dll instead, then it will be necessary to build libjpeg-turbo from source (see "libjpeg v7 and v8 API/ABI Emulation" below.)

The following information is specific to the official libjpeg-turbo binary packages for Visual C++:

-- jpeg62.dll requires the Visual C++ 2008 C run-time DLL (msvcr90.dll). msvcr90.dll ships with more recent versions of Windows, but users of older Windows releases can obtain it from the Visual C++ 2008 Redistributable Package, which is available as a free download from Microsoft's web site.

-- Features of the libjpeg API that require passing a C run-time structure, such as a file handle, from an application to the library will probably not work with jpeg62.dll, unless the application is also built to use the Visual C++ 2008 C run-time DLL. In particular, this affects jpeg_stdio_dest() and jpeg_stdio_src().

Mac

Mac applications typically embed their own copies of the libjpeg dylib inside the (hidden) application bundle, so it is not possible to globally replace libjpeg on OS X systems. Replacing the application's version of the libjpeg dylib would generally involve copying libjpeg.*.dylib from libjpeg-turbo into the appropriate place in the application bundle and using install_name_tool to repoint the libjpeg-turbo dylib to its new directory. This requires an advanced knowledge of OS X and would not survive an upgrade or a re-install of the application. Thus, it is not recommended for most users.

==========
Using libjpeg-turbo in Your Own Programs
==========

For the
most part, libjpeg-turbo should work identically to libjpeg, so in
most cases, an application can be built against libjpeg and then run against
libjpeg-turbo. On Un*x systems and Cygwin, you can build against libjpeg-turbo
instead of libjpeg by setting

CPATH=/opt/libjpeg-turbo/include
and
LIBRARY_PATH=/opt/libjpeg-turbo/{lib}

({lib} = lib32 or lib64, depending on whether you are building a 32-bit or a
64-bit application.)

If using MinGW, then set

CPATH=/c/libjpeg-turbo-gcc[64]/include
and
LIBRARY_PATH=/c/libjpeg-turbo-gcc[64]/lib

Building against libjpeg-turbo is useful, for instance, if you want to build an
application that leverages the libjpeg-turbo colorspace extensions (see below.)
On Un*x systems, you would still need to manipulate LD_LIBRARY_PATH or create
appropriate symlinks to use libjpeg-turbo at run time. On such systems, you
can pass -R /opt/libjpeg-turbo/{lib} to the linker to force the use of
libjpeg-turbo at run time rather than libjpeg (also useful
if you want to
leverage the colorspace extensions), or you can link against the libjpeg-turbo
static library.

To force a Un*x or MinGW application to link against the static version of
libjpeg-turbo, you can use the following linker options:

-Wl,-Bstatic -ljpeg -Wl,-Bdynamic

On OS X, simply add /opt/libjpeg-turbo/lib/libjpeg.a to the linker command
line.

To build Visual C++ applications using libjpeg-turbo, add
c:\libjpeg-turbo[64]\include to the system or user INCLUDE environment
variable and c:\libjpeg-turbo[64]\lib to the system or user LIB environment
variable, and then link against either jpeg.lib (to use the DLL version of
libjpeg-turbo) or jpeg-static.lib (to use the static version of libjpeg-turbo.)

==========

Colorspace Extensions
==========

libjpeg-turbo includes extensions that allow JPEG images to be compressed
directly from (and decompressed directly to) buffers that use BGR, BGRX,
RGBX, XBGR, and XRGB pixel ordering. This is implemented with
 ten new
colorspace constants:

```
 JCS_EXT_RGB   /* red/green/blue */
 JCS_EXT_RGBX  /* red/green/blue/x */
 JCS_EXT_BGR   /* blue/green/red */
 JCS_EXT_BGRX  /* blue/green/red/x */
 JCS_EXT_XBGR  /* x/blue/green/red */
 JCS_EXT_XRGB  /* x/red/green/blue */
 JCS_EXT_RGBA  /* red/green/blue/alpha */
 JCS_EXT_BGRA  /* blue/green/red/alpha */
 JCS_EXT_ABGR  /* alpha/blue/green/red */
 JCS_EXT_ARGB  /* alpha/red/green/blue */
```

Setting cinfo.in_color_space (compression) or cinfo.out_color_space
(decompression) to one of these values will cause libjpeg-turbo to read the
red, green, and blue values from (or write them to) the appropriate position in
the pixel when compressing from/decompressing to an RGB buffer.

Your application can check for the existence of these extensions at compile
time with:

```
 #ifdef JCS_EXTENSIONS
```

At run time, attempting to use these extensions with a libjpeg implementation
that does not support them will result in a "Bogus input colorspace" error.
Applications
 can trap this error in order to test whether run-time support is
available for the colorspace extensions.

When using the RGBX, BGRX, XBGR, and XRGB colorspaces during decompression, the
X byte is undefined, and in order to ensure the best performance, libjpeg-turbo
can set that byte to whatever value it wishes. If an application expects the X
byte to be used as an alpha channel, then it should specify JCS_EXT_RGBA,
JCS_EXT_BGRA, JCS_EXT_ABGR, or JCS_EXT_ARGB. When these colorspace constants
are used, the X byte is guaranteed to be 0xFF, which is interpreted as opaque.

Your application can check for the existence of the alpha channel colorspace
extensions at compile time with:

```
 #ifdef JCS_ALPHA_EXTENSIONS
```

jcstest.c, located in the libjpeg-turbo source tree, demonstrates how to check
for the existence of the colorspace extensions at compile time and run time.

==========
libjpeg v7 and v8 API/ABI Emulation
==========

With libjpeg
 v7 and v8, new features were added that necessitated extending the
compression and decompression structures. Unfortunately, due to the exposed
nature of those structures, extending them also necessitated breaking backward
ABI compatibility with previous libjpeg releases. Thus, programs that were
built to use libjpeg v7 or v8 did not work with libjpeg-turbo, since it is
based on the libjpeg v6b code base. Although libjpeg v7 and v8 are still not
as widely used as v6b, enough programs (including a few Linux distros) made
the switch that there was a demand to emulate the libjpeg v7 and v8 ABIs
in libjpeg-turbo. It should be noted, however, that this feature was added
primarily so that applications that had already been compiled to use libjpeg
v7+ could take advantage of accelerated baseline JPEG encoding/decoding
without recompiling. libjpeg-turbo does not claim to support all of the
libjpeg v7+ features, nor to produce identical output to libjpeg v7+ in all
cases (see below.)

By
 passing an argument of --with-jpeg7 or --with-jpeg8 to configure, or an
argument of -DWITH_JPEG7=1 or -DWITH_JPEG8=1 to cmake, you can build a version
of libjpeg-turbo that emulates the libjpeg v7 or v8 ABI, so that programs
that are built against libjpeg v7 or v8 can be run with libjpeg-turbo. The
following section describes which libjpeg v7+ features are supported and which
aren't.

Support for libjpeg v7 and v8 Features:

Fully supported:

-- libjpeg: IDCT scaling extensions in decompressor
  libjpeg-turbo supports IDCT scaling with scaling factors of 1/8, 1/4, 3/8,
  1/2, 5/8, 3/4, 7/8, 9/8, 5/4, 11/8, 3/2, 13/8, 7/4, 15/8, and 2/1 (only 1/4
  and 1/2 are SIMD-accelerated.)

-- libjpeg: arithmetic coding

-- libjpeg: In-memory source and destination managers
  See notes below.

-- cjpeg: Separate quality settings for luminance and chrominance
  Note that the libpjeg v7+ API was extended to accommodate this feature only

for convenience
purposes. It has always been possible to implement this
feature with libjpeg v6b (see rdswitch.c for an example.)

-- cjpeg: 32-bit BMP support

-- cjpeg: -rgb option

-- jpegtran: lossless cropping

-- jpegtran: -perfect option

-- jpegtran: forcing width/height when performing lossless crop

-- rdjpgcom: -raw option

-- rdjpgcom: locale awareness

Not supported:

NOTE: As of this writing, extensive research has been conducted into the
usefulness of DCT scaling as a means of data reduction and SmartScale as a
means of quality improvement. The reader is invited to peruse the research at
http://www.libjpeg-turbo.org/About/SmartScale and draw his/her own conclusions,
but it is the general belief of our project that these features have not
demonstrated sufficient usefulness to justify inclusion in libjpeg-turbo.

-- libjpeg: DCT scaling in compressor
cinfo.scale_num and cinfo.scale_denom are silently ignored.
There is no technical reason why DCT scaling could not be supported
when
emulating the libjpeg v7+ API/ABI, but without the SmartScale extension (see
below), only scaling factors of 1/2, 8/15, 4/7, 8/13, 2/3, 8/11, 4/5, and
8/9 would be available, which is of limited usefulness.

-- libjpeg: SmartScale
cinfo.block_size is silently ignored.
SmartScale is an extension to the JPEG format that allows for DCT block
sizes other than 8x8. Providing support for this new format would be
feasible (particularly without full acceleration.) However, until/unless
the format becomes either an official industry standard or, at minimum, an
accepted solution in the community, we are hesitant to implement it, as
there is no sense of whether or how it might change in the future. It is
our belief that SmartScale has not demonstrated sufficient usefulness as a
lossless format nor as a means of quality enhancement, and thus, our primary
interest in providing this feature would be as a means of supporting
additional DCT scaling

factors.

-- libjpeg: Fancy downsampling in compressor
cinfo.do_fancy_downsampling is silently ignored.
This requires the DCT scaling feature, which is not supported.

-- jpegtran: Scaling
This requires both the DCT scaling and SmartScale features, which are not supported.

-- Lossless RGB JPEG files
This requires the SmartScale feature, which is not supported.

What About libjpeg v9?
---

libjpeg v9 introduced yet another field to the JPEG compression structure (color_transform), thus making the ABI backward incompatible with that of libjpeg v8. This new field was introduced solely for the purpose of supporting lossless SmartScale encoding. Further, there was actually no reason to extend the API in this manner, as the color transform could have just as easily been activated by way of a new JPEG colorspace constant, thus preserving backward ABI compatibility.

Our research (see link above) has shown that lossless SmartScale does not generally accomplish
anything that can't already be accomplished better with
existing, standard lossless formats. Thus, at this time, it is our belief that there is not sufficient technical justification for software to upgrade from libjpeg v8 to libjpeg v9, and therefore, not sufficient technical justification for us to emulate the libjpeg v9 ABI.

==========
In-Memory Source/Destination Managers
==========

By default, libjpeg-turbo 1.3 and later includes the jpeg_mem_src() and jpeg_mem_dest() functions, even when not emulating the libjpeg v8 API/ABI. Previously, it was necessary to build libjpeg-turbo from source with libjpeg v8 API/ABI emulation in order to use the in-memory source/destination managers, but several projects requested that those functions be included when emulating the libjpeg v6b API/ABI as well. This allows the use of those functions by programs that need them without breaking ABI compatibility for programs that don't, and
it allows those functions to be provided in the "official"
libjpeg-turbo binaries.

Those who are concerned about maintaining strict conformance with the libjpeg

v6b or v7 API can pass an argument of --without-mem-srcdst to configure or
an argument of -DWITH_MEM_SRCDST=0 to CMake prior to building libjpeg-turbo.
This will restore the pre-1.3 behavior, in which jpeg_mem_src() and
jpeg_mem_dest() are only included when emulating the libjpeg v8 API/ABI.

On Un*x systems, including the in-memory source/destination managers changes
the dynamic library version from 62.0.0 to 62.1.0 if using libjpeg v6b API/ABI
emulation and from 7.0.0 to 7.1.0 if using libjpeg v7 API/ABI emulation.

Note that, on most Un*x systems, the dynamic linker will not look for a
function in a library until that function is actually used. Thus, if a program
is built against libjpeg-turbo 1.3+ and uses jpeg_mem_src() or jpeg_mem_dest(),
that program will not fail if run against an older version of libjpeg-turbo or
against
 libjpeg v7- until the program actually tries to call jpeg_mem_src() or
jpeg_mem_dest(). Such is not the case on Windows. If a program is built
against the libjpeg-turbo 1.3+ DLL and uses jpeg_mem_src() or jpeg_mem_dest(),
then it must use the libjpeg-turbo 1.3+ DLL at run time.

Both cjpeg and djpeg have been extended to allow testing the in-memory
source/destination manager functions. See their respective man pages for more
details.

****
** Mathematical Compatibility
****

For the most part, libjpeg-turbo should produce identical output to libjpeg
v6b. The one exception to this is when using the floating point DCT/IDCT, in
which case the outputs of libjpeg v6b and libjpeg-turbo are not guaranteed to
be identical (the accuracy of the floating point DCT/IDCT is constant when
using libjpeg-turbo's SIMD extensions, but otherwise,
 it can depend heavily on
the compiler and compiler settings.)

While libjpeg-turbo does emulate the libjpeg v8 API/ABI, under the hood, it is
still using the same algorithms as libjpeg v6b, so there are several specific
cases in which libjpeg-turbo cannot be expected to produce the same output as
libjpeg v8:

-- When decompressing using scaling factors of 1/2 and 1/4, because libjpeg v8
  implements those scaling algorithms a bit differently than libjpeg v6b does,
  and libjpeg-turbo's SIMD extensions are based on the libjpeg v6b behavior.

-- When using chrominance subsampling, because libjpeg v8 implements this
  with its DCT/IDCT scaling algorithms rather than with a separate
  downsampling/upsampling algorithm.

-- When using the floating point IDCT, for the reasons stated above and also
because the floating point IDCT algorithm was modified in libjpeg v8a to
improve accuracy.

-- When decompressing using a scaling factor > 1 and merged (AKA "non-fancy" or
"non-smooth")
chrominance upsampling, because libjpeg v8 does not support
merged upsampling with scaling factors > 1.

****
** Performance Pitfalls
****

==========
Restart Markers
==========

The optimized Huffman decoder in libjpeg-turbo does not handle restart markers
in a way that makes the rest of the libjpeg infrastructure happy, so it is
necessary to use the slow Huffman decoder when decompressing a JPEG image that
has restart markers. This can cause the decompression performance to drop by
as much as 20%, but the performance will still be much greater than that of
libjpeg. Many consumer packages, such as PhotoShop, use restart markers when
generating JPEG images, so images generated by those programs will experience
this issue.

==========
Fast Integer Forward DCT at High Quality Levels
==========

The
algorithm used by the SIMD-accelerated quantization function cannot produce
correct results whenever the fast integer forward DCT is used along with a JPEG
quality of 98-100. Thus, libjpeg-turbo must use the non-SIMD quantization
function in those cases. This causes performance to drop by as much as 40%.
It is therefore strongly advised that you use the slow integer forward DCT
whenever encoding images with a JPEG quality of 98 or higher.

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/README-turbo.txt
No license file was found, but licenses were detected in source scan.

/*
* jmemsys.h
*

```
* Copyright (C) 1992-1997, Thomas G. Lane.
* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.
*
* This include file defines the interface between the system-independent
* and system-dependent portions of the JPEG memory manager.  No other
* modules need include it.  (The system-independent portion is jmemmgr.c;
* there are several different versions of the system-dependent portion.)
*
* This file works as-is for the system-dependent memory managers supplied
* in the IJG distribution.  You may need to modify it if you write a
* custom memory manager.  If system-dependent changes are needed in
* this file, the best method is to #ifdef them based on a configuration
* symbol supplied in jconfig.h, as we have done with USE_MSDOS_MEMMGR
* and USE_MAC_MEMMGR.
*/
```

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/jmemsys.h
No license file was found, but licenses were detected in source scan.

```
/*
* jchuff.h
*
* Copyright (C) 1991-1997, Thomas G. Lane.
* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains declarations for Huffman entropy encoding routines
* that are shared between the sequential encoder (jchuff.c) and the
* progressive encoder (jcphuff.c).  No other modules need to see these.
*/
```

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/jchuff.h
No license file was found, but licenses were detected in source scan.

```
/*
* jcinit.c
*
* Copyright (C) 1991-1997, Thomas G. Lane.
* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains initialization logic for the JPEG compressor.
* This routine is in charge of selecting the modules to be executed and
```

* making an initialization call to each one.
*
* Logically, this code belongs in jcmaster.c. It's split out because
* linking this routine implies linking the entire compression library.
* For a transcoding-only application, we want to be able to use jcmaster.c
* without linking in the whole library.
*/

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/jcinit.c
No license file was found, but licenses were detected in source scan.

/*
* jchuff.c
*
* This file was part of the Independent JPEG Group's software:
* Copyright (C) 1991-1997, Thomas G. Lane.
* Modifications:
* Copyright (C) 2009-2011, D. R. Commander.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains Huffman entropy encoding routines.
*
* Much of the complexity here has to do with supporting output suspension.
* If the data destination module demands suspension, we want to be able to
* back up to the start of the current MCU. To do this, we copy state
* variables into local working storage, and update them back to the
* permanent JPEG objects only upon successful completion of an MCU.
*/

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/jchuff.c
No license file was found, but licenses were detected in source scan.

/*
* jdmaster.c
*
* This file was part of the Independent JPEG Group's software:
* Copyright (C) 1991-1997, Thomas G. Lane.
* Modified 2002-2009 by Guido Vollbeding.
* Modifications:
* Copyright (C) 2009-2011, D. R. Commander.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains master control logic for the JPEG decompressor.
* These routines are concerned with selecting the modules to be executed

* and with determining the number of passes and the work to be done in each
* pass.
*/

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/jdmaster.c
No license file was found, but licenses were detected in source scan.

/*
* jpegtran.c
*
* This file was part of the Independent JPEG Group's software:
* Copyright (C) 1995-2010, Thomas G. Lane, Guido Vollbeding.
* Modifications:
* Copyright (C) 2010, D. R. Commander.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains a command-line user interface for JPEG transcoding.
* It is very similar to cjpeg.c, and partly to djpeg.c, but provides
* lossless transcoding between different JPEG file formats. It also
* provides some lossless and sort-of-lossless transformations of JPEG data.
*/

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/jpegtran.c
No license file was found, but licenses were detected in source scan.

/*
* jdhuff.h
*
* This file was part of the Independent JPEG Group's software:
* Copyright (C) 1991-1997, Thomas G. Lane.
* Modifications:
* Copyright (C) 2010-2011, D. R. Commander.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains declarations for Huffman entropy decoding routines
* that are shared between the sequential decoder (jdhuff.c) and the
* progressive decoder (jdphuff.c). No other modules need to see these.
*/

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/jdhuff.h
No license file was found, but licenses were detected in source scan.

```
/*
* jcphuff.c
*
* Copyright (C) 1995-1997, Thomas G. Lane.
* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains Huffman entropy encoding routines for progressive JPEG.
*
* We do not support output suspension in this module, since the library
* currently does not allow multiple-scan files to be written with output
* suspension.
*/
```

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/jcphuff.c
No license file was found, but licenses were detected in source scan.

```
/*
* jddctmgr.c
*
* This file was part of the Independent JPEG Group's software:
* Copyright (C) 1994-1996, Thomas G. Lane.
* Modified 2002-2010 by Guido Vollbeding.
* Modifications:
* Copyright 2009 Pierre Ossman <ossman@cendio.se> for Cendio AB
* Copyright (C) 2010, D. R. Commander.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains the inverse-DCT management logic.
* This code selects a particular IDCT implementation to be used,
* and it performs related housekeeping chores.  No code in this file
* is executed per IDCT step, only during output pass setup.
*
* Note that the IDCT routines are responsible for performing coefficient
* dequantization as well as the IDCT proper.  This module sets up the
* dequantization multiplier table needed by the IDCT routine.
*/
```

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/jddctmgr.c
No license file was found, but licenses were detected in source scan.

```
/*
* jfdctint.c
*
```

* Copyright (C) 1991-1996, Thomas G. Lane.
* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains a slow-but-accurate integer implementation of the
* forward DCT (Discrete Cosine Transform).
*
* A 2-D DCT can be done by 1-D DCT on each row followed by 1-D DCT
* on each column. Direct algorithms are also available, but they are
* much more complex and seem not to be any faster when reduced to code.
*
* This implementation is based on an algorithm described in
*   C. Loeffler, A. Ligtenberg and G. Moschytz, "Practical Fast 1-D DCT
*   Algorithms with 11 Multiplications", Proc. Int'l. Conf. on Acoustics,
*   Speech, and Signal Processing 1989 (ICASSP '89), pp. 988-991.
* The primary algorithm described there uses 11 multiplies and 29 adds.
* We use their alternate method with 12
 multiplies and 32 adds.
* The advantage of this method is that no data path contains more than one
* multiplication; this allows a very simple and accurate implementation in
* scaled fixed-point arithmetic, with a minimal number of shifts.
*/

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/jfdctint.c
No license file was found, but licenses were detected in source scan.

/*
* transupp.c
*
* This file was part of the Independent JPEG Group's software:
* Copyright (C) 1997-2011, Thomas G. Lane, Guido Vollbeding.
* Modifications:
* Copyright (C) 2010, D. R. Commander.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains image transformation routines and other utility code
* used by the jpegtran sample application. These are NOT part of the core
* JPEG library. But we keep these routines separate from jpegtran.c to
* ease the task of maintaining jpegtran-like programs that have other user
* interfaces.
*/

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/transupp.c

No license file was found, but licenses were detected in source scan.

```
/*
* jQuery JavaScript Library v1.3.2
* http://jquery.com/
*
* Copyright (c) 2009 John Resig
* Dual licensed under the MIT and GPL licenses.
* http://docs.jquery.com/License
*
* Date: 2009-02-19 17:34:21 -0500 (Thu, 19 Feb 2009)
* Revision: 6246
*/
/*
* Sizzle CSS Selector Engine - v0.9.3
*  Copyright 2009, The Dojo Foundation
*  Released under the MIT, BSD, and GPL Licenses.
*  More information: http://sizzlejs.com/
*/
/*
* jQuery UI 1.7.2
*
* Copyright (c) 2009 AUTHORS.txt (http://jqueryui.com/about)
* Dual licensed under the MIT (MIT-LICENSE.txt)
* and GPL (GPL-LICENSE.txt) licenses.
*
* http://docs.jquery.com/UI
*/
/**
* jQuery.ScrollTo - Easy element scrolling using jQuery.
* Copyright (c) 2008 Ariel Flesler - aflesler(at)gmail(dot)com
* Licensed under GPL license (http://www.opensource.org/licenses/gpl-license.php).
* Date: 2/8/2008
* @author Ariel Flesler
* @version 1.3.2
*/
```

Found
in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/doc/html/jquery.js
No license file was found, but licenses were detected in source scan.

```
/*
* rdppm.c
*
* Copyright (C) 1991-1997, Thomas G. Lane.
* Modified 2009 by Bill Allombert, Guido Vollbeding.
```

```
* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains routines to read input images in PPM/PGM format.
* The extended 2-byte-per-sample raw PPM/PGM formats are supported.
* The PBMPLUS library is NOT required to compile this software
* (but it is highly useful as a set of PPM image manipulation programs).
*
* These routines may need modification for non-Unix environments or
* specialized applications.  As they stand, they assume input from
* an ordinary stdio stream.  They further assume that reading begins
* at the start of the file; start_input may need work if the
* user interface has already read some data (e.g., to determine that
* the file is indeed PPM format).
*/
/* Portions of
 this code are based on the PBMPLUS library, which is:
**
** Copyright (C) 1988 by Jef Poskanzer.
**
** Permission to use, copy, modify, and distribute this software and its
** documentation for any purpose and without fee is hereby granted, provided
** that the above copyright notice appear in all copies and that both that
** copyright notice and this permission notice appear in supporting
** documentation.  This software is provided "as is" without express or
** implied warranty.
*/
```

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/rdppm.c
No license file was found, but licenses were detected in source scan.

```
{\rtf1\ansi\ansicpg1252\cocoartf1038\cocoasubrtf350
{\fonttbl\f0\fswiss\fcharset0 Helvetica;}
{\colortbl;\red255\green255\blue255;}
{\*\listtable{\list\listtemplateid1\listhybrid{\listlevel\levelnfc23\levelnfcn23\leveljc0\leveljcn0\levelfollow0\levelstartat1\levelspace360\levelindent0{\*\levelmarker \{disc\}}{\leveltext\leveltemplateid1\'01\uc0\u8226
;}{\levelnumbers;}\fi-360\li720\lin720 }{\listname ;}\listid1}}
{\*\listoverridetable{\listoverride\listid1\listoverridecount0\ls1}}
\margl1440\margr1440\vieww9820\viewh8480\viewkind0
\deftab720
\pard\pardeftab720

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\
\pard\tx220\tx720\pardeftab720\li720\fi-720
```

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in binary form must reproduce the above copyright notice, this list of conditions and the following disclaimer in the documentation and/or other materials provided with the distribution.\
{\listtext \'95 }Neither the name of the libjpeg-turbo Project nor the names of its contributors may be used to endorse or promote products derived from this software without specific prior written permission.\
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\cf0 \
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HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.\
}

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/release/License.rtf
No license file was found, but licenses were detected in source scan.

```
/*
* jdcolor.c
*
* This file was part of the Independent JPEG Group's software:
* Copyright (C) 1991-1997, Thomas G. Lane.
* Modified 2011 by Guido Vollbeding.
* Modifications:
* Copyright 2009 Pierre Ossman <ossman@cendio.se> for Cendio AB
* Copyright (C) 2009, 2011-2012, D. R. Commander.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains output colorspace conversion routines.
*/
```

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/jdcolor.c
No license file was found, but licenses were detected in source scan.

```
/*
* jcapimin.c
```

```
*
* Copyright (C) 1994-1998, Thomas G. Lane.
* Modified 2003-2010 by Guido Vollbeding.
* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains application interface code for the compression half
* of the JPEG library.  These are the "minimum" API routines that may be
* needed in either the normal full-compression case or the transcoding-only
* case.
*
* Most of the routines intended to be called directly by an application
* are in this file or in jcapistd.c.  But also see jcparam.c for
* parameter-setup helper routines, jcomapi.c for routines shared by
* compression and decompression, and jctrans.c for the transcoding case.
*/
```

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/jcapimin.c
No license file was found, but licenses were detected in source scan.

IJG JPEG LIBRARY: CODING RULES

Copyright (C) 1991-1996, Thomas G. Lane.
This file is part of the Independent JPEG Group's software.
For conditions of distribution and use, see the accompanying README file.

Since numerous people will be contributing code and bug fixes, it's important
to establish a common coding style. The goal of using similar coding styles
is much more important than the details of just what that style is.

In general we follow the recommendations of "Recommended C Style and Coding
Standards" revision 6.1 (Cannon et al. as modified by Spencer, Keppel and
Brader). This document is available in the IJG FTP archive (see
jpeg/doc/cstyle.ms.tbl.Z, or cstyle.txt.Z for those without nroff/tbl).

Block comments should be laid out thusly:

```
/*
*  Block comments in this style.
*/
```

We indent statements in K&R style, e.g.,
```
 if (test) {
   then-part;
 } else {
```

```
  else-part;
 }
```
with two spaces per indentation
level. (This indentation convention is
handled automatically by GNU Emacs and many other text editors.)

Multi-word names should be written in lower case with underscores, e.g.,
multi_word_name (not multiWordName). Preprocessor symbols and enum constants
are similar but upper case (MULTI_WORD_NAME). Names should be unique within
the first fifteen characters. (On some older systems, global names must be
unique within six characters. We accommodate this without cluttering the
source code by using macros to substitute shorter names.)

We use function prototypes everywhere; we rely on automatic source code
transformation to feed prototype-less C compilers. Transformation is done
by the simple and portable tool 'ansi2knr.c' (courtesy of Ghostscript).
ansi2knr is not very bright, so it imposes a format requirement on function
declarations: the function name MUST BEGIN IN COLUMN 1. Thus all functions
should be written in the following style:

```
LOCAL(int *)
function_name (int a, char
 *b)
{
  code...
}
```

Note that each function definition must begin with GLOBAL(type), LOCAL(type),
or METHODDEF(type). These macros expand to "static type" or just "type" as
appropriate. They provide a readable indication of the routine's usage and
can readily be changed for special needs. (For instance, special linkage
keywords can be inserted for use in Windows DLLs.)

ansi2knr does not transform method declarations (function pointers in
structs). We handle these with a macro JMETHOD, defined as
```
 #ifdef HAVE_PROTOTYPES
 #define JMETHOD(type,methodname,arglist)  type (*methodname) arglist
 #else
 #define JMETHOD(type,methodname,arglist)  type (*methodname) ()
 #endif
```
which is used like this:
```
 struct function_pointers {
   JMETHOD(void, init_entropy_encoder, (int somearg, jparms *jp));
   JMETHOD(void, term_entropy_encoder, (void));
 };
```
Note the set of parentheses surrounding the parameter list.

A similar solution is used for forward and external function declarations

(see the EXTERN
and JPP macros).

If the code is to work on non-ANSI compilers, we cannot rely on a prototype declaration to coerce actual parameters into the right types. Therefore, use explicit casts on actual parameters whenever the actual parameter type is not identical to the formal parameter. Beware of implicit conversions to "int".

It seems there are some non-ANSI compilers in which the sizeof() operator is defined to return int, yet size_t is defined as long. Needless to say, this is brain-damaged. Always use the SIZEOF() macro in place of sizeof(), so that the result is guaranteed to be of type size_t.

The JPEG library is intended to be used within larger programs. Furthermore, we want it to be reentrant so that it can be used by applications that process multiple images concurrently. The following rules support these requirements:

1. Avoid direct use of file I/O, "malloc", error report printouts, etc; pass these through the common routines provided.

2. Minimize global namespace
pollution. Functions should be declared static
wherever possible. (Note that our method-based calling conventions help this a lot: in many modules only the initialization function will ever need to be called directly, so only that function need be externally visible.) All global function names should begin with "jpeg_", and should have an abbreviated name (unique in the first six characters) substituted by macro when NEED_SHORT_EXTERNAL_NAMES is set.

3. Don't use global variables; anything that must be used in another module should be in the common data structures.

4. Don't use static variables except for read-only constant tables. Variables that should be private to a module can be placed into private structures (see the system architecture document, structure.txt).

5. Source file names should begin with "j" for files that are part of the library proper; source files that are not part of the library, such as cjpeg.c and djpeg.c, do not begin with "j". Keep source file names
to eight
characters (plus ".c" or ".h", etc) to make life easy for MS-DOSers. Keep compression and decompression code in separate source files --- some applications may want only one half of the library.

Note: these rules (particularly #4) are not followed religiously in the modules that are used in cjpeg/djpeg but are not part of the JPEG library proper. Those modules are not really intended to be used in other

applications.

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/coderules.txt
No license file was found, but licenses were detected in source scan.

```
/*
* rdbmp.c
*
* This file was part of the Independent JPEG Group's software:
* Copyright (C) 1994-1996, Thomas G. Lane.
* Modified 2009-2010 by Guido Vollbeding.
* Modifications:
* Modified 2011 by Siarhei Siamashka.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains routines to read input images in Microsoft "BMP"
* format (MS Windows 3.x, OS/2 1.x, and OS/2 2.x flavors).
* Currently, only 8-bit and 24-bit images are supported, not 1-bit or
* 4-bit (feeding such low-depth images into JPEG would be silly anyway).
* Also, we don't support RLE-compressed files.
*
* These routines may need modification for non-Unix environments or
* specialized applications.  As they stand, they assume input from
* an ordinary stdio stream.  They further assume that reading begins
* at the start of the file; start_input may need work if the
* user interface has already
 read some data (e.g., to determine that
* the file is indeed BMP format).
*
* This code contributed by James Arthur Boucher.
*/
```

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/rdbmp.c
No license file was found, but licenses were detected in source scan.

```
// Natural Docs is licensed under the GPL.
```

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/doc/html/search/search.js
No license file was found, but licenses were detected in source scan.

```
/*
* jdmerge.c
```

```
*
* This file was part of the Independent JPEG Group's software:
* Copyright (C) 1994-1996, Thomas G. Lane.
* Copyright 2009 Pierre Ossman <ossman@cendio.se> for Cendio AB
* Modifications:
* Copyright (C) 2009, 2011, D. R. Commander.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains code for merged upsampling/color conversion.
*
* This file combines functions from jdsample.c and jdcolor.c;
* read those files first to understand what's going on.
*
* When the chroma components are to be upsampled by simple replication
* (ie, box filtering), we can save some work in color conversion by
* calculating all the output pixels corresponding to a pair of chroma
* samples at one time.  In the conversion equations
* R = Y           + K1 * Cr
* G = Y + K2 * Cb + K3 * Cr
* B = Y + K4 * Cb
* only the Y term varies among the group of pixels corresponding
 to a pair
* of chroma samples, so the rest of the terms can be calculated just once.
* At typical sampling ratios, this eliminates half or three-quarters of the
* multiplications needed for color conversion.
*
* This file currently provides implementations for the following cases:
* YCbCr => RGB color conversion only.
* Sampling ratios of 2h1v or 2h2v.
* No scaling needed at upsample time.
* Corner-aligned (non-CCIR601) sampling alignment.
* Other special cases could be added, but in most applications these are
* the only common cases.  (For uncommon cases we fall back on the more
* general code in jdsample.c and jdcolor.c.)
*/
```

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/jdmerge.c
No license file was found, but licenses were detected in source scan.

```
/*
* jerror.c
*
* Copyright (C) 1991-1998, Thomas G. Lane.
* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.
*
```

```
* This file contains simple error-reporting and trace-message routines.
* These are suitable for Unix-like systems and others where writing to
* stderr is the right thing to do.  Many applications will want to replace
* some or all of these routines.
*
* If you define USE_WINDOWS_MESSAGEBOX in jconfig.h or in the makefile,
* you get a Windows-specific hack to display error messages in a dialog box.
* It ain't much, but it beats dropping error messages into the bit bucket,
* which is what happens to output to stderr under most Windows C compilers.
*
* These routines are used by both the compression and decompression code.
*/
```

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/jerror.c
No license file was found, but licenses were detected in source scan.

```
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#
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# ARISING IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE
# POSSIBILITY OF SUCH DAMAGE.

#!/bin/sh

if [ ! "`id -u`" = "0" ]; then
```

```
 echo "ERROR: This script must be executed as root"
 exit -1
fi

PACKAGE=@PACKAGE_NAME@
MACPACKAGE=com.$PACKAGE.$PACKAGE
RECEIPT=/Library/Receipts/$PACKAGE.pkg

LSBOM=
if [ -d $RECEIPT ]; then
 LSBOM='lsbom -s -f -l '$RECEIPT'/Contents/Archive.bom'
else
 LSBOM='pkgutil --files '$MACPACKAGE
fi

mylsbom()
{
 $LSBOM || (echo "ERROR: Could
 not list package contents"; exit -1)
}

echo Removing package files ...
EXITSTATUS=0
pushd /
mylsbom | while read file; do
 if [ ! -d "$file" ]; then rm "$file" 2>&1 || EXITSTATUS=-1; fi
done
popd

echo Removing package directories ...
if [ -d /opt/$PACKAGE/bin ]; then
 rmdir /opt/$PACKAGE/bin 2>&1 || EXITSTATUS=-1
fi
if [ -d /opt/$PACKAGE/lib ]; then
 rmdir /opt/$PACKAGE/lib 2>&1 || EXITSTATUS=-1
fi
if [ -d /opt/$PACKAGE/include ]; then
 rmdir /opt/$PACKAGE/include 2>&1 || EXITSTATUS=-1
fi
rm /opt/$PACKAGE/lib32 2>&1 || EXITSTATUS=-1
rm /opt/$PACKAGE/lib64 2>&1 || EXITSTATUS=-1
if [ -d /opt/$PACKAGE/man/man1 ]; then
 rmdir /opt/$PACKAGE/man/man1 2>&1 || EXITSTATUS=-1
fi
if [ -d /opt/$PACKAGE/man ]; then
 rmdir /opt/$PACKAGE/man 2>&1 || EXITSTATUS=-1
fi
if [ -d /opt/$PACKAGE/classes ]; then
```

```
 rmdir /opt/$PACKAGE/classes 2>&1 || EXITSTATUS=-1
fi
rmdir /opt/$PACKAGE 2>&1 || EXITSTATUS=-1
rmdir /Library/Documentation/$PACKAGE 2>&1 || EXITSTATUS=-1

if [ -d $RECEIPT ]; then
 echo Removing
 package receipt ...
 rm -r $RECEIPT 2>&1 || EXITSTATUS=-1
else
 echo Forgetting package $MACPACKAGE ...
 pkgutil --forget $MACPACKAGE
fi

exit $EXITSTATUS
```

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/release/uninstall.in
No license file was found, but licenses were detected in source scan.

```
/*
* jcmarker.c
*
* This file was part of the Independent JPEG Group's software:
* Copyright (C) 1991-1998, Thomas G. Lane.
* Modifications:
* Copyright (C) 2010, D. R. Commander.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains routines to write JPEG datastream markers.
*/
```

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/jcmarker.c
No license file was found, but licenses were detected in source scan.

```
/*
* jdmarker.c
*
* This file was part of the Independent JPEG Group's software:
* Copyright (C) 1991-1998, Thomas G. Lane.
* Modifications:
* Copyright (C) 2012, D. R. Commander.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains routines to decode JPEG datastream markers.
```

* Most of the complexity arises from our desire to support input
* suspension: if not all of the data for a marker is available,
* we must exit back to the application. On resumption, we reprocess
* the marker.
*/

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/jdmarker.c
No license file was found, but licenses were detected in source scan.

;
; jsimdext.inc - common declarations
;
; Copyright 2009 Pierre Ossman <ossman@cendio.se> for Cendio AB
; Copyright 2010 D. R. Commander
;
; Based on
; x86 SIMD extension for IJG JPEG library - version 1.02
;
; Copyright (C) 1999-2006, MIYASAKA Masaru.
;
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;
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; freely, subject to the following restrictions:
;
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;   in a product, an acknowledgment in the product documentation would be
;   appreciated but is not required.
; 2. Altered source versions must
 be plainly marked as such, and must not be
;   misrepresented as being the original software.
; 3. This notice may not be removed or altered from any source distribution.
;
; [TAB8]

; ==
; System-dependent configurations

%ifdef WIN32 ; ----(nasm -fwin32 -DWIN32 ...)--------
; * Microsoft Visual C++
; * MinGW (Minimalist GNU for Windows)
; * CygWin

```
; * LCC-Win32

; -- segment definition --
;
%ifdef __YASM_VER__
%define SEG_TEXT    .text  align=16
%define SEG_CONST   .rdata align=16
%else
%define SEG_TEXT    .text  align=16 public use32 class=CODE
%define SEG_CONST   .rdata align=16 public use32 class=CONST
%endif

%elifdef WIN64 ; ----(nasm -fwin64 -DWIN64 ...)--------
; * Microsoft Visual C++

; -- segment definition --
;
%ifdef __YASM_VER__
%define SEG_TEXT    .text  align=16
%define SEG_CONST   .rdata align=16
%else
%define SEG_TEXT    .text  align=16 public use64 class=CODE
%define SEG_CONST   .rdata align=16
 public use64 class=CONST
%endif
%define EXTN(name)  name   ; foo() -> foo

%elifdef OBJ32 ; ----(nasm -fobj -DOBJ32 ...)----------
; * Borland C++ (Win32)

; -- segment definition --
;
%define SEG_TEXT    .text  align=16 public use32 class=CODE
%define SEG_CONST   .data  align=16 public use32 class=DATA

%elifdef ELF ; ----(nasm -felf[64] -DELF ...)------------
; * Linux
; * *BSD family Unix using elf format
; * Unix System V, including Solaris x86, UnixWare and SCO Unix

; mark stack as non-executable
section .note.GNU-stack noalloc noexec nowrite progbits

; -- segment definition --
;
%ifdef __x86_64__
%define SEG_TEXT    .text   progbits align=16
%define SEG_CONST   .rodata progbits align=16
```

```
%else
%define SEG_TEXT    .text   progbits alloc exec   nowrite align=16
%define SEG_CONST   .rodata progbits alloc noexec nowrite align=16
%endif

; To make the code position-independent, append -DPIC to the commandline
;
%define GOT_SYMBOL  _GLOBAL_OFFSET_TABLE_ ; ELF supports PIC
%define EXTN(name)
  name   ; foo() -> foo

%elifdef AOUT ; ----(nasm -faoutb/aout -DAOUT ...)----
; * Older Linux using a.out format  (nasm -f aout -DAOUT ...)
; * *BSD family Unix using a.out format  (nasm -f aoutb -DAOUT ...)

; -- segment definition --
;
%define SEG_TEXT    .text
%define SEG_CONST   .data

; To make the code position-independent, append -DPIC to the commandline
;
%define GOT_SYMBOL  __GLOBAL_OFFSET_TABLE_ ; BSD-style a.out supports PIC

%elifdef MACHO ; ----(nasm -fmacho -DMACHO ...)--------
; * NeXTstep/OpenStep/Rhapsody/Darwin/MacOS X (Mach-O format)

; -- segment definition --
;
%define SEG_TEXT    .text  ;align=16 ; nasm doesn't accept align=16. why?
%define SEG_CONST   .rodata align=16

; The generation of position-independent code (PIC) is the default on Darwin.
;
%define PIC
%define GOT_SYMBOL  _MACHO_PIC_  ; Mach-O style code-relative addressing

%else  ; ----(Other case)----------------------

; -- segment definition --
;
%define SEG_TEXT    .text
%define SEG_CONST
   .data

%endif ; ------------------------------------------------

; ============================================================================
```

```
; --------------------------------------------------------------------------
;  Common types
;
%ifdef __x86_64__
%define POINTER              qword          ; general pointer type
%define SIZEOF_POINTER       SIZEOF_QWORD    ; sizeof(POINTER)
%define POINTER_BIT          QWORD_BIT       ; sizeof(POINTER)*BYTE_BIT
%else
%define POINTER              dword          ; general pointer type
%define SIZEOF_POINTER       SIZEOF_DWORD    ; sizeof(POINTER)
%define POINTER_BIT          DWORD_BIT       ; sizeof(POINTER)*BYTE_BIT
%endif

%define INT                  dword          ; signed integer type
%define SIZEOF_INT           SIZEOF_DWORD    ; sizeof(INT)
%define INT_BIT              DWORD_BIT       ; sizeof(INT)*BYTE_BIT

%define FP32                 dword          ; IEEE754 single
%define SIZEOF_FP32          SIZEOF_DWORD
   ; sizeof(FP32)
%define FP32_BIT             DWORD_BIT       ; sizeof(FP32)*BYTE_BIT

%define MMWORD               qword          ; int64  (MMX register)
%define SIZEOF_MMWORD        SIZEOF_QWORD    ; sizeof(MMWORD)
%define MMWORD_BIT           QWORD_BIT       ; sizeof(MMWORD)*BYTE_BIT

; NASM is buggy and doesn't properly handle operand sizes for SSE
; instructions, so for now we have to define XMMWORD as blank.
%define XMMWORD                             ; int128 (SSE register)
%define SIZEOF_XMMWORD       SIZEOF_OWORD    ; sizeof(XMMWORD)
%define XMMWORD_BIT          OWORD_BIT       ; sizeof(XMMWORD)*BYTE_BIT

; Similar hacks for when we load a dword or MMWORD into an xmm# register
%define XMM_DWORD
%define XMM_MMWORD

%define SIZEOF_BYTE          1               ; sizeof(BYTE)
%define SIZEOF_WORD          2               ; sizeof(WORD)
%define SIZEOF_DWORD         4               ; sizeof(DWORD)
%define SIZEOF_QWORD         8
   ; sizeof(QWORD)
%define SIZEOF_OWORD         16              ; sizeof(OWORD)

%define BYTE_BIT             8             ; CHAR_BIT in C
%define WORD_BIT             16            ; sizeof(WORD)*BYTE_BIT
%define DWORD_BIT            32            ; sizeof(DWORD)*BYTE_BIT
%define QWORD_BIT            64            ; sizeof(QWORD)*BYTE_BIT
```

```
%define OWORD_BIT               128             ; sizeof(OWORD)*BYTE_BIT

; ---------------------------------------------------------------------------
;  External Symbol Name
;
%ifndef EXTN
%define EXTN(name)   _ %+ name  ; foo() -> _foo
%endif

; ---------------------------------------------------------------------------
;  Macros for position-independent code (PIC) support
;
%ifndef GOT_SYMBOL
%undef PIC
%endif

%ifdef PIC ; ------------------------------------------

%ifidn GOT_SYMBOL,_MACHO_PIC_ ; ---------------------

; At present, nasm doesn't seem to support PIC generation for Mach-O.
; The PIC support code below is a
 little tricky.

 SECTION SEG_CONST
const_base:

%define GOTOFF(got,sym) (got) + (sym) - const_base

%imacro get_GOT 1
 ; NOTE: this macro destroys ecx resister.
 call %%geteip
 add ecx, byte (%%ref - $)
 jmp short %%adjust
%%geteip:
 mov ecx, POINTER [esp]
 ret
%%adjust:
 push ebp
 xor ebp,ebp  ; ebp = 0
%ifidni %1,ebx ; (%1 == ebx)
 ; db 0x8D,0x9C + jmp near const_base =
 ;   lea ebx, [ecx+ebp*8+(const_base-%%ref)] ; 8D,9C,E9,(offset32)
 db 0x8D,0x9C  ; 8D,9C
 jmp near const_base  ; E9,(const_base-%%ref)
%%ref:
%else  ; (%1 != ebx)
 ; db 0x8D,0x8C + jmp near const_base =
```

```
 ;   lea ecx, [ecx+ebp*8+(const_base-%%ref)] ; 8D,8C,E9,(offset32)
 db 0x8D,0x8C  ; 8D,8C
 jmp near const_base  ; E9,(const_base-%%ref)
%%ref: mov %1, ecx
%endif ; (%1 == ebx)
 pop ebp
%endmacro

%else ; GOT_SYMBOL != _MACHO_PIC_ ----------------

%define GOTOFF(got,sym) (got) + (sym) wrt ..gotoff

%imacro get_GOT 1
 extern GOT_SYMBOL
 call %%geteip
 add %1, GOT_SYMBOL + $$ - $ wrt ..gotpc
 jmp short %%done
%%geteip:
 mov %1,
 POINTER [esp]
 ret
%%done:
%endmacro

%endif ; GOT_SYMBOL == _MACHO_PIC_ ----------------

%imacro pushpic 1.nolist
 push %1
%endmacro
%imacro poppic 1.nolist
 pop %1
%endmacro
%imacro movpic 2.nolist
 mov %1,%2
%endmacro

%else ; !PIC -----------------------------------------

%define GOTOFF(got,sym) (sym)

%imacro get_GOT 1.nolist
%endmacro
%imacro pushpic 1.nolist
%endmacro
%imacro poppic 1.nolist
%endmacro
%imacro movpic 2.nolist
%endmacro
```

```
%endif ;  PIC ---------------------------------------

; ---------------------------------------------------------------------------
;  Align the next instruction on {2,4,8,16,..}-byte boundary.
;  ".balign n,,m" in GNU as
;
%define MSKLE(x,y)  (~(((y) & 0xFFFF) - ((x) & 0xFFFF)) >> 16)
%define FILLB(b,n)  (($$-(b)) & ((n)-1))

%imacro alignx 1-2.nolist 0xFFFF
%%bs: times MSKLE(FILLB(%%bs,%1),%2) & MSKLE(16,FILLB($,%1)) & FILLB($,%1) \
       db 0x90                          ; nop
 times MSKLE(FILLB(%%bs,%1),%2) & FILLB($,%1)/9 \

      db 0x8D,0x9C,0x23,0x00,0x00,0x00,0x00 ; lea ebx,[ebx+0x00000000]
 times MSKLE(FILLB(%%bs,%1),%2) & FILLB($,%1)/7 \
       db 0x8D,0xAC,0x25,0x00,0x00,0x00,0x00 ; lea ebp,[ebp+0x00000000]
 times MSKLE(FILLB(%%bs,%1),%2) & FILLB($,%1)/6 \
       db 0x8D,0xAD,0x00,0x00,0x00,0x00      ; lea ebp,[ebp+0x00000000]
 times MSKLE(FILLB(%%bs,%1),%2) & FILLB($,%1)/4 \
       db 0x8D,0x6C,0x25,0x00               ; lea ebp,[ebp+0x00]
 times MSKLE(FILLB(%%bs,%1),%2) & FILLB($,%1)/3 \
       db 0x8D,0x6D,0x00                    ; lea ebp,[ebp+0x00]
 times MSKLE(FILLB(%%bs,%1),%2) & FILLB($,%1)/2 \
       db 0x8B,0xED                         ; mov ebp,ebp
 times MSKLE(FILLB(%%bs,%1),%2) & FILLB($,%1)/1 \
       db 0x90                          ; nop
%endmacro

; Align the next data on {2,4,8,16,..}-byte boundary.
;
%imacro alignz 1.nolist
 align %1, db 0  ; filling zeros
%endmacro

%ifdef __x86_64__

%ifdef WIN64

%imacro collect_args 0
 push r12
 push r13
 push r14
 push r15
 mov
 r10, rcx
 mov r11, rdx
```

```
 mov r12, r8
 mov r13, r9
 mov r14, [rax+48]
 mov r15, [rax+56]
 push rsi
 push rdi
 sub     rsp, SIZEOF_XMMWORD
 movaps  XMMWORD [rsp], xmm6
 sub     rsp, SIZEOF_XMMWORD
 movaps  XMMWORD [rsp], xmm7
%endmacro

%imacro uncollect_args 0
 movaps  xmm7, XMMWORD [rsp]
 add     rsp, SIZEOF_XMMWORD
 movaps  xmm6, XMMWORD [rsp]
 add     rsp, SIZEOF_XMMWORD
 pop rdi
 pop rsi
 pop r15
 pop r14
 pop r13
 pop r12
%endmacro

%else

%imacro collect_args 0
 push r10
 push r11
 push r12
 push r13
 push r14
 push r15
 mov r10, rdi
 mov r11, rsi
 mov r12, rdx
 mov r13, rcx
 mov r14, r8
 mov r15, r9
%endmacro

%imacro uncollect_args 0
 pop r15
 pop r14
 pop r13
 pop r12
 pop r11
```

```
 pop r10
%endmacro

%endif

%endif

; --------------------------------------------------------------------------
;  Defines picked up from the C headers
;
%include "jsimdcfg.inc"

; --------------------------------------------------------------------------
```

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/simd/jsimdext.inc
No license file was found, but licenses were detected in source scan.

```
/*
* rdjpgcom.c
*
* Copyright (C) 1994-1997, Thomas G. Lane.
* Modified 2009 by Bill Allombert, Guido Vollbeding.
* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains a very simple stand-alone application that displays
* the text in COM (comment) markers in a JFIF file.
* This may be useful as an example of the minimum logic needed to parse
* JPEG markers.
*/
```

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/rdjpgcom.c
No license file was found, but licenses were detected in source scan.

```
/*
* jcomapi.c
*
* Copyright (C) 1994-1997, Thomas G. Lane.
* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains application interface routines that are used for both
* compression and decompression.
*/
```

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/jcomapi.c
No license file was found, but licenses were detected in source scan.

```
/*
* jcmainct.c
*
* Copyright (C) 1994-1996, Thomas G. Lane.
* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains the main buffer controller for compression.
* The main buffer lies between the pre-processor and the JPEG
* compressor proper; it holds downsampled data in the JPEG colorspace.
*/
```

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/jcmainct.c
No license file was found, but licenses were detected in source scan.

```
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*
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* CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE)
```

```
* ARISING IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE
* POSSIBILITY OF SUCH DAMAGE.
*/

package org.libjpegturbo.turbojpeg;

final class TJLoader {
 static void load() {
   System.loadLibrary("@TURBOJPEG_DLL_NAME@");
 }
};
```

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/java/org/libjpegturbo/turbojpeg/TJLoader.java.in
No license file was found, but licenses were detected in source scan.

```
/*
* jdtrans.c
*
* Copyright (C) 1995-1997, Thomas G. Lane.
* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains library routines for transcoding decompression,
* that is, reading raw DCT coefficient arrays from an input JPEG file.
* The routines in jdapimin.c will also be needed by a transcoder.
*/
```

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/jdtrans.c
No license file was found, but licenses were detected in source scan.

```
/*
* jccoefct.c
*
* Copyright (C) 1994-1997, Thomas G. Lane.
* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains the coefficient buffer controller for compression.
* This controller is the top level of the JPEG compressor proper.
* The coefficient buffer lies between forward-DCT and entropy encoding steps.
*/
```

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-

archive-C8ga4kAj/libjpeg-turbo-1.2.90/jccoefct.c
No license file was found, but licenses were detected in source scan.

```
/*
* jversion.h
*
* This file was part of the Independent JPEG Group's software:
* Copyright (C) 1991-2012, Thomas G. Lane, Guido Vollbeding.
* Modifications:
* Copyright (C) 2010, 2012-2013, D. R. Commander.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains software version identification.
*/
```

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/jversion.h
No license file was found, but licenses were detected in source scan.

```
/*
* rdswitch.c
*
* This file was part of the Independent JPEG Group's software:
* Copyright (C) 1991-1996, Thomas G. Lane.
* Modifications:
* Copyright (C) 2010, D. R. Commander.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains routines to process some of cjpeg's more complicated
* command-line switches.  Switches processed here are:
* -qtables file  Read quantization tables from text file
* -scans file  Read scan script from text file
* -quality N[,N,...] Set quality ratings
* -qslots N[,N,...] Set component quantization table selectors
* -sample HxV[,HxV,...] Set component sampling factors
*/
```

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/rdswitch.c
No license file was found, but licenses were detected in source scan.

```
/*
* jcprepct.c
*
* Copyright (C) 1994-1996, Thomas G. Lane.
* This file is part of the Independent JPEG Group's software.
```

* For conditions of distribution and use, see the accompanying README file.
*
* This file contains the compression preprocessing controller.
* This controller manages the color conversion, downsampling,
* and edge expansion steps.
*
* Most of the complexity here is associated with buffering input rows
* as required by the downsampler. See the comments at the head of
* jcsample.c for the downsampler's needs.
*/

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/jcprepct.c
No license file was found, but licenses were detected in source scan.

/*
* jdct.h
*
* Copyright (C) 1994-1996, Thomas G. Lane.
* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.
*
* This include file contains common declarations for the forward and
* inverse DCT modules. These declarations are private to the DCT managers
* (jcdctmgr.c, jddctmgr.c) and the individual DCT algorithms.
* The individual DCT algorithms are kept in separate files to ease
* machine-dependent tuning (e.g., assembly coding).
*/

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/jdct.h
No license file was found, but licenses were detected in source scan.

TurboJPEG Java Wrapper
======================

The TurboJPEG shared library can optionally be built with a Java Native
Interface wrapper, which allows the library to be loaded and used directly from
Java applications. The Java front end for this is defined in several classes
located under org/libjpegturbo/turbojpeg. The source code for these Java
classes is licensed under a BSD-style license, so the files can be incorporated
directly into both open source and proprietary projects without restriction. A
Java archive (JAR) file containing these classes is also shipped with the
"official" distribution packages of libjpeg-turbo.

TJExample.java, which should also be located in the same directory as this

README file, demonstrates how to use the TurboJPEG Java API to compress and
decompress JPEG images in memory.

Performance Pitfalls

The TurboJPEG Java API defines several convenience methods that
can allocate
image buffers or instantiate classes to hold the result of compress,
decompress, or transform operations. However, if you use these methods, then
be mindful of the amount of new data you are creating on the heap. It may be
necessary to manually invoke the garbage collector to prevent heap exhaustion
or to prevent performance degradation. Background garbage collection can kill
performance, particularly in a multi-threaded environment (Java pauses all
threads when the GC runs.)

The TurboJPEG Java API always gives you the option of pre-allocating your own
source and destination buffers, which allows you to re-use those buffers for
compressing/decompressing multiple images. If the image sequence you are
compressing or decompressing consists of images of the same size, then
pre-allocating the buffers is recommended.

Installation Directory

If the TurboJPEG JNI library (libturbojpeg.so, libturbojpeg.jnilib, or
turbojpeg.dll) is not installed under
a system library directory or under a
directory specified in LD_LIBRARY_PATH (Unix) or PATH (Windows), then you will
need to pass an argument of -Djava.library.path={path_to_JNI_library} to java.

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/java/README
No license file was found, but licenses were detected in source scan.

/*
* wrppm.c
*
* Copyright (C) 1991-1996, Thomas G. Lane.
* Modified 2009 by Guido Vollbeding.
* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains routines to write output images in PPM/PGM format.
* The extended 2-byte-per-sample raw PPM/PGM formats are supported.

```
* The PBMPLUS library is NOT required to compile this software
* (but it is highly useful as a set of PPM image manipulation programs).
*
* These routines may need modification for non-Unix environments or
* specialized applications.  As they stand, they assume output to
* an ordinary stdio stream.
*/
```

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/wrppm.c
No license file was found, but licenses were detected in source scan.

```
/*
* wrjpgcom.c
*
* Copyright (C) 1994-1997, Thomas G. Lane.
* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains a very simple stand-alone application that inserts
* user-supplied text as a COM (comment) marker in a JFIF file.
* This may be useful as an example of the minimum logic needed to parse
* JPEG markers.
*/
```

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/wrjpgcom.c
No license file was found, but licenses were detected in source scan.

```
/*
* wrrle.c
*
* Copyright (C) 1991-1996, Thomas G. Lane.
* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains routines to write output images in RLE format.
* The Utah Raster Toolkit library is required (version 3.1 or later).
*
* These routines may need modification for non-Unix environments or
* specialized applications.  As they stand, they assume output to
* an ordinary stdio stream.
*
* Based on code contributed by Mike Lijewski,
* with updates from Robert Hutchinson.
*/
```

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/wrrle.c
No license file was found, but licenses were detected in source scan.

```
/*
* wrbmp.c
*
* Copyright (C) 1994-1996, Thomas G. Lane.
* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains routines to write output images in Microsoft "BMP"
* format (MS Windows 3.x and OS/2 1.x flavors).
* Either 8-bit colormapped or 24-bit full-color format can be written.
* No compression is supported.
*
* These routines may need modification for non-Unix environments or
* specialized applications.  As they stand, they assume output to
* an ordinary stdio stream.
*
* This code contributed by James Arthur Boucher.
*/
```

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/wrbmp.c
No license file was found, but licenses were detected in source scan.

```
/*
* jinclude.h
*
* Copyright (C) 1991-1994, Thomas G. Lane.
* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.
*
* This file exists to provide a single place to fix any problems with
* including the wrong system include files.  (Common problems are taken
* care of by the standard jconfig symbols, but on really weird systems
* you may have to edit this file.)
*
* NOTE: this file is NOT intended to be included by applications using the
* JPEG library.  Most applications need only include jpeglib.h.
*/
```

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-

archive-C8ga4kAj/libjpeg-turbo-1.2.90/jinclude.h
No license file was found, but licenses were detected in source scan.

```
/*
* jdphuff.c
*
* Copyright (C) 1995-1997, Thomas G. Lane.
* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains Huffman entropy decoding routines for progressive JPEG.
*
* Much of the complexity here has to do with supporting input suspension.
* If the data source module demands suspension, we want to be able to back
* up to the start of the current MCU.  To do this, we copy state variables
* into local working storage, and update them back to the permanent
* storage only upon successful completion of an MCU.
*/
```

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/jdphuff.c
No license file was found, but licenses were detected in source scan.

```
/*
* jfdctflt.c
*
* Copyright (C) 1994-1996, Thomas G. Lane.
* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains a floating-point implementation of the
* forward DCT (Discrete Cosine Transform).
*
* This implementation should be more accurate than either of the integer
* DCT implementations.  However, it may not give the same results on all
* machines because of differences in roundoff behavior.  Speed will depend
* on the hardware's floating point capacity.
*
* A 2-D DCT can be done by 1-D DCT on each row followed by 1-D DCT
* on each column.  Direct algorithms are also available, but they are
* much more complex and seem not to be any faster when reduced to code.
*
* This implementation is based on Arai, Agui, and Nakajima's algorithm for
* scaled DCT.  Their original paper (Trans. IEICE
 E-71(11):1095) is in
* Japanese, but the algorithm is described in the Pennebaker & Mitchell
* JPEG textbook (see REFERENCES section in file README).  The following code
```

* is based directly on figure 4-8 in P&M.
* While an 8-point DCT cannot be done in less than 11 multiplies, it is
* possible to arrange the computation so that many of the multiplies are
* simple scalings of the final outputs. These multiplies can then be
* folded into the multiplications or divisions by the JPEG quantization
* table entries. The AA&N method leaves only 5 multiplies and 29 adds
* to be done in the DCT itself.
* The primary disadvantage of this method is that with a fixed-point
* implementation, accuracy is lost due to imprecise representation of the
* scaled quantization values. However, that problem does not arise if
* we use floating point arithmetic.
*/

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/jfdctflt.c
No license file was found, but licenses were detected in source scan.

/*
* jdpostct.c
*
* Copyright (C) 1994-1996, Thomas G. Lane.
* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains the decompression postprocessing controller.
* This controller manages the upsampling, color conversion, and color
* quantization/reduction steps; specifically, it controls the buffering
* between upsample/color conversion and color quantization/reduction.
*
* If no color quantization/reduction is required, then this module has no
* work to do, and it just hands off to the upsample/color conversion code.
* An integrated upsample/convert/quantize process would replace this module
* entirely.
*/

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/jdpostct.c
No license file was found, but licenses were detected in source scan.

;
; jcolsamp.inc - private declarations for color conversion & up/downsampling
;
; Copyright 2009 Pierre Ossman <ossman@cendio.se> for Cendio AB
;
; Based on
; x86 SIMD extension for IJG JPEG library

```
; Copyright (C) 1999-2006, MIYASAKA Masaru.
; For conditions of distribution and use, see copyright notice in jsimdext.inc
;
; [TAB8]

; --------------------------------------------------------------------------

; pseudo-resisters to make ordering of RGB configurable
;
%if RGB_RED == 0
%define  mmA  mm0
%define  mmB  mm1
%define xmmA xmm0
%define xmmB xmm1
%elif RGB_GREEN == 0
%define  mmA  mm2
%define  mmB  mm3
%define xmmA xmm2
%define xmmB xmm3
%elif RGB_BLUE == 0
%define  mmA  mm4
%define  mmB  mm5
%define xmmA xmm4
%define xmmB xmm5
%else
%define  mmA  mm6
%define  mmB  mm7
%define xmmA xmm6
%define xmmB xmm7
%endif

%if RGB_RED == 1
%define  mmC  mm0
%define  mmD  mm1
%define xmmC xmm0
%define xmmD xmm1
%elif RGB_GREEN
 == 1
%define  mmC  mm2
%define  mmD  mm3
%define xmmC xmm2
%define xmmD xmm3
%elif RGB_BLUE == 1
%define  mmC  mm4
%define  mmD  mm5
%define xmmC xmm4
%define xmmD xmm5
%else
```

```
%define  mmC  mm6
%define  mmD  mm7
%define xmmC xmm6
%define xmmD xmm7
%endif

%if RGB_RED == 2
%define  mmE  mm0
%define  mmF  mm1
%define xmmE xmm0
%define xmmF xmm1
%elif RGB_GREEN == 2
%define  mmE  mm2
%define  mmF  mm3
%define xmmE xmm2
%define xmmF xmm3
%elif RGB_BLUE == 2
%define  mmE  mm4
%define  mmF  mm5
%define xmmE xmm4
%define xmmF xmm5
%else
%define  mmE  mm6
%define  mmF  mm7
%define xmmE xmm6
%define xmmF xmm7
%endif

%if RGB_RED == 3
%define  mmG  mm0
%define  mmH  mm1
%define xmmG xmm0
%define xmmH xmm1
%elif RGB_GREEN == 3
%define  mmG  mm2
%define  mmH  mm3
%define xmmG xmm2
%define xmmH xmm3
%elif RGB_BLUE == 3
%define  mmG  mm4
%define  mmH  mm5
%define xmmG xmm4
%define xmmH xmm5
%else
%define  mmG  mm6
%define  mmH  mm7
%define xmmG xmm6
%define xmmH xmm7
```

%endif

; ---

Found
 in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/simd/jcolsamp.inc
No license file was found, but licenses were detected in source scan.

{\rtf1\ansi\ansicpg1252\cocoartf1038\cocoasubrtf360
{\fonttbl\f0\fswiss\fcharset0 Helvetica;}
{\colortbl;\red255\green255\blue255;}
\margl1440\margr1440\vieww26380\viewh15840\viewkind0
\deftab720
\pard\pardeftab720\ql\qnatural

\f0\fs24 \cf0 libjpeg-turbo is a JPEG image codec that uses SIMD instructions (MMX, SSE2, NEON) to accelerate baseline JPEG compression and decompression on x86, x86-64, and ARM systems. On such systems, libjpeg-turbo is generally 2-4x as fast as libjpeg, all else being equal. On other types of systems, libjpeg-turbo can still outperform libjpeg by a significant amount, by virtue of its highly-optimized Huffman coding routines. In many cases, the performance of libjpeg-turbo rivals that of proprietary high-speed JPEG codecs.\
\
libjpeg-turbo implements both the traditional libjpeg API as well as the less powerful but more straightforward TurboJPEG API. libjpeg-turbo also features colorspace
 extensions that allow it to compress from/decompress to 32-bit and\
big-endian pixel buffers (RGBX, XBGR, etc.), as well as a full-featured Java interface.\
\
libjpeg-turbo was originally based on libjpeg/SIMD, an MMX-accelerated derivative of libjpeg v6b developed by Miyasaka Masaru. The TigerVNC and VirtualGL projects made numerous enhancements to the codec in 2009, and in early 2010, libjpeg-turbo spun off into an independent project, with the goal of making high-speed JPEG compression/decompression technology available to a broader range of users and developers.\
}

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/release/ReadMe.rtf
No license file was found, but licenses were detected in source scan.

/*
* jutils.c
*
* Copyright (C) 1991-1996, Thomas G. Lane.
* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains tables and miscellaneous utility routines needed
* for both compression and decompression.

* Note we prefix all global names with "j" to minimize conflicts with
* a surrounding application.
*/

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/jutils.c
No license file was found, but licenses were detected in source scan.

/*
* jdatasrc-tj.c
*
* This file was part of the Independent JPEG Group's software:
* Copyright (C) 1994-1996, Thomas G. Lane.
* Modified 2009-2011 by Guido Vollbeding.
* Modifications:
* Copyright (C) 2011, D. R. Commander.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains decompression data source routines for the case of
* reading JPEG data from memory or from a file (or any stdio stream).
* While these routines are sufficient for most applications,
* some will want to use a different source manager.
* IMPORTANT: we assume that fread() will correctly transcribe an array of
* JOCTETs from 8-bit-wide elements on external storage. If char is wider
* than 8 bits on your machine, you may need to do some tweaking.
*/

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/jdatasrc-tj.c
No license file was found, but licenses were detected in source scan.

USING THE IJG JPEG LIBRARY

This file was part of the Independent JPEG Group's software:
Copyright (C) 1994-2011, Thomas G. Lane, Guido Vollbeding.
Modifications:
Copyright (C) 2010, D. R. Commander.
For conditions of distribution and use, see the accompanying README file.

This file describes how to use the IJG JPEG library within an application
program. Read it if you want to write a program that uses the library.

The file example.c provides heavily commented skeleton code for calling the
JPEG library. Also see jpeglib.h (the include file to be used by application
programs) for full details about data structures and function parameter lists.

The library source code, of course, is the ultimate reference.

Note that there have been *major* changes from the application interface
presented by IJG version 4 and earlier versions. The old design had several
inherent limitations, and it had accumulated a lot of cruft
as we added
features while trying to minimize application-interface changes. We have
sacrificed backward compatibility in the version 5 rewrite, but we think the
improvements justify this.

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Really raw data: DCT coefficients
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Memory management
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Notes for MS-DOS implementors

You should read at least the overview and basic usage
sections before trying
to program with the library. The sections on advanced features can be read
if and when you need them.

OVERVIEW
========

Functions provided by the library

The IJG JPEG library provides C code to read and write JPEG-compressed image files. The surrounding application program receives or supplies image data a scanline at a time, using a straightforward uncompressed image format. All details of color conversion and other preprocessing/postprocessing can be handled by the library.

The library includes a substantial amount of code that is not covered by the JPEG standard but is necessary for typical applications of JPEG. These functions preprocess the image before JPEG compression or postprocess it after decompression. They include colorspace conversion, downsampling/upsampling, and color quantization. The application indirectly selects use of this code by specifying the format in which it wishes to supply or receive image data.
For example, if colormapped output is requested, then the decompression library automatically invokes color quantization.

A wide range of quality vs. speed tradeoffs are possible in JPEG processing, and even more so in decompression postprocessing. The decompression library provides multiple implementations that cover most of the useful tradeoffs, ranging from very-high-quality down to fast-preview operation. On the compression side we have generally not provided low-quality choices, since compression is normally less time-critical. It should be understood that the low-quality modes may not meet the JPEG standard's accuracy requirements; nonetheless, they are useful for viewers.

A word about functions *not* provided by the library. We handle a subset of the ISO JPEG standard; most baseline, extended-sequential, and progressive JPEG processes are supported. (Our subset includes all features now in common use.) Unsupported ISO options include:
* Hierarchical storage
* Lossless
JPEG
* DNL marker
* Nonintegral subsampling ratios
We support both 8- and 12-bit data precision, but this is a compile-time choice rather than a run-time choice; hence it is difficult to use both precisions in a single application.

By itself, the library handles only interchange JPEG datastreams --- in particular the widely used JFIF file format. The library can be used by surrounding code to process interchange or abbreviated JPEG datastreams that are embedded in more complex file formats. (For example, this library is

used by the free LIBTIFF library to support JPEG compression in TIFF.)

Outline of typical usage

The rough outline of a JPEG compression operation is:

```
 Allocate and initialize a JPEG compression object
 Specify the destination for the compressed data (eg, a file)
 Set parameters for compression, including image size & colorspace
 jpeg_start_compress(...);
 while (scan lines remain to be written)
  jpeg_write_scanlines(...);
 jpeg_finish_compress(...);
 Release
 the JPEG compression object
```

A JPEG compression object holds parameters and working state for the JPEG library. We make creation/destruction of the object separate from starting or finishing compression of an image; the same object can be re-used for a series of image compression operations. This makes it easy to re-use the same parameter settings for a sequence of images. Re-use of a JPEG object also has important implications for processing abbreviated JPEG datastreams, as discussed later.

The image data to be compressed is supplied to jpeg_write_scanlines() from in-memory buffers. If the application is doing file-to-file compression, reading image data from the source file is the application's responsibility. The library emits compressed data by calling a "data destination manager", which typically will write the data into a file; but the application can provide its own destination manager to do something else.

Similarly, the rough outline of a JPEG
 decompression operation is:

```
 Allocate and initialize a JPEG decompression object
 Specify the source of the compressed data (eg, a file)
 Call jpeg_read_header() to obtain image info
 Set parameters for decompression
 jpeg_start_decompress(...);
 while (scan lines remain to be read)
  jpeg_read_scanlines(...);
 jpeg_finish_decompress(...);
 Release the JPEG decompression object
```

This is comparable to the compression outline except that reading the datastream header is a separate step. This is helpful because information

about the image's size, colorspace, etc is available when the application selects decompression parameters. For example, the application can choose an output scaling ratio that will fit the image into the available screen size.

The decompression library obtains compressed data by calling a data source manager, which typically will read the data from a file; but other behaviors can be obtained with a custom source manager. Decompressed data is delivered into in-memory
buffers passed to jpeg_read_scanlines().

It is possible to abort an incomplete compression or decompression operation by calling jpeg_abort(); or, if you do not need to retain the JPEG object, simply release it by calling jpeg_destroy().

JPEG compression and decompression objects are two separate struct types. However, they share some common fields, and certain routines such as jpeg_destroy() can work on either type of object.

The JPEG library has no static variables: all state is in the compression or decompression object. Therefore it is possible to process multiple compression and decompression operations concurrently, using multiple JPEG objects.

Both compression and decompression can be done in an incremental memory-to-memory fashion, if suitable source/destination managers are used. See the section on "I/O suspension" for more details.

BASIC LIBRARY USAGE

Data formats

Before diving into procedural details, it is helpful to understand
the
image data format that the JPEG library expects or returns.

The standard input image format is a rectangular array of pixels, with each pixel having the same number of "component" or "sample" values (color channels). You must specify how many components there are and the colorspace interpretation of the components. Most applications will use RGB data (three components per pixel) or grayscale data (one component per pixel).
PLEASE NOTE THAT RGB DATA IS THREE SAMPLES PER PIXEL, GRAYSCALE ONLY ONE.
A remarkable number of people manage to miss this, only to find that their programs don't work with grayscale JPEG files.

There is no provision for colormapped input. JPEG files are always full-color

or full grayscale (or sometimes another colorspace such as CMYK). You can feed in a colormapped image by expanding it to full-color format. However JPEG often doesn't work very well with source data that has been colormapped, because of dithering noise. This is discussed in more detail in the JPEG FAQ and the other references mentioned in the README file.

Pixels are stored by scanlines, with each scanline running from left to right. The component values for each pixel are adjacent in the row; for example, R,G,B,R,G,B,R,G,B,... for 24-bit RGB color. Each scanline is an array of data type JSAMPLE --- which is typically "unsigned char", unless you've changed jmorecfg.h. (You can also change the RGB pixel layout, say to B,G,R order, by modifying jmorecfg.h. But see the restrictions listed in that file before doing so.)

A 2-D array of pixels is formed by making a list of pointers to the starts of scanlines; so the scanlines need not be physically adjacent in memory. Even if you process just one scanline at a time, you must make a one-element pointer array to conform to this structure. Pointers to JSAMPLE rows are of type JSAMPROW, and the pointer to the pointer array is of type JSAMPARRAY.

The library accepts or supplies one or more complete scanlines per call. It is not possible to process part of a row at a time. Scanlines are always processed top-to-bottom. You can process an entire image in one call if you have it all in memory, but usually it's simplest to process one scanline at a time.

For best results, source data values should have the precision specified by BITS_IN_JSAMPLE (normally 8 bits). For instance, if you choose to compress data that's only 6 bits/channel, you should left-justify each value in a byte before passing it to the compressor. If you need to compress data that has more than 8 bits/channel, compile with BITS_IN_JSAMPLE = 12. (See "Library compile-time options", later.)

The data format returned by the decompressor is the same in all details, except that colormapped output is supported. (Again, a JPEG file is never colormapped. But you can ask the decompressor to perform on-the-fly color quantization to deliver colormapped output.) If you request colormapped output then the returned data array contains a single JSAMPLE per pixel; its value is an index into a color map. The color map is represented as a 2-D JSAMPARRAY in which each row holds the values of one color component, that is, colormap[i][j] is the value of the i'th color component for pixel value (map index) j. Note that since the colormap indexes are stored in JSAMPLEs, the maximum number of colors is limited by the size of JSAMPLE (ie, at most 256 colors for an 8-bit JPEG library).

Compression details

Here we revisit the JPEG compression outline given in the overview.

1. Allocate and initialize a JPEG compression object.

A JPEG compression object is a "struct jpeg_compress_struct". (It also has a bunch of subsidiary structures which are allocated via malloc(), but the application doesn't control those directly.) This struct can be just a local variable in the calling routine, if a single routine is going to execute the whole JPEG compression sequence. Otherwise it can be static or allocated from malloc().

You
will also need a structure representing a JPEG error handler. The part of this that the library cares about is a "struct jpeg_error_mgr". If you are providing your own error handler, you'll typically want to embed the jpeg_error_mgr struct in a larger structure; this is discussed later under "Error handling". For now we'll assume you are just using the default error handler. The default error handler will print JPEG error/warning messages on stderr, and it will call exit() if a fatal error occurs.

You must initialize the error handler structure, store a pointer to it into the JPEG object's "err" field, and then call jpeg_create_compress() to initialize the rest of the JPEG object.

Typical code for this step, if you are using the default error handler, is

```
struct jpeg_compress_struct cinfo;
struct jpeg_error_mgr jerr;
...
cinfo.err = jpeg_std_error(&jerr);
jpeg_create_compress(&cinfo);
```

jpeg_create_compress allocates a small amount of memory, so it could fail if
you are out of memory. In that case it will exit via the error handler; that's why the error handler must be initialized first.

2. Specify the destination for the compressed data (eg, a file).

As previously mentioned, the JPEG library delivers compressed data to a "data destination" module. The library includes one data destination module which knows how to write to a stdio stream. You can use your own

destination module if you want to do something else, as discussed later.

If you use the standard destination module, you must open the target stdio
stream beforehand. Typical code for this step looks like:

```
 FILE * outfile;
 ...
 if ((outfile = fopen(filename, "wb")) == NULL) {
     fprintf(stderr, "can't open %s\n", filename);
     exit(1);
 }
 jpeg_stdio_dest(&cinfo, outfile);
```

where the last line invokes the standard destination module.

WARNING: it is critical that the binary compressed data be delivered to the
output file unchanged. On non-Unix systems the stdio library may
 perform
newline translation or otherwise corrupt binary data. To suppress this
behavior, you may need to use a "b" option to fopen (as shown above), or use
setmode() or another routine to put the stdio stream in binary mode. See
cjpeg.c and djpeg.c for code that has been found to work on many systems.

You can select the data destination after setting other parameters (step 3),
if that's more convenient. You may not change the destination between
calling jpeg_start_compress() and jpeg_finish_compress().

3. Set parameters for compression, including image size & colorspace.

You must supply information about the source image by setting the following
fields in the JPEG object (cinfo structure):

```
 image_width  Width of image, in pixels
 image_height  Height of image, in pixels
 input_components Number of color channels (samples per pixel)
 in_color_space  Color space of source image
```

The image dimensions are, hopefully, obvious. JPEG supports image dimensions
of 1 to 64K pixels in
 either direction. The input color space is typically
RGB or grayscale, and input_components is 3 or 1 accordingly. (See "Special
color spaces", later, for more info.) The in_color_space field must be
assigned one of the J_COLOR_SPACE enum constants, typically JCS_RGB or
JCS_GRAYSCALE.

JPEG has a large number of compression parameters that determine how the
image is encoded. Most applications don't need or want to know about all

these parameters. You can set all the parameters to reasonable defaults by calling jpeg_set_defaults(); then, if there are particular values you want to change, you can do so after that. The "Compression parameter selection" section tells about all the parameters.

You must set in_color_space correctly before calling jpeg_set_defaults(), because the defaults depend on the source image colorspace. However the other three source image parameters need not be valid until you call jpeg_start_compress(). There's no harm in calling jpeg_set_defaults() more than
once, if that happens to be convenient.

Typical code for a 24-bit RGB source image is

```
cinfo.image_width = Width;  /* image width and height, in pixels */
cinfo.image_height = Height;
cinfo.input_components = 3; /* # of color components per pixel */
cinfo.in_color_space = JCS_RGB; /* colorspace of input image */

jpeg_set_defaults(&cinfo);
/* Make optional parameter settings here */
```

4. jpeg_start_compress(...);

After you have established the data destination and set all the necessary source image info and other parameters, call jpeg_start_compress() to begin a compression cycle. This will initialize internal state, allocate working storage, and emit the first few bytes of the JPEG datastream header.

Typical code:

```
jpeg_start_compress(&cinfo, TRUE);
```

The "TRUE" parameter ensures that a complete JPEG interchange datastream will be written. This is appropriate in most cases. If you think you might want to use an abbreviated datastream, read the section on abbreviated datastreams,
below.

Once you have called jpeg_start_compress(), you may not alter any JPEG parameters or other fields of the JPEG object until you have completed the compression cycle.

5. while (scan lines remain to be written)
jpeg_write_scanlines(...);

Now write all the required image data by calling jpeg_write_scanlines()
one or more times. You can pass one or more scanlines in each call, up
to the total image height. In most applications it is convenient to pass
just one or a few scanlines at a time. The expected format for the passed
data is discussed under "Data formats", above.

Image data should be written in top-to-bottom scanline order. The JPEG spec
contains some weasel wording about how top and bottom are application-defined
terms (a curious interpretation of the English language...) but if you want
your files to be compatible with everyone else's, you WILL use top-to-bottom
order. If the source data must be read in bottom-to-top order, you can use
the JPEG library's
 virtual array mechanism to invert the data efficiently.
Examples of this can be found in the sample application cjpeg.

The library maintains a count of the number of scanlines written so far
in the next_scanline field of the JPEG object. Usually you can just use
this variable as the loop counter, so that the loop test looks like
"while (cinfo.next_scanline < cinfo.image_height)".

Code for this step depends heavily on the way that you store the source data.
example.c shows the following code for the case of a full-size 2-D source
array containing 3-byte RGB pixels:

```
 JSAMPROW row_pointer[1]; /* pointer to a single row */
 int row_stride;   /* physical row width in buffer */

 row_stride = image_width * 3; /* JSAMPLEs per row in image_buffer */

 while (cinfo.next_scanline < cinfo.image_height) {
    row_pointer[0] = & image_buffer[cinfo.next_scanline * row_stride];
    jpeg_write_scanlines(&cinfo, row_pointer, 1);
 }
```

jpeg_write_scanlines() returns the number of scanlines actually
 written.
This will normally be equal to the number passed in, so you can usually
ignore the return value. It is different in just two cases:
 * If you try to write more scanlines than the declared image height,
   the additional scanlines are ignored.
 * If you use a suspending data destination manager, output buffer overrun
   will cause the compressor to return before accepting all the passed lines.
   This feature is discussed under "I/O suspension", below. The normal
   stdio destination manager will NOT cause this to happen.
In any case, the return value is the same as the change in the value of
next_scanline.

6. jpeg_finish_compress(...);

After all the image data has been written, call jpeg_finish_compress() to complete the compression cycle. This step is ESSENTIAL to ensure that the last bufferload of data is written to the data destination. jpeg_finish_compress() also releases working memory associated with the JPEG object.

Typical code:

jpeg_finish_compress(&cinfo);

If
using the stdio destination manager, don't forget to close the output stdio stream (if necessary) afterwards.

If you have requested a multi-pass operating mode, such as Huffman code optimization, jpeg_finish_compress() will perform the additional passes using data buffered by the first pass. In this case jpeg_finish_compress() may take quite a while to complete. With the default compression parameters, this will not happen.

It is an error to call jpeg_finish_compress() before writing the necessary total number of scanlines. If you wish to abort compression, call jpeg_abort() as discussed below.

After completing a compression cycle, you may dispose of the JPEG object as discussed next, or you may use it to compress another image. In that case return to step 2, 3, or 4 as appropriate. If you do not change the destination manager, the new datastream will be written to the same target. If you do not change any JPEG parameters, the new datastream will be written with the same
parameters as before. Note that you can change the input image dimensions freely between cycles, but if you change the input colorspace, you should call jpeg_set_defaults() to adjust for the new colorspace; and then you'll need to repeat all of step 3.

7. Release the JPEG compression object.

When you are done with a JPEG compression object, destroy it by calling jpeg_destroy_compress(). This will free all subsidiary memory (regardless of the previous state of the object). Or you can call jpeg_destroy(), which works for either compression or decompression objects --- this may be more convenient if you are sharing code between compression and decompression cases. (Actually, these routines are equivalent except for the declared type of the passed pointer. To avoid gripes from ANSI C compilers, jpeg_destroy() should be passed a j_common_ptr.)

If you allocated the jpeg_compress_struct structure from malloc(), freeing
it is your responsibility --- jpeg_destroy() won't. Ditto for
 the error
handler structure.

Typical code:

 jpeg_destroy_compress(&cinfo);

8. Aborting.

If you decide to abort a compression cycle before finishing, you can clean up
in either of two ways:

* If you don't need the JPEG object any more, just call
 jpeg_destroy_compress() or jpeg_destroy() to release memory. This is
 legitimate at any point after calling jpeg_create_compress() --- in fact,
 it's safe even if jpeg_create_compress() fails.

* If you want to re-use the JPEG object, call jpeg_abort_compress(), or call
 jpeg_abort() which works on both compression and decompression objects.
 This will return the object to an idle state, releasing any working memory.
 jpeg_abort() is allowed at any time after successful object creation.

Note that cleaning up the data destination, if required, is your
responsibility; neither of these routines will call term_destination().
(See "Compressed data handling", below, for more about that.)

jpeg_destroy() and jpeg_abort() are the only safe
 calls to make on a JPEG
object that has reported an error by calling error_exit (see "Error handling"
for more info). The internal state of such an object is likely to be out of
whack. Either of these two routines will return the object to a known state.

Decompression details

Here we revisit the JPEG decompression outline given in the overview.

1. Allocate and initialize a JPEG decompression object.

This is just like initialization for compression, as discussed above,
except that the object is a "struct jpeg_decompress_struct" and you
call jpeg_create_decompress(). Error handling is exactly the same.

Typical code:

```
struct jpeg_decompress_struct cinfo;
struct jpeg_error_mgr jerr;
...
cinfo.err = jpeg_std_error(&jerr);
jpeg_create_decompress(&cinfo);
```

(Both here and in the IJG code, we usually use variable name "cinfo" for
both compression and decompression objects.)

2. Specify the source of the compressed data (eg, a file).

As previously mentioned,
the JPEG library reads compressed data from a "data
source" module. The library includes one data source module which knows how
to read from a stdio stream. You can use your own source module if you want
to do something else, as discussed later.

If you use the standard source module, you must open the source stdio stream
beforehand. Typical code for this step looks like:

```
FILE * infile;
...
if ((infile = fopen(filename, "rb")) == NULL) {
    fprintf(stderr, "can't open %s\n", filename);
    exit(1);
}
jpeg_stdio_src(&cinfo, infile);
```

where the last line invokes the standard source module.

WARNING: it is critical that the binary compressed data be read unchanged.
On non-Unix systems the stdio library may perform newline translation or
otherwise corrupt binary data. To suppress this behavior, you may need to use
a "b" option to fopen (as shown above), or use setmode() or another routine to
put the stdio stream in binary mode. See cjpeg.c and djpeg.c for code that
has been
found to work on many systems.

You may not change the data source between calling jpeg_read_header() and
jpeg_finish_decompress(). If you wish to read a series of JPEG images from
a single source file, you should repeat the jpeg_read_header() to
jpeg_finish_decompress() sequence without reinitializing either the JPEG
object or the data source module; this prevents buffered input data from
being discarded.

3. Call jpeg_read_header() to obtain image info.

Typical code for this step is just

```
jpeg_read_header(&cinfo, TRUE);
```

This will read the source datastream header markers, up to the beginning
of the compressed data proper. On return, the image dimensions and other
info have been stored in the JPEG object. The application may wish to
consult this information before selecting decompression parameters.

More complex code is necessary if
 * A suspending data source is used --- in that case jpeg_read_header()
   may return before it has read all the header data. See "I/O suspension",
   below. The normal stdio source manager will NOT cause this to happen.
 * Abbreviated JPEG files are to be processed --- see the section on
   abbreviated datastreams. Standard applications that deal only in
   interchange JPEG files need not be concerned with this case either.

It is permissible to stop at this point if you just wanted to find out the
image dimensions and other header info for a JPEG file. In that case,
call jpeg_destroy() when you are done with the JPEG object, or call
jpeg_abort() to return it to an idle state before selecting a new data
source and reading another header.

4. Set parameters for decompression.

jpeg_read_header() sets appropriate default decompression parameters based on
the properties of the image (in particular, its colorspace). However, you
may well want to alter these defaults before beginning the decompression.
For example, the default is to produce full color output from a color file.
If you want colormapped output you must ask
 for it. Other options allow the
returned image to be scaled and allow various speed/quality tradeoffs to be
selected. "Decompression parameter selection", below, gives details.

If the defaults are appropriate, nothing need be done at this step.

Note that all default values are set by each call to jpeg_read_header().
If you reuse a decompression object, you cannot expect your parameter
settings to be preserved across cycles, as you can for compression.
You must set desired parameter values each time.

5. jpeg_start_decompress(...);

Once the parameter values are satisfactory, call jpeg_start_decompress() to
begin decompression. This will initialize internal state, allocate working
memory, and prepare for returning data.

Typical code is just

 jpeg_start_decompress(&cinfo);

If you have requested a multi-pass operating mode, such as 2-pass color
quantization, jpeg_start_decompress() will do everything needed before data
output can begin. In this case jpeg_start_decompress() may
 take quite a while
to complete. With a single-scan (non progressive) JPEG file and default
decompression parameters, this will not happen; jpeg_start_decompress() will
return quickly.

After this call, the final output image dimensions, including any requested
scaling, are available in the JPEG object; so is the selected colormap, if
colormapped output has been requested. Useful fields include

 output_width image width and height, as scaled
 output_height
 out_color_components # of color components in out_color_space
 output_components # of color components returned per pixel
 colormap the selected colormap, if any
 actual_number_of_colors number of entries in colormap

output_components is 1 (a colormap index) when quantizing colors; otherwise it
equals out_color_components. It is the number of JSAMPLE values that will be
emitted per pixel in the output arrays.

Typically you will need to allocate data buffers to hold the incoming image.
You will need output_width * output_components
 JSAMPLEs per scanline in your
output buffer, and a total of output_height scanlines will be returned.

Note: if you are using the JPEG library's internal memory manager to allocate
data buffers (as djpeg does), then the manager's protocol requires that you
request large buffers *before* calling jpeg_start_decompress(). This is a
little tricky since the output_XXX fields are not normally valid then. You
can make them valid by calling jpeg_calc_output_dimensions() after setting the
relevant parameters (scaling, output color space, and quantization flag).

6. while (scan lines remain to be read)
 jpeg_read_scanlines(...);

Now you can read the decompressed image data by calling jpeg_read_scanlines()

one or more times. At each call, you pass in the maximum number of scanlines
to be read (ie, the height of your working buffer); jpeg_read_scanlines()
will return up to that many lines. The return value is the number of lines
actually read. The format of the returned data is discussed
 under "Data
formats", above. Don't forget that grayscale and color JPEGs will return
different data formats!

Image data is returned in top-to-bottom scanline order. If you must write
out the image in bottom-to-top order, you can use the JPEG library's virtual
array mechanism to invert the data efficiently. Examples of this can be
found in the sample application djpeg.

The library maintains a count of the number of scanlines returned so far
in the output_scanline field of the JPEG object. Usually you can just use
this variable as the loop counter, so that the loop test looks like
"while (cinfo.output_scanline < cinfo.output_height)". (Note that the test
should NOT be against image_height, unless you never use scaling. The
image_height field is the height of the original unscaled image.)
The return value always equals the change in the value of output_scanline.

If you don't use a suspending data source, it is safe to assume that
jpeg_read_scanlines() reads at least one scanline
 per call, until the
bottom of the image has been reached.

If you use a buffer larger than one scanline, it is NOT safe to assume that
jpeg_read_scanlines() fills it. (The current implementation returns only a
few scanlines per call, no matter how large a buffer you pass.) So you must
always provide a loop that calls jpeg_read_scanlines() repeatedly until the
whole image has been read.

7. jpeg_finish_decompress(...);

After all the image data has been read, call jpeg_finish_decompress() to
complete the decompression cycle. This causes working memory associated
with the JPEG object to be released.

Typical code:

 jpeg_finish_decompress(&cinfo);

If using the stdio source manager, don't forget to close the source stdio
stream if necessary.

It is an error to call jpeg_finish_decompress() before reading the correct
total number of scanlines. If you wish to abort decompression, call

jpeg_abort() as discussed below.

After completing a decompression cycle, you may dispose of the
 JPEG object as
discussed next, or you may use it to decompress another image. In that case
return to step 2 or 3 as appropriate. If you do not change the source
manager, the next image will be read from the same source.

8. Release the JPEG decompression object.

When you are done with a JPEG decompression object, destroy it by calling
jpeg_destroy_decompress() or jpeg_destroy(). The previous discussion of
destroying compression objects applies here too.

Typical code:

 jpeg_destroy_decompress(&cinfo);

9. Aborting.

You can abort a decompression cycle by calling jpeg_destroy_decompress() or
jpeg_destroy() if you don't need the JPEG object any more, or
jpeg_abort_decompress() or jpeg_abort() if you want to reuse the object.
The previous discussion of aborting compression cycles applies here too.

Mechanics of usage: include files, linking, etc

Applications using the JPEG library should include the header file jpeglib.h
to obtain
 declarations of data types and routines. Before including
jpeglib.h, include system headers that define at least the typedefs FILE and
size_t. On ANSI-conforming systems, including <stdio.h> is sufficient; on
older Unix systems, you may need <sys/types.h> to define size_t.

If the application needs to refer to individual JPEG library error codes, also
include jerror.h to define those symbols.

jpeglib.h indirectly includes the files jconfig.h and jmorecfg.h. If you are
installing the JPEG header files in a system directory, you will want to
install all four files: jpeglib.h, jerror.h, jconfig.h, jmorecfg.h.

The most convenient way to include the JPEG code into your executable program
is to prepare a library file ("libjpeg.a", or a corresponding name on non-Unix
machines) and reference it at your link step. If you use only half of the

library (only compression or only decompression), only that much code will be included from the library, unless your linker is hopelessly brain-damaged. The
supplied makefiles build libjpeg.a automatically (see install.txt).

While you can build the JPEG library as a shared library if the whim strikes you, we don't really recommend it. The trouble with shared libraries is that at some point you'll probably try to substitute a new version of the library without recompiling the calling applications. That generally doesn't work because the parameter struct declarations usually change with each new version. In other words, the library's API is *not* guaranteed binary compatible across versions; we only try to ensure source-code compatibility. (In hindsight, it might have been smarter to hide the parameter structs from applications and introduce a ton of access functions instead. Too late now, however.)

On some systems your application may need to set up a signal handler to ensure that temporary files are deleted if the program is interrupted. This is most critical if you are on MS-DOS and use the jmemdos.c memory manager back end; it
will try to grab extended memory for temp files, and that space will NOT be freed automatically. See cjpeg.c or djpeg.c for an example signal handler.

It may be worth pointing out that the core JPEG library does not actually require the stdio library: only the default source/destination managers and error handler need it. You can use the library in a stdio-less environment if you replace those modules and use jmemnobs.c (or another memory manager of your own devising). More info about the minimum system library requirements may be found in jinclude.h.

ADVANCED FEATURES

Compression parameter selection

This section describes all the optional parameters you can set for JPEG compression, as well as the "helper" routines provided to assist in this task. Proper setting of some parameters requires detailed understanding of the JPEG standard; if you don't know what a parameter is for, it's best not to mess with it! See REFERENCES
in the README file for pointers to
more info about JPEG.

It's a good idea to call jpeg_set_defaults() first, even if you plan to set all the parameters; that way your code is more likely to work with future JPEG libraries that have additional parameters. For the same reason, we recommend

you use a helper routine where one is provided, in preference to twiddling
cinfo fields directly.

The helper routines are:

jpeg_set_defaults (j_compress_ptr cinfo)
 This routine sets all JPEG parameters to reasonable defaults, using
 only the input image's color space (field in_color_space, which must
 already be set in cinfo). Many applications will only need to use
 this routine and perhaps jpeg_set_quality().

jpeg_set_colorspace (j_compress_ptr cinfo, J_COLOR_SPACE colorspace)
 Sets the JPEG file's colorspace (field jpeg_color_space) as specified,
 and sets other color-space-dependent parameters appropriately. See
 "Special color spaces", below, before using this. A large number of
 parameters,
 including all per-component parameters, are set by this
 routine; if you want to twiddle individual parameters you should call
 jpeg_set_colorspace() before rather than after.

jpeg_default_colorspace (j_compress_ptr cinfo)
 Selects an appropriate JPEG colorspace based on cinfo->in_color_space,
 and calls jpeg_set_colorspace(). This is actually a subroutine of
 jpeg_set_defaults(). It's broken out in case you want to change
 just the colorspace-dependent JPEG parameters.

jpeg_set_quality (j_compress_ptr cinfo, int quality, boolean force_baseline)
 Constructs JPEG quantization tables appropriate for the indicated
 quality setting. The quality value is expressed on the 0..100 scale
 recommended by IJG (cjpeg's "-quality" switch uses this routine).
 Note that the exact mapping from quality values to tables may change
 in future IJG releases as more is learned about DCT quantization.
 If the force_baseline parameter is TRUE, then the quantization table
 entries are constrained to
 the range 1..255 for full JPEG baseline
 compatibility. In the current implementation, this only makes a
 difference for quality settings below 25, and it effectively prevents
 very small/low quality files from being generated. The IJG decoder
 is capable of reading the non-baseline files generated at low quality
 settings when force_baseline is FALSE, but other decoders may not be.

jpeg_set_linear_quality (j_compress_ptr cinfo, int scale_factor,
    boolean force_baseline)
 Same as jpeg_set_quality() except that the generated tables are the
 sample tables given in the JPEC spec section K.1, multiplied by the
 specified scale factor (which is expressed as a percentage; thus
 scale_factor = 100 reproduces the spec's tables). Note that larger
 scale factors give lower quality. This entry point is useful for

conforming to the Adobe PostScript DCT conventions, but we do not
recommend linear scaling as a user-visible quality scale otherwise.
force_baseline again constrains the computed
table entries to 1..255.

int jpeg_quality_scaling (int quality)
Converts a value on the IJG-recommended quality scale to a linear
scaling percentage. Note that this routine may change or go away
in future releases --- IJG may choose to adopt a scaling method that
can't be expressed as a simple scalar multiplier, in which case the
premise of this routine collapses. Caveat user.

jpeg_default_qtables (j_compress_ptr cinfo, boolean force_baseline)
[libjpeg v7+ API/ABI emulation only]
Set default quantization tables with linear q_scale_factor[] values
(see below).

jpeg_add_quant_table (j_compress_ptr cinfo, int which_tbl,
const unsigned int *basic_table,
int scale_factor, boolean force_baseline)
Allows an arbitrary quantization table to be created. which_tbl
indicates which table slot to fill. basic_table points to an array
of 64 unsigned ints given in normal array order. These values are
multiplied by scale_factor/100 and then clamped to the range
1..65535
(or to 1..255 if force_baseline is TRUE).
CAUTION: prior to library version 6a, jpeg_add_quant_table expected
the basic table to be given in JPEG zigzag order. If you need to
write code that works with either older or newer versions of this
routine, you must check the library version number. Something like
"#if JPEG_LIB_VERSION >= 61" is the right test.

jpeg_simple_progression (j_compress_ptr cinfo)
Generates a default scan script for writing a progressive-JPEG file.
This is the recommended method of creating a progressive file,
unless you want to make a custom scan sequence. You must ensure that
the JPEG color space is set correctly before calling this routine.

Compression parameters (cinfo fields) include:

J_DCT_METHOD dct_method
Selects the algorithm used for the DCT step. Choices are:
JDCT_ISLOW: slow but accurate integer algorithm
JDCT_IFAST: faster, less accurate integer method
JDCT_FLOAT: floating-point method
JDCT_DEFAULT: default method (normally

JDCT_ISLOW)
JDCT_FASTEST: fastest method (normally JDCT_IFAST)
The FLOAT method is very slightly more accurate than the ISLOW method,
but may give different results on different machines due to varying
roundoff behavior. The integer methods should give the same results
on all machines. On machines with sufficiently fast FP hardware, the
floating-point method may also be the fastest. The IFAST method is
considerably less accurate than the other two; its use is not
recommended if high quality is a concern. JDCT_DEFAULT and
JDCT_FASTEST are macros configurable by each installation.

J_COLOR_SPACE jpeg_color_space
int num_components
The JPEG color space and corresponding number of components; see
"Special color spaces", below, for more info. We recommend using
jpeg_set_color_space() if you want to change these.

boolean optimize_coding
TRUE causes the compressor to compute optimal Huffman coding tables
for the image. This requires an extra pass over the data and
therefore
costs a good deal of space and time. The default is
FALSE, which tells the compressor to use the supplied or default
Huffman tables. In most cases optimal tables save only a few percent
of file size compared to the default tables. Note that when this is
TRUE, you need not supply Huffman tables at all, and any you do
supply will be overwritten.

unsigned int restart_interval
int restart_in_rows
To emit restart markers in the JPEG file, set one of these nonzero.
Set restart_interval to specify the exact interval in MCU blocks.
Set restart_in_rows to specify the interval in MCU rows. (If
restart_in_rows is not 0, then restart_interval is set after the
image width in MCUs is computed.) Defaults are zero (no restarts).
One restart marker per MCU row is often a good choice.
NOTE: the overhead of restart markers is higher in grayscale JPEG
files than in color files, and MUCH higher in progressive JPEGs.
If you use restarts, you may want to use larger intervals in
those
cases.

const jpeg_scan_info * scan_info
int num_scans
By default, scan_info is NULL; this causes the compressor to write a
single-scan sequential JPEG file. If not NULL, scan_info points to
an array of scan definition records of length num_scans. The
compressor will then write a JPEG file having one scan for each scan

definition record. This is used to generate noninterleaved or
progressive JPEG files. The library checks that the scan array
defines a valid JPEG scan sequence. (jpeg_simple_progression creates
a suitable scan definition array for progressive JPEG.) This is
discussed further under "Progressive JPEG support".

int smoothing_factor
If non-zero, the input image is smoothed; the value should be 1 for
minimal smoothing to 100 for maximum smoothing. Consult jcsample.c
for details of the smoothing algorithm. The default is zero.

boolean write_JFIF_header
If TRUE, a JFIF APP0 marker is emitted. jpeg_set_defaults() and
jpeg_set_colorspace() set this
TRUE if a JFIF-legal JPEG color space
(ie, YCbCr or grayscale) is selected, otherwise FALSE.

UINT8 JFIF_major_version
UINT8 JFIF_minor_version
The version number to be written into the JFIF marker.
jpeg_set_defaults() initializes the version to 1.01 (major=minor=1).
You should set it to 1.02 (major=1, minor=2) if you plan to write
any JFIF 1.02 extension markers.

UINT8 density_unit
UINT16 X_density
UINT16 Y_density
The resolution information to be written into the JFIF marker;
not used otherwise. density_unit may be 0 for unknown,
1 for dots/inch, or 2 for dots/cm. The default values are 0,1,1
indicating square pixels of unknown size.

boolean write_Adobe_marker
If TRUE, an Adobe APP14 marker is emitted. jpeg_set_defaults() and
jpeg_set_colorspace() set this TRUE if JPEG color space RGB, CMYK,
or YCCK is selected, otherwise FALSE. It is generally a bad idea
to set both write_JFIF_header and write_Adobe_marker. In fact,
you probably shouldn't change the default settings
at all --- the
default behavior ensures that the JPEG file's color space can be
recognized by the decoder.

JQUANT_TBL * quant_tbl_ptrs[NUM_QUANT_TBLS]
Pointers to coefficient quantization tables, one per table slot,
or NULL if no table is defined for a slot. Usually these should
be set via one of the above helper routines; jpeg_add_quant_table()
is general enough to define any quantization table. The other
routines will set up table slot 0 for luminance quality and table

slot 1 for chrominance.

int q_scale_factor[NUM_QUANT_TBLS]
[libjpeg v7+ API/ABI emulation only]
Linear quantization scaling factors (0-100, default 100)
for use with jpeg_default_qtables().
See rdswitch.c and cjpeg.c for an example of usage.
Note that the q_scale_factor[] values use "linear" scales, so JPEG
quality levels chosen by the user must be converted to these scales
using jpeg_quality_scaling(). Here is an example that corresponds to
cjpeg -quality 90,70:

```
jpeg_set_defaults(cinfo);

/*
Set luminance quality 90. */
cinfo->q_scale_factor[0] = jpeg_quality_scaling(90);
/* Set chrominance quality 70. */
cinfo->q_scale_factor[1] = jpeg_quality_scaling(70);

jpeg_default_qtables(cinfo, force_baseline);
```

CAUTION: Setting separate quality levels for chrominance and luminance
is mainly only useful if chrominance subsampling is disabled. 2x2
chrominance subsampling (AKA "4:2:0") is the default, but you can
explicitly disable subsampling as follows:

```
cinfo->comp_info[0].v_samp_factor = 1;
cinfo->comp_info[0].h_samp_factor = 1;
```

JHUFF_TBL * dc_huff_tbl_ptrs[NUM_HUFF_TBLS]
JHUFF_TBL * ac_huff_tbl_ptrs[NUM_HUFF_TBLS]
Pointers to Huffman coding tables, one per table slot, or NULL if
no table is defined for a slot. Slots 0 and 1 are filled with the
JPEG sample tables by jpeg_set_defaults(). If you need to allocate
more table structures, jpeg_alloc_huff_table() may be used.
Note that optimal Huffman tables can be computed for an image
by setting optimize_coding,
as discussed above; there's seldom
any need to mess with providing your own Huffman tables.

[libjpeg v7+ API/ABI emulation only]
The actual dimensions of the JPEG image that will be written to the file are
given by the following fields. These are computed from the input image
dimensions and the compression parameters by jpeg_start_compress(). You can
also call jpeg_calc_jpeg_dimensions() to obtain the values that will result
from the current parameter settings. This can be useful if you are trying

to pick a scaling ratio that will get close to a desired target size.

JDIMENSION jpeg_width Actual dimensions of output image.
JDIMENSION jpeg_height

Per-component parameters are stored in the struct cinfo.comp_info[i] for
component number i. Note that components here refer to components of the
JPEG color space, *not* the source image color space. A suitably large
comp_info[] array is allocated by jpeg_set_defaults(); if you choose not
to use that routine, it's up to you
 to allocate the array.

int component_id
 The one-byte identifier code to be recorded in the JPEG file for
 this component. For the standard color spaces, we recommend you
 leave the default values alone.

int h_samp_factor
int v_samp_factor
 Horizontal and vertical sampling factors for the component; must
 be 1..4 according to the JPEG standard. Note that larger sampling
 factors indicate a higher-resolution component; many people find
 this behavior quite unintuitive. The default values are 2,2 for
 luminance components and 1,1 for chrominance components, except
 for grayscale where 1,1 is used.

int quant_tbl_no
 Quantization table number for component. The default value is
 0 for luminance components and 1 for chrominance components.

int dc_tbl_no
int ac_tbl_no
 DC and AC entropy coding table numbers. The default values are
 0 for luminance components and 1 for chrominance components.

int component_index
 Must equal the component's index in comp_info[]. (Beginning in
 release
 v6, the compressor library will fill this in automatically;
 you don't have to.)

Decompression parameter selection

Decompression parameter selection is somewhat simpler than compression
parameter selection, since all of the JPEG internal parameters are

recorded in the source file and need not be supplied by the application.
(Unless you are working with abbreviated files, in which case see
"Abbreviated datastreams", below.) Decompression parameters control
the postprocessing done on the image to deliver it in a format suitable
for the application's use. Many of the parameters control speed/quality
tradeoffs, in which faster decompression may be obtained at the price of
a poorer-quality image. The defaults select the highest quality (slowest)
processing.

The following fields in the JPEG object are set by jpeg_read_header() and
may be useful to the application in choosing decompression parameters:

JDIMENSION image_width   Width and height of
 image
JDIMENSION image_height
int num_components   Number of color components
J_COLOR_SPACE jpeg_color_space Colorspace of image
boolean saw_JFIF_marker   TRUE if a JFIF APP0 marker was seen
 UINT8 JFIF_major_version Version information from JFIF marker
 UINT8 JFIF_minor_version
 UINT8 density_unit   Resolution data from JFIF marker
 UINT16 X_density
 UINT16 Y_density
boolean saw_Adobe_marker TRUE if an Adobe APP14 marker was seen
 UINT8 Adobe_transform   Color transform code from Adobe marker

The JPEG color space, unfortunately, is something of a guess since the JPEG
standard proper does not provide a way to record it. In practice most files
adhere to the JFIF or Adobe conventions, and the decoder will recognize these
correctly. See "Special color spaces", below, for more info.

The decompression parameters that determine the basic properties of the
returned image are:

J_COLOR_SPACE out_color_space
 Output color space. jpeg_read_header() sets an appropriate default
 based
 on jpeg_color_space; typically it will be RGB or grayscale.
 The application can change this field to request output in a different
 colorspace. For example, set it to JCS_GRAYSCALE to get grayscale
 output from a color file. (This is useful for previewing: grayscale
 output is faster than full color since the color components need not
 be processed.) Note that not all possible color space transforms are
 currently implemented; you may need to extend jdcolor.c if you want an
 unusual conversion.

unsigned int scale_num, scale_denom

Scale the image by the fraction scale_num/scale_denom. Default is
1/1, or no scaling. Currently, the only supported scaling ratios
are M/8 with all M from 1 to 16, or any reduced fraction thereof (such
as 1/2, 3/4, etc.) (The library design allows for arbitrary
scaling ratios but this is not likely to be implemented any time soon.)
Smaller scaling ratios permit significantly faster decoding since
fewer pixels need be processed and a simpler IDCT
method can be used.

boolean quantize_colors
If set TRUE, colormapped output will be delivered. Default is FALSE,
meaning that full-color output will be delivered.

The next three parameters are relevant only if quantize_colors is TRUE.

int desired_number_of_colors
Maximum number of colors to use in generating a library-supplied color
map (the actual number of colors is returned in a different field).
Default 256. Ignored when the application supplies its own color map.

boolean two_pass_quantize
If TRUE, an extra pass over the image is made to select a custom color
map for the image. This usually looks a lot better than the one-size-
fits-all colormap that is used otherwise. Default is TRUE. Ignored
when the application supplies its own color map.

J_DITHER_MODE dither_mode
Selects color dithering method. Supported values are:
JDITHER_NONE no dithering: fast, very low quality
JDITHER_ORDERED ordered dither: moderate speed and quality
JDITHER_FS Floyd-Steinberg
dither: slow, high quality
Default is JDITHER_FS. (At present, ordered dither is implemented
only in the single-pass, standard-colormap case. If you ask for
ordered dither when two_pass_quantize is TRUE or when you supply
an external color map, you'll get F-S dithering.)

When quantize_colors is TRUE, the target color map is described by the next
two fields. colormap is set to NULL by jpeg_read_header(). The application
can supply a color map by setting colormap non-NULL and setting
actual_number_of_colors to the map size. Otherwise, jpeg_start_decompress()
selects a suitable color map and sets these two fields itself.
[Implementation restriction: at present, an externally supplied colormap is
only accepted for 3-component output color spaces.]

JSAMPARRAY colormap
The color map, represented as a 2-D pixel array of out_color_components
rows and actual_number_of_colors columns. Ignored if not quantizing.

CAUTION: if the JPEG library creates its own colormap, the storage
pointed
to by this field is released by jpeg_finish_decompress().
Copy the colormap somewhere else first, if you want to save it.

int actual_number_of_colors
The number of colors in the color map.

Additional decompression parameters that the application may set include:

J_DCT_METHOD dct_method
Selects the algorithm used for the DCT step. Choices are the same
as described above for compression.

boolean do_fancy_upsampling
If TRUE, do careful upsampling of chroma components. If FALSE,
a faster but sloppier method is used. Default is TRUE. The visual
impact of the sloppier method is often very small.

boolean do_block_smoothing
If TRUE, interblock smoothing is applied in early stages of decoding
progressive JPEG files; if FALSE, not. Default is TRUE. Early
progression stages look "fuzzy" with smoothing, "blocky" without.
In any case, block smoothing ceases to be applied after the first few
AC coefficients are known to full accuracy, so it is relevant only
when using
buffered-image mode for progressive images.

boolean enable_1pass_quant
boolean enable_external_quant
boolean enable_2pass_quant
These are significant only in buffered-image mode, which is
described in its own section below.

The output image dimensions are given by the following fields. These are
computed from the source image dimensions and the decompression parameters
by jpeg_start_decompress(). You can also call jpeg_calc_output_dimensions()
to obtain the values that will result from the current parameter settings.
This can be useful if you are trying to pick a scaling ratio that will get
close to a desired target size. It's also important if you are using the
JPEG library's memory manager to allocate output buffer space, because you
are supposed to request such buffers *before* jpeg_start_decompress().

JDIMENSION output_width Actual dimensions of output image.
JDIMENSION output_height
int out_color_components Number of color components in out_color_space.
int output_components Number

of color components returned.
int rec_outbuf_height Recommended height of scanline buffer.

When quantizing colors, output_components is 1, indicating a single color map
index per pixel. Otherwise it equals out_color_components. The output arrays
are required to be output_width * output_components JSAMPLEs wide.

rec_outbuf_height is the recommended minimum height (in scanlines) of the
buffer passed to jpeg_read_scanlines(). If the buffer is smaller, the
library will still work, but time will be wasted due to unnecessary data
copying. In high-quality modes, rec_outbuf_height is always 1, but some
faster, lower-quality modes set it to larger values (typically 2 to 4).
If you are going to ask for a high-speed processing mode, you may as well
go to the trouble of honoring rec_outbuf_height so as to avoid data copying.
(An output buffer larger than rec_outbuf_height lines is OK, but won't
provide any material speed improvement over that height.)

Special color spaces

The
JPEG standard itself is "color blind" and doesn't specify any particular
color space. It is customary to convert color data to a luminance/chrominance
color space before compressing, since this permits greater compression. The
existing de-facto JPEG file format standards specify YCbCr or grayscale data
(JFIF), or grayscale, RGB, YCbCr, CMYK, or YCCK (Adobe). For special
applications such as multispectral images, other color spaces can be used,
but it must be understood that such files will be unportable.

The JPEG library can handle the most common colorspace conversions (namely
RGB <=> YCbCr and CMYK <=> YCCK). It can also deal with data of an unknown
color space, passing it through without conversion. If you deal extensively
with an unusual color space, you can easily extend the library to understand
additional color spaces and perform appropriate conversions.

For compression, the source data's color space is specified by field
in_color_space. This is
transformed to the JPEG file's color space given
by jpeg_color_space. jpeg_set_defaults() chooses a reasonable JPEG color
space depending on in_color_space, but you can override this by calling
jpeg_set_colorspace(). Of course you must select a supported transformation.
jccolor.c currently supports the following transformations:
RGB => YCbCr
RGB => GRAYSCALE
YCbCr => GRAYSCALE
CMYK => YCCK
plus the null transforms: GRAYSCALE => GRAYSCALE, RGB => RGB,

YCbCr => YCbCr, CMYK => CMYK, YCCK => YCCK, and UNKNOWN => UNKNOWN.

The de-facto file format standards (JFIF and Adobe) specify APPn markers that
indicate the color space of the JPEG file. It is important to ensure that
these are written correctly, or omitted if the JPEG file's color space is not
one of the ones supported by the de-facto standards. jpeg_set_colorspace()
will set the compression parameters to include or omit the APPn markers
properly, so long as it is told the truth about the JPEG color space.
For example, if you are
writing some random 3-component color space without
conversion, don't try to fake out the library by setting in_color_space and
jpeg_color_space to JCS_YCbCr; use JCS_UNKNOWN. You may want to write an
APPn marker of your own devising to identify the colorspace --- see "Special
markers", below.

When told that the color space is UNKNOWN, the library will default to using
luminance-quality compression parameters for all color components. You may
well want to change these parameters. See the source code for
jpeg_set_colorspace(), in jcparam.c, for details.

For decompression, the JPEG file's color space is given in jpeg_color_space,
and this is transformed to the output color space out_color_space.
jpeg_read_header's setting of jpeg_color_space can be relied on if the file
conforms to JFIF or Adobe conventions, but otherwise it is no better than a
guess. If you know the JPEG file's color space for certain, you can override
jpeg_read_header's guess by setting jpeg_color_space. jpeg_read_header
also
selects a default output color space based on (its guess of) jpeg_color_space;
set out_color_space to override this. Again, you must select a supported
transformation. jdcolor.c currently supports
YCbCr => RGB
YCbCr => GRAYSCALE
RGB => GRAYSCALE
GRAYSCALE => RGB
YCCK => CMYK
as well as the null transforms. (Since GRAYSCALE=>RGB is provided, an
application can force grayscale JPEGs to look like color JPEGs if it only
wants to handle one case.)

The two-pass color quantizer, jquant2.c, is specialized to handle RGB data
(it weights distances appropriately for RGB colors). You'll need to modify
the code if you want to use it for non-RGB output color spaces. Note that
jquant2.c is used to map to an application-supplied colormap as well as for
the normal two-pass colormap selection process.

CAUTION: it appears that Adobe Photoshop writes inverted data in CMYK JPEG
files: 0 represents 100% ink coverage, rather than 0% ink as you'd expect.
This is arguably a bug in

Photoshop, but if you need to work with Photoshop
CMYK files, you will have to deal with it in your application. We cannot
"fix" this in the library by inverting the data during the CMYK<=>YCCK
transform, because that would break other applications, notably Ghostscript.
Photoshop versions prior to 3.0 write EPS files containing JPEG-encoded CMYK
data in the same inverted-YCCK representation used in bare JPEG files, but
the surrounding PostScript code performs an inversion using the PS image
operator. I am told that Photoshop 3.0 will write uninverted YCCK in
EPS/JPEG files, and will omit the PS-level inversion. (But the data
polarity used in bare JPEG files will not change in 3.0.) In either case,
the JPEG library must not invert the data itself, or else Ghostscript would
read these EPS files incorrectly.

Error handling

When the default error handler is used, any error detected inside the JPEG
routines will cause a message to be printed on stderr, followed by exit().
You
can supply your own error handling routines to override this behavior
and to control the treatment of nonfatal warnings and trace/debug messages.
The file example.c illustrates the most common case, which is to have the
application regain control after an error rather than exiting.

The JPEG library never writes any message directly; it always goes through
the error handling routines. Three classes of messages are recognized:
* Fatal errors: the library cannot continue.
* Warnings: the library can continue, but the data is corrupt, and a
damaged output image is likely to result.
* Trace/informational messages. These come with a trace level indicating
the importance of the message; you can control the verbosity of the
program by adjusting the maximum trace level that will be displayed.

You may, if you wish, simply replace the entire JPEG error handling module
(jerror.c) with your own code. However, you can avoid code duplication by
only replacing some of the
routines depending on the behavior you need.
This is accomplished by calling jpeg_std_error() as usual, but then overriding
some of the method pointers in the jpeg_error_mgr struct, as illustrated by
example.c.

All of the error handling routines will receive a pointer to the JPEG object
(a j_common_ptr which points to either a jpeg_compress_struct or a
jpeg_decompress_struct; if you need to tell which, test the is_decompressor
field). This struct includes a pointer to the error manager struct in its
"err" field. Frequently, custom error handler routines will need to access
additional data which is not known to the JPEG library or the standard error

handler. The most convenient way to do this is to embed either the JPEG
object or the jpeg_error_mgr struct in a larger structure that contains
additional fields; then casting the passed pointer provides access to the
additional fields. Again, see example.c for one way to do it. (Beginning
with IJG version 6b, there is also a void pointer
 "client_data" in each
JPEG object, which the application can also use to find related data.
The library does not touch client_data at all.)

The individual methods that you might wish to override are:

error_exit (j_common_ptr cinfo)
 Receives control for a fatal error. Information sufficient to
 generate the error message has been stored in cinfo->err; call
 output_message to display it. Control must NOT return to the caller;
 generally this routine will exit() or longjmp() somewhere.
 Typically you would override this routine to get rid of the exit()
 default behavior. Note that if you continue processing, you should
 clean up the JPEG object with jpeg_abort() or jpeg_destroy().

output_message (j_common_ptr cinfo)
 Actual output of any JPEG message. Override this to send messages
 somewhere other than stderr. Note that this method does not know
 how to generate a message, only where to send it.

format_message (j_common_ptr cinfo, char * buffer)
 Constructs a readable error
 message string based on the error info
 stored in cinfo->err. This method is called by output_message. Few
 applications should need to override this method. One possible
 reason for doing so is to implement dynamic switching of error message
 language.

emit_message (j_common_ptr cinfo, int msg_level)
 Decide whether or not to emit a warning or trace message; if so,
 calls output_message. The main reason for overriding this method
 would be to abort on warnings. msg_level is -1 for warnings,
 0 and up for trace messages.

Only error_exit() and emit_message() are called from the rest of the JPEG
library; the other two are internal to the error handler.

The actual message texts are stored in an array of strings which is pointed to
by the field err->jpeg_message_table. The messages are numbered from 0 to
err->last_jpeg_message, and it is these code numbers that are used in the
JPEG library code. You could replace the message texts (for instance, with
messages in French or German)

by changing the message table pointer. See
jerror.h for the default texts. CAUTION: this table will almost certainly
change or grow from one library version to the next.

It may be useful for an application to add its own message texts that are
handled by the same mechanism. The error handler supports a second "add-on"
message table for this purpose. To define an addon table, set the pointer
err->addon_message_table and the message numbers err->first_addon_message and
err->last_addon_message. If you number the addon messages beginning at 1000
or so, you won't have to worry about conflicts with the library's built-in
messages. See the sample applications cjpeg/djpeg for an example of using
addon messages (the addon messages are defined in cderror.h).

Actual invocation of the error handler is done via macros defined in jerror.h:
ERREXITn(...) for fatal errors
WARNMSn(...) for corrupt-data warnings
TRACEMSn(...) for trace and informational messages.
These macros store the message
code and any additional parameters into the
error handler struct, then invoke the error_exit() or emit_message() method.
The variants of each macro are for varying numbers of additional parameters.
The additional parameters are inserted into the generated message using
standard printf() format codes.

See jerror.h and jerror.c for further details.

Compressed data handling (source and destination managers)

The JPEG compression library sends its compressed data to a "destination
manager" module. The default destination manager just writes the data to a
memory buffer or to a stdio stream, but you can provide your own manager to
do something else. Similarly, the decompression library calls a "source
manager" to obtain the compressed data; you can provide your own source
manager if you want the data to come from somewhere other than a memory
buffer or a stdio stream.

In both cases, compressed data is processed a bufferload
at a time: the
destination or source manager provides a work buffer, and the library invokes
the manager only when the buffer is filled or emptied. (You could define a
one-character buffer to force the manager to be invoked for each byte, but
that would be rather inefficient.) The buffer's size and location are
controlled by the manager, not by the library. For example, the memory
source manager just makes the buffer pointer and length point to the original
data in memory. In this case the buffer-reload procedure will be invoked
only if the decompressor ran off the end of the datastream, which would

indicate an erroneous datastream.

The work buffer is defined as an array of datatype JOCTET, which is generally
"char" or "unsigned char". On a machine where char is not exactly 8 bits
wide, you must define JOCTET as a wider data type and then modify the data
source and destination modules to transcribe the work arrays into 8-bit units
on external storage.

A data destination manager
struct contains a pointer and count defining the
next byte to write in the work buffer and the remaining free space:

```
JOCTET * next_output_byte;  /* => next byte to write in buffer */
size_t free_in_buffer;      /* # of byte spaces remaining in buffer */
```

The library increments the pointer and decrements the count until the buffer
is filled. The manager's empty_output_buffer method must reset the pointer
and count. The manager is expected to remember the buffer's starting address
and total size in private fields not visible to the library.

A data destination manager provides three methods:

init_destination (j_compress_ptr cinfo)
Initialize destination. This is called by jpeg_start_compress()
before any data is actually written. It must initialize
next_output_byte and free_in_buffer. free_in_buffer must be
initialized to a positive value.

empty_output_buffer (j_compress_ptr cinfo)
This is called whenever the buffer has filled (free_in_buffer
reaches zero). In typical
applications, it should write out the
entire buffer (use the saved start address and buffer length;
ignore the current state of next_output_byte and free_in_buffer).
Then reset the pointer & count to the start of the buffer, and
return TRUE indicating that the buffer has been dumped.
free_in_buffer must be set to a positive value when TRUE is
returned. A FALSE return should only be used when I/O suspension is
desired (this operating mode is discussed in the next section).

term_destination (j_compress_ptr cinfo)
Terminate destination --- called by jpeg_finish_compress() after all
data has been written. In most applications, this must flush any
data remaining in the buffer. Use either next_output_byte or
free_in_buffer to determine how much data is in the buffer.

term_destination() is NOT called by jpeg_abort() or jpeg_destroy(). If you
want the destination manager to be cleaned up during an abort, you must do it

yourself.

You will also need code to create a jpeg_destination_mgr
 struct, fill in its
method pointers, and insert a pointer to the struct into the "dest" field of
the JPEG compression object. This can be done in-line in your setup code if
you like, but it's probably cleaner to provide a separate routine similar to
the jpeg_stdio_dest() or jpeg_mem_dest() routines of the supplied destination
managers.

Decompression source managers follow a parallel design, but with some
additional frammishes. The source manager struct contains a pointer and count
defining the next byte to read from the work buffer and the number of bytes
remaining:

```
 const JOCTET * next_input_byte; /* => next byte to read from buffer */
 size_t bytes_in_buffer;         /* # of bytes remaining in buffer */
```

The library increments the pointer and decrements the count until the buffer
is emptied. The manager's fill_input_buffer method must reset the pointer and
count. In most applications, the manager must remember the buffer's starting
address and total size in private
 fields not visible to the library.

A data source manager provides five methods:

init_source (j_decompress_ptr cinfo)
 Initialize source. This is called by jpeg_read_header() before any
 data is actually read. Unlike init_destination(), it may leave
 bytes_in_buffer set to 0 (in which case a fill_input_buffer() call
 will occur immediately).

fill_input_buffer (j_decompress_ptr cinfo)
 This is called whenever bytes_in_buffer has reached zero and more
 data is wanted. In typical applications, it should read fresh data
 into the buffer (ignoring the current state of next_input_byte and
 bytes_in_buffer), reset the pointer & count to the start of the
 buffer, and return TRUE indicating that the buffer has been reloaded.
 It is not necessary to fill the buffer entirely, only to obtain at
 least one more byte. bytes_in_buffer MUST be set to a positive value
 if TRUE is returned. A FALSE return should only be used when I/O
 suspension is desired (this mode is discussed in the next section).

skip_input_data
 (j_decompress_ptr cinfo, long num_bytes)
 Skip num_bytes worth of data. The buffer pointer and count should
 be advanced over num_bytes input bytes, refilling the buffer as
 needed. This is used to skip over a potentially large amount of

uninteresting data (such as an APPn marker). In some applications
it may be possible to optimize away the reading of the skipped data,
but it's not clear that being smart is worth much trouble; large
skips are uncommon. bytes_in_buffer may be zero on return.
A zero or negative skip count should be treated as a no-op.

resync_to_restart (j_decompress_ptr cinfo, int desired)
This routine is called only when the decompressor has failed to find
a restart (RSTn) marker where one is expected. Its mission is to
find a suitable point for resuming decompression. For most
applications, we recommend that you just use the default resync
procedure, jpeg_resync_to_restart(). However, if you are able to back
up in the input
data stream, or if you have a-priori knowledge about
the likely location of restart markers, you may be able to do better.
Read the read_restart_marker() and jpeg_resync_to_restart() routines
in jdmarker.c if you think you'd like to implement your own resync
procedure.

term_source (j_decompress_ptr cinfo)
Terminate source --- called by jpeg_finish_decompress() after all
data has been read. Often a no-op.

For both fill_input_buffer() and skip_input_data(), there is no such thing
as an EOF return. If the end of the file has been reached, the routine has
a choice of exiting via ERREXIT() or inserting fake data into the buffer.
In most cases, generating a warning message and inserting a fake EOI marker
is the best course of action --- this will allow the decompressor to output
however much of the image is there. In pathological cases, the decompressor
may swallow the EOI and again demand data ... just keep feeding it fake EOIs.
jdatasrc.c illustrates the recommended error recovery
behavior.

term_source() is NOT called by jpeg_abort() or jpeg_destroy(). If you want
the source manager to be cleaned up during an abort, you must do it yourself.

You will also need code to create a jpeg_source_mgr struct, fill in its method
pointers, and insert a pointer to the struct into the "src" field of the JPEG
decompression object. This can be done in-line in your setup code if you
like, but it's probably cleaner to provide a separate routine similar to the
jpeg_stdio_src() or jpeg_mem_src() routines of the supplied source managers.

For more information, consult the memory and stdio source and destination
managers in jdatasrc.c and jdatadst.c.

I/O suspension

Some applications need to use the JPEG library as an incremental memory-to-memory filter: when the compressed data buffer is filled or emptied, they want control to return to the outer loop, rather than expecting that the buffer can be emptied or reloaded within the data source/destination manager subroutine.
The library supports this need by providing an "I/O suspension" mode, which we describe in this section.

The I/O suspension mode is not a panacea: nothing is guaranteed about the maximum amount of time spent in any one call to the library, so it will not eliminate response-time problems in single-threaded applications. If you need guaranteed response time, we suggest you "bite the bullet" and implement a real multi-tasking capability.

To use I/O suspension, cooperation is needed between the calling application and the data source or destination manager; you will always need a custom source/destination manager. (Please read the previous section if you haven't already.) The basic idea is that the empty_output_buffer() or fill_input_buffer() routine is a no-op, merely returning FALSE to indicate that it has done nothing. Upon seeing this, the JPEG library suspends operation and returns to its caller. The surrounding application is responsible for emptying or refilling the work buffer before calling the JPEG library again.

Compression suspension:

For compression suspension, use an empty_output_buffer() routine that returns FALSE; typically it will not do anything else. This will cause the compressor to return to the caller of jpeg_write_scanlines(), with the return value indicating that not all the supplied scanlines have been accepted. The application must make more room in the output buffer, adjust the output buffer pointer/count appropriately, and then call jpeg_write_scanlines() again, pointing to the first unconsumed scanline.

When forced to suspend, the compressor will backtrack to a convenient stopping point (usually the start of the current MCU); it will regenerate some output data when restarted. Therefore, although empty_output_buffer() is only called when the buffer is filled, you should NOT write out the entire buffer after a suspension. Write only the data up to the current position of next_output_byte/free_in_buffer. The data beyond that point will be regenerated after resumption.

Because of the backtracking behavior, a good-size output buffer is essential for efficiency; you don't want the compressor to suspend often. (In fact, an overly small buffer could lead to infinite looping, if a single MCU required

more data than would fit in the buffer.) We recommend a buffer of at least
several Kbytes. You may want to insert explicit code to ensure that you don't
call jpeg_write_scanlines() unless there is a reasonable amount of space in
the output buffer; in other words, flush the buffer before trying to compress
more data.

The compressor does not allow suspension while it is trying to write JPEG
markers at the beginning and end of the file. This means that:
 * At the beginning of a compression operation, there must be enough free
   space in the output buffer to hold the header markers (typically 600 or
   so bytes). The recommended buffer size is bigger than this anyway, so
   this is not a problem as
 long as you start with an empty buffer. However,
   this restriction might catch you if you insert large special markers, such
   as a JFIF thumbnail image, without flushing the buffer afterwards.
 * When you call jpeg_finish_compress(), there must be enough space in the
   output buffer to emit any buffered data and the final EOI marker. In the
   current implementation, half a dozen bytes should suffice for this, but
   for safety's sake we recommend ensuring that at least 100 bytes are free
   before calling jpeg_finish_compress().

A more significant restriction is that jpeg_finish_compress() cannot suspend.
This means you cannot use suspension with multi-pass operating modes, namely
Huffman code optimization and multiple-scan output. Those modes write the
whole file during jpeg_finish_compress(), which will certainly result in
buffer overrun. (Note that this restriction applies only to compression,
not decompression. The decompressor supports input suspension in all of
 its
operating modes.)

Decompression suspension:

For decompression suspension, use a fill_input_buffer() routine that simply
returns FALSE (except perhaps during error recovery, as discussed below).
This will cause the decompressor to return to its caller with an indication
that suspension has occurred. This can happen at four places:
 * jpeg_read_header(): will return JPEG_SUSPENDED.
 * jpeg_start_decompress(): will return FALSE, rather than its usual TRUE.
 * jpeg_read_scanlines(): will return the number of scanlines already
 completed (possibly 0).
 * jpeg_finish_decompress(): will return FALSE, rather than its usual TRUE.
The surrounding application must recognize these cases, load more data into
the input buffer, and repeat the call. In the case of jpeg_read_scanlines(),
increment the passed pointers past any scanlines successfully read.

Just as with compression, the decompressor will typically backtrack to a
convenient restart point before suspending. When fill_input_buffer()

is
called, next_input_byte/bytes_in_buffer point to the current restart point,
which is where the decompressor will backtrack to if FALSE is returned.
The data beyond that position must NOT be discarded if you suspend; it needs
to be re-read upon resumption. In most implementations, you'll need to shift
this data down to the start of your work buffer and then load more data after
it. Again, this behavior means that a several-Kbyte work buffer is essential
for decent performance; furthermore, you should load a reasonable amount of
new data before resuming decompression. (If you loaded, say, only one new
byte each time around, you could waste a LOT of cycles.)

The skip_input_data() source manager routine requires special care in a
suspension scenario. This routine is NOT granted the ability to suspend the
decompressor; it can decrement bytes_in_buffer to zero, but no more. If the
requested skip distance exceeds the amount of data currently in the input
buffer, then skip_input_data()
must set bytes_in_buffer to zero and record the
additional skip distance somewhere else. The decompressor will immediately
call fill_input_buffer(), which should return FALSE, which will cause a
suspension return. The surrounding application must then arrange to discard
the recorded number of bytes before it resumes loading the input buffer.
(Yes, this design is rather baroque, but it avoids complexity in the far more
common case where a non-suspending source manager is used.)

If the input data has been exhausted, we recommend that you emit a warning
and insert dummy EOI markers just as a non-suspending data source manager
would do. This can be handled either in the surrounding application logic or
within fill_input_buffer(); the latter is probably more efficient. If
fill_input_buffer() knows that no more data is available, it can set the
pointer/count to point to a dummy EOI marker and then return TRUE just as
though it had read more data in a non-suspending situation.

The
decompressor does not attempt to suspend within standard JPEG markers;
instead it will backtrack to the start of the marker and reprocess the whole
marker next time. Hence the input buffer must be large enough to hold the
longest standard marker in the file. Standard JPEG markers should normally
not exceed a few hundred bytes each (DHT tables are typically the longest).
We recommend at least a 2K buffer for performance reasons, which is much
larger than any correct marker is likely to be. For robustness against
damaged marker length counts, you may wish to insert a test in your
application for the case that the input buffer is completely full and yet
the decoder has suspended without consuming any data --- otherwise, if this
situation did occur, it would lead to an endless loop. (The library can't
provide this test since it has no idea whether "the buffer is full", or
even whether there is a fixed-size input buffer.)

The input buffer would need to be 64K to allow for arbitrary

COM or APPn
markers, but these are handled specially: they are either saved into allocated memory, or skipped over by calling skip_input_data(). In the former case, suspension is handled correctly, and in the latter case, the problem of buffer overrun is placed on skip_input_data's shoulders, as explained above. Note that if you provide your own marker handling routine for large markers, you should consider how to deal with buffer overflow.

Multiple-buffer management:

In some applications it is desirable to store the compressed data in a linked list of buffer areas, so as to avoid data copying. This can be handled by having empty_output_buffer() or fill_input_buffer() set the pointer and count to reference the next available buffer; FALSE is returned only if no more buffers are available. Although seemingly straightforward, there is a pitfall in this approach: the backtrack that occurs when FALSE is returned could back up into an earlier buffer. For example, when fill_input_buffer() is
called, the current pointer & count indicate the backtrack restart point. Since fill_input_buffer() will set the pointer and count to refer to a new buffer, the restart position must be saved somewhere else. Suppose a second call to fill_input_buffer() occurs in the same library call, and no additional input data is available, so fill_input_buffer must return FALSE. If the JPEG library has not moved the pointer/count forward in the current buffer, then *the correct restart point is the saved position in the prior buffer*. Prior buffers may be discarded only after the library establishes a restart point within a later buffer. Similar remarks apply for output into a chain of buffers.

The library will never attempt to backtrack over a skip_input_data() call, so any skipped data can be permanently discarded. You still have to deal with the case of skipping not-yet-received data, however.

It's much simpler to use only a single buffer; when fill_input_buffer() is called, move any
unconsumed data (beyond the current pointer/count) down to
the beginning of this buffer and then load new data into the remaining buffer space. This approach requires a little more data copying but is far easier to get right.

Progressive JPEG support

Progressive JPEG rearranges the stored data into a series of scans of increasing quality. In situations where a JPEG file is transmitted across a slow communications link, a decoder can generate a low-quality image very quickly from the first scan, then gradually improve the displayed quality as

more scans are received. The final image after all scans are complete is identical to that of a regular (sequential) JPEG file of the same quality setting. Progressive JPEG files are often slightly smaller than equivalent sequential JPEG files, but the possibility of incremental display is the main reason for using progressive JPEG.

The IJG encoder library generates progressive JPEG files when given a suitable "scan
 script" defining how to divide the data into scans.
Creation of progressive JPEG files is otherwise transparent to the encoder.
Progressive JPEG files can also be read transparently by the decoder library.
If the decoding application simply uses the library as defined above, it will receive a final decoded image without any indication that the file was progressive. Of course, this approach does not allow incremental display.
To perform incremental display, an application needs to use the decoder library's "buffered-image" mode, in which it receives a decoded image multiple times.

Each displayed scan requires about as much work to decode as a full JPEG image of the same size, so the decoder must be fairly fast in relation to the data transmission rate in order to make incremental display useful. However, it is possible to skip displaying the image and simply add the incoming bits to the decoder's coefficient buffer. This is fast because only Huffman decoding need be done, not IDCT,
 upsampling, colorspace conversion, etc.
The IJG decoder library allows the application to switch dynamically between displaying the image and simply absorbing the incoming bits. A properly coded application can automatically adapt the number of display passes to suit the time available as the image is received. Also, a final higher-quality display cycle can be performed from the buffered data after the end of the file is reached.

Progressive compression:

To create a progressive JPEG file (or a multiple-scan sequential JPEG file), set the scan_info cinfo field to point to an array of scan descriptors, and perform compression as usual. Instead of constructing your own scan list, you can call the jpeg_simple_progression() helper routine to create a recommended progression sequence; this method should be used by all applications that don't want to get involved in the nitty-gritty of progressive scan sequence design. (If you want to provide user control of scan sequences, you may
 wish to borrow the scan script reading code found
in rdswitch.c, so that you can read scan script files just like cjpeg's.)
When scan_info is not NULL, the compression library will store DCT'd data into a buffer array as jpeg_write_scanlines() is called, and will emit all the requested scans during jpeg_finish_compress(). This implies that multiple-scan output cannot be created with a suspending data destination

manager, since jpeg_finish_compress() does not support suspension. We should also note that the compressor currently forces Huffman optimization mode when creating a progressive JPEG file, because the default Huffman tables are unsuitable for progressive files.

Progressive decompression:

When buffered-image mode is not used, the decoder library will read all of a multi-scan file during jpeg_start_decompress(), so that it can provide a final decoded image. (Here "multi-scan" means either progressive or multi-scan sequential.) This makes multi-scan files transparent to the decoding
application. However, existing applications that used suspending input with version 5 of the IJG library will need to be modified to check for a suspension return from jpeg_start_decompress().

To perform incremental display, an application must use the library's buffered-image mode. This is described in the next section.

Buffered-image mode

In buffered-image mode, the library stores the partially decoded image in a coefficient buffer, from which it can be read out as many times as desired. This mode is typically used for incremental display of progressive JPEG files, but it can be used with any JPEG file. Each scan of a progressive JPEG file adds more data (more detail) to the buffered image. The application can display in lockstep with the source file (one display pass per input scan), or it can allow input processing to outrun display processing. By making input and display processing run independently, it is possible for the application to adapt
progressive display to a wide range of data transmission rates.

The basic control flow for buffered-image decoding is

```
jpeg_create_decompress()
set data source
jpeg_read_header()
set overall decompression parameters
cinfo.buffered_image = TRUE; /* select buffered-image mode */
jpeg_start_decompress()
for (each output pass) {
    adjust output decompression parameters if required
    jpeg_start_output()  /* start a new output pass */
    for (all scanlines in image) {
        jpeg_read_scanlines()
```

```
      display scanlines
    }
    jpeg_finish_output() /* terminate output pass */
  }
  jpeg_finish_decompress()
  jpeg_destroy_decompress()
```

This differs from ordinary unbuffered decoding in that there is an additional level of looping. The application can choose how many output passes to make and how to display each pass.

The simplest approach to displaying progressive images is to do one display pass for each scan appearing in the input file. In this case the outer loop condition

```
 is typically
 while (! jpeg_input_complete(&cinfo))
```

and the start-output call should read

```
 jpeg_start_output(&cinfo, cinfo.input_scan_number);
```

The second parameter to jpeg_start_output() indicates which scan of the input file is to be displayed; the scans are numbered starting at 1 for this purpose. (You can use a loop counter starting at 1 if you like, but using the library's input scan counter is easier.) The library automatically reads data as necessary to complete each requested scan, and jpeg_finish_output() advances to the next scan or end-of-image marker (hence input_scan_number will be incremented by the time control arrives back at jpeg_start_output()). With this technique, data is read from the input file only as needed, and input and output processing run in lockstep.

After reading the final scan and reaching the end of the input file, the buffered image remains available; it can be read additional times by repeating the jpeg_start_output()/jpeg_read_scanlines()/jpeg_finish_output() sequence.

For example, a useful technique is to use fast one-pass color quantization for display passes made while the image is arriving, followed by a final display pass using two-pass quantization for highest quality. This is done by changing the library parameters before the final output pass. Changing parameters between passes is discussed in detail below.

In general the last scan of a progressive file cannot be recognized as such until after it is read, so a post-input display pass is the best approach if you want special processing in the final pass.

When done with the image, be sure to call jpeg_finish_decompress() to release the buffered image (or just use jpeg_destroy_decompress()).

If input data arrives faster than it can be displayed, the application can cause the library to decode input data in advance of what's needed to produce output. This is done by calling the routine jpeg_consume_input().

The return value is one of the following:
 JPEG_REACHED_SOS:
    reached an SOS marker (the start of a new scan)
 JPEG_REACHED_EOI: reached the EOI marker (end of image)
 JPEG_ROW_COMPLETED: completed reading one MCU row of compressed data
 JPEG_SCAN_COMPLETED: completed reading last MCU row of current scan
 JPEG_SUSPENDED: suspended before completing any of the above
(JPEG_SUSPENDED can occur only if a suspending data source is used.) This
routine can be called at any time after initializing the JPEG object. It
reads some additional data and returns when one of the indicated significant
events occurs. (If called after the EOI marker is reached, it will
immediately return JPEG_REACHED_EOI without attempting to read more data.)

The library's output processing will automatically call jpeg_consume_input()
whenever the output processing overtakes the input; thus, simple lockstep
display requires no direct calls to jpeg_consume_input(). But by adding
calls to jpeg_consume_input(), you can absorb data in advance of what is
being displayed.
  This has two benefits:
 * You can limit buildup of unprocessed data in your input buffer.
 * You can eliminate extra display passes by paying attention to the
   state of the library's input processing.

The first of these benefits only requires interspersing calls to
jpeg_consume_input() with your display operations and any other processing
you may be doing. To avoid wasting cycles due to backtracking, it's best to
call jpeg_consume_input() only after a hundred or so new bytes have arrived.
This is discussed further under "I/O suspension", above. (Note: the JPEG
library currently is not thread-safe. You must not call jpeg_consume_input()
from one thread of control if a different library routine is working on the
same JPEG object in another thread.)

When input arrives fast enough that more than one new scan is available
before you start a new output pass, you may as well skip the output pass
corresponding to the completed scan. This occurs for free if you pass
cinfo.input_scan_number
 as the target scan number to jpeg_start_output().
The input_scan_number field is simply the index of the scan currently being
consumed by the input processor. You can ensure that this is up-to-date by
emptying the input buffer just before calling jpeg_start_output(): call
jpeg_consume_input() repeatedly until it returns JPEG_SUSPENDED or
JPEG_REACHED_EOI.

The target scan number passed to jpeg_start_output() is saved in the
cinfo.output_scan_number field. The library's output processing calls
jpeg_consume_input() whenever the current input scan number and row within
that scan is less than or equal to the current output scan number and row.
Thus, input processing can "get ahead" of the output processing but is not

allowed to "fall behind". You can achieve several different effects by manipulating this interlock rule. For example, if you pass a target scan number greater than the current input scan number, the output processor will wait until that scan starts to arrive
before producing any output. (To avoid
an infinite loop, the target scan number is automatically reset to the last scan number when the end of image is reached. Thus, if you specify a large target scan number, the library will just absorb the entire input file and then perform an output pass. This is effectively the same as what jpeg_start_decompress() does when you don't select buffered-image mode.) When you pass a target scan number equal to the current input scan number, the image is displayed no faster than the current input scan arrives. The final possibility is to pass a target scan number less than the current input scan number; this disables the input/output interlock and causes the output processor to simply display whatever it finds in the image buffer, without waiting for input. (However, the library will not accept a target scan number less than one, so you can't avoid waiting for the first scan.)

When data is arriving faster than the output display processing can
advance
through the image, jpeg_consume_input() will store data into the buffered image beyond the point at which the output processing is reading data out again. If the input arrives fast enough, it may "wrap around" the buffer to the point where the input is more than one whole scan ahead of the output. If the output processing simply proceeds through its display pass without paying attention to the input, the effect seen on-screen is that the lower part of the image is one or more scans better in quality than the upper part. Then, when the next output scan is started, you have a choice of what target scan number to use. The recommended choice is to use the current input scan number at that time, which implies that you've skipped the output scans corresponding to the input scans that were completed while you processed the previous output scan. In this way, the decoder automatically adapts its speed to the arriving data, by skipping output scans as necessary to keep up with the arriving
data.

When using this strategy, you'll want to be sure that you perform a final output pass after receiving all the data; otherwise your last display may not be full quality across the whole screen. So the right outer loop logic is something like this:

```
do {
    absorb any waiting input by calling jpeg_consume_input()
    final_pass = jpeg_input_complete(&cinfo);
    adjust output decompression parameters if required
    jpeg_start_output(&cinfo, cinfo.input_scan_number);
    ...
    jpeg_finish_output()
} while (! final_pass);
```

rather than quitting as soon as jpeg_input_complete() returns TRUE. This
arrangement makes it simple to use higher-quality decoding parameters
for the final pass. But if you don't want to use special parameters for
the final pass, the right loop logic is like this:

```
 for (;;) {
    absorb any waiting input by calling jpeg_consume_input()
    jpeg_start_output(&cinfo, cinfo.input_scan_number);
    ...
    jpeg_finish_output()
    if (jpeg_input_complete(&cinfo)
 &&
        cinfo.input_scan_number == cinfo.output_scan_number)
      break;
 }
```

In this case you don't need to know in advance whether an output pass is to
be the last one, so it's not necessary to have reached EOF before starting
the final output pass; rather, what you want to test is whether the output
pass was performed in sync with the final input scan. This form of the loop
will avoid an extra output pass whenever the decoder is able (or nearly able)
to keep up with the incoming data.

When the data transmission speed is high, you might begin a display pass,
then find that much or all of the file has arrived before you can complete
the pass. (You can detect this by noting the JPEG_REACHED_EOI return code
from jpeg_consume_input(), or equivalently by testing jpeg_input_complete().)
In this situation you may wish to abort the current display pass and start a
new one using the newly arrived information. To do so, just call
jpeg_finish_output() and then start
 a new pass with jpeg_start_output().

A variant strategy is to abort and restart display if more than one complete
scan arrives during an output pass; this can be detected by noting
JPEG_REACHED_SOS returns and/or examining cinfo.input_scan_number. This
idea should be employed with caution, however, since the display process
might never get to the bottom of the image before being aborted, resulting
in the lower part of the screen being several passes worse than the upper.
In most cases it's probably best to abort an output pass only if the whole
file has arrived and you want to begin the final output pass immediately.

When receiving data across a communication link, we recommend always using
the current input scan number for the output target scan number; if a
higher-quality final pass is to be done, it should be started (aborting any
incomplete output pass) as soon as the end of file is received. However,
many other strategies are possible. For example, the application can examine
the
 parameters of the current input scan and decide whether to display it or
not. If the scan contains only chroma data, one might choose not to use it
as the target scan, expecting that the scan will be small and will arrive

quickly. To skip to the next scan, call jpeg_consume_input() until it
returns JPEG_REACHED_SOS or JPEG_REACHED_EOI. Or just use the next higher
number as the target scan for jpeg_start_output(); but that method doesn't
let you inspect the next scan's parameters before deciding to display it.

In buffered-image mode, jpeg_start_decompress() never performs input and
thus never suspends. An application that uses input suspension with
buffered-image mode must be prepared for suspension returns from these
routines:
* jpeg_start_output() performs input only if you request 2-pass quantization
 and the target scan isn't fully read yet. (This is discussed below.)
* jpeg_read_scanlines(), as always, returns the number of scanlines that it
 was able to produce before
 suspending.
* jpeg_finish_output() will read any markers following the target scan,
 up to the end of the file or the SOS marker that begins another scan.
 (But it reads no input if jpeg_consume_input() has already reached the
 end of the file or a SOS marker beyond the target output scan.)
* jpeg_finish_decompress() will read until the end of file, and thus can
 suspend if the end hasn't already been reached (as can be tested by
 calling jpeg_input_complete()).
jpeg_start_output(), jpeg_finish_output(), and jpeg_finish_decompress()
all return TRUE if they completed their tasks, FALSE if they had to suspend.
In the event of a FALSE return, the application must load more input data
and repeat the call. Applications that use non-suspending data sources need
not check the return values of these three routines.

It is possible to change decoding parameters between output passes in the
buffered-image mode. The decoder library currently supports only very
limited changes of parameters.
  ONLY THE FOLLOWING parameter changes are
allowed after jpeg_start_decompress() is called:
* dct_method can be changed before each call to jpeg_start_output().
 For example, one could use a fast DCT method for early scans, changing
 to a higher quality method for the final scan.
* dither_mode can be changed before each call to jpeg_start_output();
 of course this has no impact if not using color quantization. Typically
 one would use ordered dither for initial passes, then switch to
 Floyd-Steinberg dither for the final pass. Caution: changing dither mode
 can cause more memory to be allocated by the library. Although the amount
 of memory involved is not large (a scanline or so), it may cause the
 initial max_memory_to_use specification to be exceeded, which in the worst
 case would result in an out-of-memory failure.
* do_block_smoothing can be changed before each call to jpeg_start_output().
 This setting is relevant only when decoding a progressive JPEG image.

During the first DC-only scan, block smoothing provides a very "fuzzy" look
instead of the very "blocky" look seen without it; which is better seems a
matter of personal taste. But block smoothing is nearly always a win
during later stages, especially when decoding a successive-approximation
image: smoothing helps to hide the slight blockiness that otherwise shows
up on smooth gradients until the lowest coefficient bits are sent.
* Color quantization mode can be changed under the rules described below.
You *cannot* change between full-color and quantized output (because that
would alter the required I/O buffer sizes), but you can change which
quantization method is used.

When generating color-quantized output, changing quantization method is a
very useful way of switching between high-speed and high-quality display.
The library allows you to change among its three quantization methods:
1. Single-pass quantization to a fixed color cube.
Selected by cinfo.two_pass_quantize
= FALSE and cinfo.colormap = NULL.
2. Single-pass quantization to an application-supplied colormap.
Selected by setting cinfo.colormap to point to the colormap (the value of
two_pass_quantize is ignored); also set cinfo.actual_number_of_colors.
3. Two-pass quantization to a colormap chosen specifically for the image.
Selected by cinfo.two_pass_quantize = TRUE and cinfo.colormap = NULL.
(This is the default setting selected by jpeg_read_header, but it is
probably NOT what you want for the first pass of progressive display!)
These methods offer successively better quality and lesser speed. However,
only the first method is available for quantizing in non-RGB color spaces.

IMPORTANT: because the different quantizer methods have very different
working-storage requirements, the library requires you to indicate which
one(s) you intend to use before you call jpeg_start_decompress(). (If we did
not require this, the max_memory_to_use setting would be a complete fiction.)
You
do this by setting one or more of these three cinfo fields to TRUE:
enable_1pass_quant Fixed color cube colormap
enable_external_quant Externally-supplied colormap
enable_2pass_quant Two-pass custom colormap
All three are initialized FALSE by jpeg_read_header(). But
jpeg_start_decompress() automatically sets TRUE the one selected by the
current two_pass_quantize and colormap settings, so you only need to set the
enable flags for any other quantization methods you plan to change to later.

After setting the enable flags correctly at jpeg_start_decompress() time, you
can change to any enabled quantization method by setting two_pass_quantize
and colormap properly just before calling jpeg_start_output(). The following
special rules apply:
1. You must explicitly set cinfo.colormap to NULL when switching to 1-pass
or 2-pass mode from a different mode, or when you want the 2-pass
quantizer to be re-run to generate a new colormap.

2. To switch to an external colormap, or to
change to a different external
colormap than was used on the prior pass, you must call
jpeg_new_colormap() after setting cinfo.colormap.
NOTE: if you want to use the same colormap as was used in the prior pass,
you should not do either of these things. This will save some nontrivial
switchover costs.
(These requirements exist because cinfo.colormap will always be non-NULL
after completing a prior output pass, since both the 1-pass and 2-pass
quantizers set it to point to their output colormaps. Thus you have to
do one of these two things to notify the library that something has changed.
Yup, it's a bit klugy, but it's necessary to do it this way for backwards
compatibility.)

Note that in buffered-image mode, the library generates any requested colormap
during jpeg_start_output(), not during jpeg_start_decompress().

When using two-pass quantization, jpeg_start_output() makes a pass over the
buffered image to determine the optimum color map; it therefore may take a
significant
amount of time, whereas ordinarily it does little work. The
progress monitor hook is called during this pass, if defined. It is also
important to realize that if the specified target scan number is greater than
or equal to the current input scan number, jpeg_start_output() will attempt
to consume input as it makes this pass. If you use a suspending data source,
you need to check for a FALSE return from jpeg_start_output() under these
conditions. The combination of 2-pass quantization and a not-yet-fully-read
target scan is the only case in which jpeg_start_output() will consume input.

Application authors who support buffered-image mode may be tempted to use it
for all JPEG images, even single-scan ones. This will work, but it is
inefficient: there is no need to create an image-sized coefficient buffer for
single-scan images. Requesting buffered-image mode for such an image wastes
memory. Worse, it can cost time on large images, since the buffered data has
to be swapped out or
written to a temporary file. If you are concerned about
maximum performance on baseline JPEG files, you should use buffered-image
mode only when the incoming file actually has multiple scans. This can be
tested by calling jpeg_has_multiple_scans(), which will return a correct
result at any time after jpeg_read_header() completes.

It is also worth noting that when you use jpeg_consume_input() to let input
processing get ahead of output processing, the resulting pattern of access to
the coefficient buffer is quite nonsequential. It's best to use the memory
manager jmemnobs.c if you can (ie, if you have enough real or virtual main
memory). If not, at least make sure that max_memory_to_use is set as high as
possible. If the JPEG memory manager has to use a temporary file, you will

probably see a lot of disk traffic and poor performance. (This could be improved with additional work on the memory manager, but we haven't gotten around to it yet.)

In some applications it may be convenient to use jpeg_consume_input() for all input processing, including reading the initial markers; that is, you may wish to call jpeg_consume_input() instead of jpeg_read_header() during startup. This works, but note that you must check for JPEG_REACHED_SOS and JPEG_REACHED_EOI return codes as the equivalent of jpeg_read_header's codes. Once the first SOS marker has been reached, you must call jpeg_start_decompress() before jpeg_consume_input() will consume more input; it'll just keep returning JPEG_REACHED_SOS until you do. If you read a tables-only file this way, jpeg_consume_input() will return JPEG_REACHED_EOI without ever returning JPEG_REACHED_SOS; be sure to check for this case. If this happens, the decompressor will not read any more input until you call jpeg_abort() to reset it. It is OK to call jpeg_consume_input() even when not using buffered-image mode, but in that case it's basically a no-op after the initial markers have been read: it will just return JPEG_SUSPENDED.

Abbreviated datastreams and multiple images

A JPEG compression or decompression object can be reused to process multiple images. This saves a small amount of time per image by eliminating the "create" and "destroy" operations, but that isn't the real purpose of the feature. Rather, reuse of an object provides support for abbreviated JPEG datastreams. Object reuse can also simplify processing a series of images in a single input or output file. This section explains these features.

A JPEG file normally contains several hundred bytes worth of quantization and Huffman tables. In a situation where many images will be stored or transmitted with identical tables, this may represent an annoying overhead. The JPEG standard therefore permits tables to be omitted. The standard defines three classes of JPEG datastreams:

* "Interchange" datastreams contain an image and all tables needed to decode the image. These are the usual kind of JPEG file.
* "Abbreviated image" datastreams contain an image, but are missing some or all of the tables needed to decode that image.
* "Abbreviated table specification" (henceforth "tables-only") datastreams contain only table specifications.

To decode an abbreviated image, it is necessary to load the missing table(s) into the decoder beforehand. This can be accomplished by reading a separate tables-only file. A variant scheme uses a series of images in which the first image is an interchange (complete) datastream, while subsequent ones are

abbreviated and rely on the tables loaded by the first image. It is assumed that once the decoder has read a table, it will remember that table until a new definition for the same table number is encountered.

It is the application designer's responsibility to figure out how to associate the correct tables with an abbreviated image. While abbreviated datastreams can be useful in a closed environment, their use is strongly discouraged in any situation where data exchange with other applications might be needed. Caveat designer.

The JPEG library provides support for reading and writing any combination of tables-only datastreams and abbreviated images. In both compression and decompression objects, a quantization or Huffman table will be retained for the lifetime of the object, unless it is overwritten by a new table definition.

To create abbreviated image datastreams, it is only necessary to tell the compressor not to emit some or all of the tables it is using. Each quantization and Huffman table struct contains a boolean field "sent_table", which normally is initialized to FALSE. For each table used by the image, the header-writing process emits the table and sets sent_table = TRUE unless it is already TRUE. (In normal usage, this prevents outputting the same table definition multiple times, as would otherwise occur because the chroma components typically share tables.) Thus, setting this field to TRUE before calling jpeg_start_compress() will prevent the table from being written at all.

If you want to create a "pure" abbreviated image file containing no tables, just call "jpeg_suppress_tables(&cinfo, TRUE)" after constructing all the tables. If you want to emit some but not all tables, you'll need to set the individual sent_table fields directly.

To create an abbreviated image, you must also call jpeg_start_compress() with a second parameter of FALSE, not TRUE. Otherwise jpeg_start_compress() will force all the sent_table fields to FALSE. (This is a safety feature to prevent abbreviated images from being created accidentally.)

To create a tables-only file, perform the same parameter setup that you normally would, but instead of calling jpeg_start_compress() and so on, call jpeg_write_tables(&cinfo). This will write an abbreviated datastream containing only SOI, DQT and/or DHT markers, and EOI. All the quantization and Huffman tables that are currently defined in the compression object will be emitted unless their sent_tables flag is already TRUE, and then all the sent_tables flags will be set TRUE.

A sure-fire way to create matching tables-only and abbreviated image files
is to proceed as follows:

```
create JPEG compression object
set JPEG parameters
set destination to tables-only file
jpeg_write_tables(&cinfo);
set destination to image file
jpeg_start_compress(&cinfo, FALSE);
write data...
jpeg_finish_compress(&cinfo);
```

Since the JPEG parameters are not altered between writing the table file and
the abbreviated image file, the same tables are sure to be used. Of course,
you can repeat the jpeg_start_compress() ... jpeg_finish_compress() sequence
many times to produce many abbreviated image files matching the table file.

You cannot suppress output of the computed Huffman tables when Huffman
optimization is selected. (If you could, there'd be no way to decode the
image...) Generally, you don't want to set optimize_coding = TRUE when
you are trying to
produce abbreviated files.

In some cases you might want to compress an image using tables which are
not stored in the application, but are defined in an interchange or
tables-only file readable by the application. This can be done by setting up
a JPEG decompression object to read the specification file, then copying the
tables into your compression object. See jpeg_copy_critical_parameters()
for an example of copying quantization tables.

To read abbreviated image files, you simply need to load the proper tables
into the decompression object before trying to read the abbreviated image.
If the proper tables are stored in the application program, you can just
allocate the table structs and fill in their contents directly. For example,
to load a fixed quantization table into table slot "n":

```
  if (cinfo.quant_tbl_ptrs[n] == NULL)
    cinfo.quant_tbl_ptrs[n] = jpeg_alloc_quant_table((j_common_ptr) &cinfo);
  quant_ptr = cinfo.quant_tbl_ptrs[n]; /* quant_ptr is JQUANT_TBL* */

  for (i = 0; i < 64; i++) {
    /* Qtable[] is desired quantization table, in natural array order */
    quant_ptr->quantval[i] = Qtable[i];
  }
```

Code to load a fixed Huffman table is typically (for AC table "n"):

```
  if (cinfo.ac_huff_tbl_ptrs[n] == NULL)
    cinfo.ac_huff_tbl_ptrs[n] = jpeg_alloc_huff_table((j_common_ptr) &cinfo);
  huff_ptr = cinfo.ac_huff_tbl_ptrs[n]; /* huff_ptr is JHUFF_TBL* */
  for (i = 1; i <= 16; i++) {
    /* counts[i] is number of Huffman codes of length i bits, i=1..16 */
    huff_ptr->bits[i] = counts[i];
  }
  for (i = 0; i < 256; i++) {
    /* symbols[] is the list of Huffman symbols, in code-length order */
    huff_ptr->huffval[i] = symbols[i];
  }
```

(Note that trying to set cinfo.quant_tbl_ptrs[n] to point directly at a
constant JQUANT_TBL object is not safe. If the incoming file happened to
contain a quantization table definition, your master table would get
overwritten! Instead allocate a working table copy and copy the
 master table
into it, as illustrated above. Ditto for Huffman tables, of course.)

You might want to read the tables from a tables-only file, rather than
hard-wiring them into your application. The jpeg_read_header() call is
sufficient to read a tables-only file. You must pass a second parameter of
FALSE to indicate that you do not require an image to be present. Thus, the
typical scenario is

```
 create JPEG decompression object
 set source to tables-only file
 jpeg_read_header(&cinfo, FALSE);
 set source to abbreviated image file
 jpeg_read_header(&cinfo, TRUE);
 set decompression parameters
 jpeg_start_decompress(&cinfo);
 read data...
 jpeg_finish_decompress(&cinfo);
```

In some cases, you may want to read a file without knowing whether it contains
an image or just tables. In that case, pass FALSE and check the return value
from jpeg_read_header(): it will be JPEG_HEADER_OK if an image was found,
JPEG_HEADER_TABLES_ONLY if only tables were found. (A third return value,
JPEG_SUSPENDED,
 is possible when using a suspending data source manager.)
Note that jpeg_read_header() will not complain if you read an abbreviated
image for which you haven't loaded the missing tables; the missing-table check
occurs later, in jpeg_start_decompress().

It is possible to read a series of images from a single source file by
repeating the jpeg_read_header() ... jpeg_finish_decompress() sequence,

without releasing/recreating the JPEG object or the data source module.
(If you did reinitialize, any partial bufferload left in the data source
buffer at the end of one image would be discarded, causing you to lose the
start of the next image.) When you use this method, stored tables are
automatically carried forward, so some of the images can be abbreviated images
that depend on tables from earlier images.

If you intend to write a series of images into a single destination file,
you might want to make a specialized data destination module that doesn't
flush the output buffer at term_destination()
 time. This would speed things
up by some trifling amount. Of course, you'd need to remember to flush the
buffer after the last image. You can make the later images be abbreviated
ones by passing FALSE to jpeg_start_compress().

Special markers

Some applications may need to insert or extract special data in the JPEG
datastream. The JPEG standard provides marker types "COM" (comment) and
"APP0" through "APP15" (application) to hold application-specific data.
Unfortunately, the use of these markers is not specified by the standard.
COM markers are fairly widely used to hold user-supplied text. The JFIF file
format spec uses APP0 markers with specified initial strings to hold certain
data. Adobe applications use APP14 markers beginning with the string "Adobe"
for miscellaneous data. Other APPn markers are rarely seen, but might
contain almost anything.

If you wish to store user-supplied text, we recommend you use COM markers
and place readable 7-bit ASCII
 text in them. Newline conventions are not
standardized --- expect to find LF (Unix style), CR/LF (DOS style), or CR
(Mac style). A robust COM reader should be able to cope with random binary
garbage, including nulls, since some applications generate COM markers
containing non-ASCII junk. (But yours should not be one of them.)

For program-supplied data, use an APPn marker, and be sure to begin it with an
identifying string so that you can tell whether the marker is actually yours.
It's probably best to avoid using APP0 or APP14 for any private markers.
(NOTE: the upcoming SPIFF standard will use APP8 markers; we recommend you
not use APP8 markers for any private purposes, either.)

Keep in mind that at most 65533 bytes can be put into one marker, but you
can have as many markers as you like.

By default, the IJG compression library will write a JFIF APP0 marker if the
selected JPEG colorspace is grayscale or YCbCr, or an Adobe APP14 marker if

the selected colorspace is RGB, CMYK,
or YCCK. You can disable this, but
we don't recommend it. The decompression library will recognize JFIF and
Adobe markers and will set the JPEG colorspace properly when one is found.

You can write special markers immediately following the datastream header by
calling jpeg_write_marker() after jpeg_start_compress() and before the first
call to jpeg_write_scanlines(). When you do this, the markers appear after
the SOI and the JFIF APP0 and Adobe APP14 markers (if written), but before
all else. Specify the marker type parameter as "JPEG_COM" for COM or
"JPEG_APP0 + n" for APPn. (Actually, jpeg_write_marker will let you write
any marker type, but we don't recommend writing any other kinds of marker.)
For example, to write a user comment string pointed to by comment_text:
jpeg_write_marker(cinfo, JPEG_COM, comment_text, strlen(comment_text));

If it's not convenient to store all the marker data in memory at once,
you can instead call jpeg_write_m_header() followed by multiple calls
to
jpeg_write_m_byte(). If you do it this way, it's your responsibility to
call jpeg_write_m_byte() exactly the number of times given in the length
parameter to jpeg_write_m_header(). (This method lets you empty the
output buffer partway through a marker, which might be important when
using a suspending data destination module. In any case, if you are using
a suspending destination, you should flush its buffer after inserting
any special markers. See "I/O suspension".)

Or, if you prefer to synthesize the marker byte sequence yourself,
you can just cram it straight into the data destination module.

If you are writing JFIF 1.02 extension markers (thumbnail images), don't
forget to set cinfo.JFIF_minor_version = 2 so that the encoder will write the
correct JFIF version number in the JFIF header marker. The library's default
is to write version 1.01, but that's wrong if you insert any 1.02 extension
markers. (We could probably get away with just defaulting to 1.02, but there
used
to be broken decoders that would complain about unknown minor version
numbers. To reduce compatibility risks it's safest not to write 1.02 unless
you are actually using 1.02 extensions.)

When reading, two methods of handling special markers are available:
1. You can ask the library to save the contents of COM and/or APPn markers
into memory, and then examine them at your leisure afterwards.
2. You can supply your own routine to process COM and/or APPn markers
on-the-fly as they are read.
The first method is simpler to use, especially if you are using a suspending
data source; writing a marker processor that copes with input suspension is

not easy (consider what happens if the marker is longer than your available
input buffer). However, the second method conserves memory since the marker
data need not be kept around after it's been processed.

For either method, you'd normally set up marker handling after creating a
decompression object and before calling jpeg_read_header(), because
 the
markers of interest will typically be near the head of the file and so will
be scanned by jpeg_read_header. Once you've established a marker handling
method, it will be used for the life of that decompression object
(potentially many datastreams), unless you change it. Marker handling is
determined separately for COM markers and for each APPn marker code.

To save the contents of special markers in memory, call
 jpeg_save_markers(cinfo, marker_code, length_limit)
where marker_code is the marker type to save, JPEG_COM or JPEG_APP0+n.
(To arrange to save all the special marker types, you need to call this
routine 17 times, for COM and APP0-APP15.) If the incoming marker is longer
than length_limit data bytes, only length_limit bytes will be saved; this
parameter allows you to avoid chewing up memory when you only need to see the
first few bytes of a potentially large marker. If you want to save all the
data, set length_limit to 0xFFFF; that is enough since marker lengths are only
16
 bits. As a special case, setting length_limit to 0 prevents that marker
type from being saved at all. (That is the default behavior, in fact.)

After jpeg_read_header() completes, you can examine the special markers by
following the cinfo->marker_list pointer chain. All the special markers in
the file appear in this list, in order of their occurrence in the file (but
omitting any markers of types you didn't ask for). Both the original data
length and the saved data length are recorded for each list entry; the latter
will not exceed length_limit for the particular marker type. Note that these
lengths exclude the marker length word, whereas the stored representation
within the JPEG file includes it. (Hence the maximum data length is really
only 65533.)

It is possible that additional special markers appear in the file beyond the
SOS marker at which jpeg_read_header stops; if so, the marker list will be
extended during reading of the rest of the file. This is not expected to
 be
common, however. If you are short on memory you may want to reset the length
limit to zero for all marker types after finishing jpeg_read_header, to
ensure that the max_memory_to_use setting cannot be exceeded due to addition
of later markers.

The marker list remains stored until you call jpeg_finish_decompress or
jpeg_abort, at which point the memory is freed and the list is set to empty.

(jpeg_destroy also releases the storage, of course.)

Note that the library is internally interested in APP0 and APP14 markers;
if you try to set a small nonzero length limit on these types, the library
will silently force the length up to the minimum it wants. (But you can set
a zero length limit to prevent them from being saved at all.) Also, in a
16-bit environment, the maximum length limit may be constrained to less than
65533 by malloc() limitations. It is therefore best not to assume that the
effective length limit is exactly what you set it to be.

If you want to supply your own marker-reading
routine, you do it by calling
jpeg_set_marker_processor(). A marker processor routine must have the
signature
boolean jpeg_marker_parser_method (j_decompress_ptr cinfo)
Although the marker code is not explicitly passed, the routine can find it
in cinfo->unread_marker. At the time of call, the marker proper has been
read from the data source module. The processor routine is responsible for
reading the marker length word and the remaining parameter bytes, if any.
Return TRUE to indicate success. (FALSE should be returned only if you are
using a suspending data source and it tells you to suspend. See the standard
marker processors in jdmarker.c for appropriate coding methods if you need to
use a suspending data source.)

If you override the default APP0 or APP14 processors, it is up to you to
recognize JFIF and Adobe markers if you want colorspace recognition to occur
properly. We recommend copying and extending the default processors if you
want to do that. (A better idea
is to save these marker types for later
examination by calling jpeg_save_markers(); that method doesn't interfere
with the library's own processing of these markers.)

jpeg_set_marker_processor() and jpeg_save_markers() are mutually exclusive
--- if you call one it overrides any previous call to the other, for the
particular marker type specified.

A simple example of an external COM processor can be found in djpeg.c.
Also, see jpegtran.c for an example of using jpeg_save_markers.

Raw (downsampled) image data

Some applications need to supply already-downsampled image data to the JPEG
compressor, or to receive raw downsampled data from the decompressor. The
library supports this requirement by allowing the application to write or
read raw data, bypassing the normal preprocessing or postprocessing steps.

The interface is different from the standard one and is somewhat harder to use. If your interest is merely in bypassing color conversion, we recommend that you use the standard interface and simply set jpeg_color_space = in_color_space (or jpeg_color_space = out_color_space for decompression). The mechanism described in this section is necessary only to supply or receive downsampled image data, in which not all components have the same dimensions.

To compress raw data, you must supply the data in the colorspace to be used in the JPEG file (please read the earlier section on Special color spaces) and downsampled to the sampling factors specified in the JPEG parameters. You must supply the data in the format used internally by the JPEG library, namely a JSAMPIMAGE array. This is an array of pointers to two-dimensional arrays, each of type JSAMPARRAY. Each 2-D array holds the values for one color component. This structure is necessary since the components are of different sizes. If the image dimensions are not a multiple of the MCU size, you must also pad the data correctly (usually, this is done by replicating the last column and/or row). The data must be padded to a multiple of a DCT block in each component: that is, each downsampled row must contain a multiple of 8 valid samples, and there must be a multiple of 8 sample rows for each component. (For applications such as conversion of digital TV images, the standard image size is usually a multiple of the DCT block size, so that no padding need actually be done.)

The procedure for compression of raw data is basically the same as normal compression, except that you call jpeg_write_raw_data() in place of jpeg_write_scanlines(). Before calling jpeg_start_compress(), you must do the following:

* Set cinfo->raw_data_in to TRUE. (It is set FALSE by jpeg_set_defaults().) This notifies the library that you will be supplying raw data.
* Ensure jpeg_color_space is correct --- an explicit jpeg_set_colorspace() call is a good idea. Note that since color conversion is bypassed, in_color_space is ignored, except that jpeg_set_defaults() uses it to choose the default jpeg_color_space setting.
* Ensure the sampling factors, cinfo->comp_info[i].h_samp_factor and cinfo->comp_info[i].v_samp_factor, are correct. Since these indicate the dimensions of the data you are supplying, it's wise to set them explicitly, rather than assuming the library's defaults are what you want.

To pass raw data to the library, call jpeg_write_raw_data() in place of jpeg_write_scanlines(). The two routines work similarly except that jpeg_write_raw_data takes a JSAMPIMAGE data array rather than JSAMPARRAY. The scanlines count passed to and returned from jpeg_write_raw_data is measured in terms of the component with the largest v_samp_factor.

jpeg_write_raw_data() processes one MCU row per call, which is to say
v_samp_factor*DCTSIZE sample rows of each component. The passed num_lines
value must be at least max_v_samp_factor*DCTSIZE, and the return value will
be exactly that amount (or possibly some multiple of that amount, in future
library
versions). This is true even on the last call at the bottom of the
image; don't forget to pad your data as necessary.

The required dimensions of the supplied data can be computed for each
component as
cinfo->comp_info[i].width_in_blocks*DCTSIZE samples per row
cinfo->comp_info[i].height_in_blocks*DCTSIZE rows in image
after jpeg_start_compress() has initialized those fields. If the valid data
is smaller than this, it must be padded appropriately. For some sampling
factors and image sizes, additional dummy DCT blocks are inserted to make
the image a multiple of the MCU dimensions. The library creates such dummy
blocks itself; it does not read them from your supplied data. Therefore you
need never pad by more than DCTSIZE samples. An example may help here.
Assume 2h2v downsampling of YCbCr data, that is
cinfo->comp_info[0].h_samp_factor = 2 for Y
cinfo->comp_info[0].v_samp_factor = 2
cinfo->comp_info[1].h_samp_factor = 1 for Cb
cinfo->comp_info[1].v_samp_factor = 1
cinfo->comp_info[2].h_samp_factor
= 1 for Cr
cinfo->comp_info[2].v_samp_factor = 1
and suppose that the nominal image dimensions (cinfo->image_width and
cinfo->image_height) are 101x101 pixels. Then jpeg_start_compress() will
compute downsampled_width = 101 and width_in_blocks = 13 for Y,
downsampled_width = 51 and width_in_blocks = 7 for Cb and Cr (and the same
for the height fields). You must pad the Y data to at least 13*8 = 104
columns and rows, the Cb/Cr data to at least 7*8 = 56 columns and rows. The
MCU height is max_v_samp_factor = 2 DCT rows so you must pass at least 16
scanlines on each call to jpeg_write_raw_data(), which is to say 16 actual
sample rows of Y and 8 each of Cb and Cr. A total of 7 MCU rows are needed,
so you must pass a total of 7*16 = 112 "scanlines". The last DCT block row
of Y data is dummy, so it doesn't matter what you pass for it in the data
arrays, but the scanlines count must total up to 112 so that all of the Cb
and Cr data gets passed.

Output
suspension is supported with raw-data compression: if the data
destination module suspends, jpeg_write_raw_data() will return 0.
In this case the same data rows must be passed again on the next call.

Decompression with raw data output implies bypassing all postprocessing:
you cannot ask for rescaling or color quantization, for instance. More

seriously, you must deal with the color space and sampling factors present in the incoming file. If your application only handles, say, 2h1v YCbCr data, you must check for and fail on other color spaces or other sampling factors. The library will not convert to a different color space for you.

To obtain raw data output, set cinfo->raw_data_out = TRUE before jpeg_start_decompress() (it is set FALSE by jpeg_read_header()). Be sure to verify that the color space and sampling factors are ones you can handle. Then call jpeg_read_raw_data() in place of jpeg_read_scanlines(). The decompression process is otherwise the same as usual.

jpeg_read_raw_data()
returns one MCU row per call, and thus you must pass a buffer of at least max_v_samp_factor*DCTSIZE scanlines (scanline counting is the same as for raw-data compression). The buffer you pass must be large enough to hold the actual data plus padding to DCT-block boundaries. As with compression, any entirely dummy DCT blocks are not processed so you need not allocate space for them, but the total scanline count includes them. The above example of computing buffer dimensions for raw-data compression is equally valid for decompression.

Input suspension is supported with raw-data decompression: if the data source module suspends, jpeg_read_raw_data() will return 0. You can also use buffered-image mode to read raw data in multiple passes.

Really raw data: DCT coefficients

It is possible to read or write the contents of a JPEG file as raw DCT coefficients. This facility is mainly intended for use in lossless transcoding between different JPEG
file formats. Other possible applications include lossless cropping of a JPEG image, lossless reassembly of a multi-strip or multi-tile TIFF/JPEG file into a single JPEG datastream, etc.

To read the contents of a JPEG file as DCT coefficients, open the file and do jpeg_read_header() as usual. But instead of calling jpeg_start_decompress() and jpeg_read_scanlines(), call jpeg_read_coefficients(). This will read the entire image into a set of virtual coefficient-block arrays, one array per component. The return value is a pointer to an array of virtual-array descriptors. Each virtual array can be accessed directly using the JPEG memory manager's access_virt_barray method (see Memory management, below, and also read structure.txt's discussion of virtual array handling). Or, for simple transcoding to a different JPEG file format, the array list can just be handed directly to jpeg_write_coefficients().

Each block in the block arrays contains quantized coefficient values in

normal array
 order (not JPEG zigzag order). The block arrays contain only
DCT blocks containing real data; any entirely-dummy blocks added to fill out
interleaved MCUs at the right or bottom edges of the image are discarded
during reading and are not stored in the block arrays. (The size of each
block array can be determined from the width_in_blocks and height_in_blocks
fields of the component's comp_info entry.) This is also the data format
expected by jpeg_write_coefficients().

When you are done using the virtual arrays, call jpeg_finish_decompress()
to release the array storage and return the decompression object to an idle
state; or just call jpeg_destroy() if you don't need to reuse the object.

If you use a suspending data source, jpeg_read_coefficients() will return
NULL if it is forced to suspend; a non-NULL return value indicates successful
completion. You need not test for a NULL return value when using a
non-suspending data source.

It is also possible to call jpeg_read_coefficients()
 to obtain access to the
decoder's coefficient arrays during a normal decode cycle in buffered-image
mode. This frammish might be useful for progressively displaying an incoming
image and then re-encoding it without loss. To do this, decode in buffered-
image mode as discussed previously, then call jpeg_read_coefficients() after
the last jpeg_finish_output() call. The arrays will be available for your use
until you call jpeg_finish_decompress().

To write the contents of a JPEG file as DCT coefficients, you must provide
the DCT coefficients stored in virtual block arrays. You can either pass
block arrays read from an input JPEG file by jpeg_read_coefficients(), or
allocate virtual arrays from the JPEG compression object and fill them
yourself. In either case, jpeg_write_coefficients() is substituted for
jpeg_start_compress() and jpeg_write_scanlines(). Thus the sequence is
 * Create compression object
 * Set all compression parameters as necessary
 * Request virtual arrays
 if needed
 * jpeg_write_coefficients()
 * jpeg_finish_compress()
 * Destroy or re-use compression object
jpeg_write_coefficients() is passed a pointer to an array of virtual block
array descriptors; the number of arrays is equal to cinfo.num_components.

The virtual arrays need only have been requested, not realized, before
jpeg_write_coefficients() is called. A side-effect of
jpeg_write_coefficients() is to realize any virtual arrays that have been
requested from the compression object's memory manager. Thus, when obtaining

the virtual arrays from the compression object, you should fill the arrays
after calling jpeg_write_coefficients(). The data is actually written out
when you call jpeg_finish_compress(); jpeg_write_coefficients() only writes
the file header.

When writing raw DCT coefficients, it is crucial that the JPEG quantization
tables and sampling factors match the way the data was encoded, or the
resulting file will be invalid. For transcoding from an existing JPEG
file,
we recommend using jpeg_copy_critical_parameters(). This routine initializes
all the compression parameters to default values (like jpeg_set_defaults()),
then copies the critical information from a source decompression object.
The decompression object should have just been used to read the entire
JPEG input file --- that is, it should be awaiting jpeg_finish_decompress().

jpeg_write_coefficients() marks all tables stored in the compression object
as needing to be written to the output file (thus, it acts like
jpeg_start_compress(cinfo, TRUE)). This is for safety's sake, to avoid
emitting abbreviated JPEG files by accident. If you really want to emit an
abbreviated JPEG file, call jpeg_suppress_tables(), or set the tables'
individual sent_table flags, between calling jpeg_write_coefficients() and
jpeg_finish_compress().

Progress monitoring

Some applications may need to regain control from the JPEG library every so
often. The typical use of this feature
is to produce a percent-done bar or
other progress display. (For a simple example, see cjpeg.c or djpeg.c.)
Although you do get control back frequently during the data-transferring pass
(the jpeg_read_scanlines or jpeg_write_scanlines loop), any additional passes
will occur inside jpeg_finish_compress or jpeg_start_decompress; those
routines may take a long time to execute, and you don't get control back
until they are done.

You can define a progress-monitor routine which will be called periodically
by the library. No guarantees are made about how often this call will occur,
so we don't recommend you use it for mouse tracking or anything like that.
At present, a call will occur once per MCU row, scanline, or sample row
group, whichever unit is convenient for the current processing mode; so the
wider the image, the longer the time between calls. During the data
transferring pass, only one call occurs per call of jpeg_read_scanlines or
jpeg_write_scanlines, so don't pass a large number
of scanlines at once if
you want fine resolution in the progress count. (If you really need to use
the callback mechanism for time-critical tasks like mouse tracking, you could

insert additional calls inside some of the library's inner loops.)

To establish a progress-monitor callback, create a struct jpeg_progress_mgr,
fill in its progress_monitor field with a pointer to your callback routine,
and set cinfo->progress to point to the struct. The callback will be called
whenever cinfo->progress is non-NULL. (This pointer is set to NULL by
jpeg_create_compress or jpeg_create_decompress; the library will not change
it thereafter. So if you allocate dynamic storage for the progress struct,
make sure it will live as long as the JPEG object does. Allocating from the
JPEG memory manager with lifetime JPOOL_PERMANENT will work nicely.) You
can use the same callback routine for both compression and decompression.

The jpeg_progress_mgr struct contains four fields which are set by the
library:

```
long pass_counter; /* work units completed in this pass */
long pass_limit; /* total number of work units in this pass */
int completed_passes; /* passes completed so far */
int total_passes; /* total number of passes expected */
```

During any one pass, pass_counter increases from 0 up to (not including)
pass_limit; the step size is usually but not necessarily 1. The pass_limit
value may change from one pass to another. The expected total number of
passes is in total_passes, and the number of passes already completed is in
completed_passes. Thus the fraction of work completed may be estimated as

```
  completed_passes + (pass_counter/pass_limit)
 -----------------------------------------
    total_passes
```

ignoring the fact that the passes may not be equal amounts of work.

When decompressing, pass_limit can even change within a pass, because it
depends on the number of scans in the JPEG file, which isn't always known in
advance. The computed fraction-of-work-done may jump
suddenly (if the library
discovers it has overestimated the number of scans) or even decrease (in the
opposite case). It is not wise to put great faith in the work estimate.

When using the decompressor's buffered-image mode, the progress monitor work
estimate is likely to be completely unhelpful, because the library has no way
to know how many output passes will be demanded of it. Currently, the library
sets total_passes based on the assumption that there will be one more output
pass if the input file end hasn't yet been read (jpeg_input_complete() isn't
TRUE), but no more output passes if the file end has been reached when the
output pass is started. This means that total_passes will rise as additional
output passes are requested. If you have a way of determining the input file
size, estimating progress based on the fraction of the file that's been read
will probably be more useful than using the library's value.

Memory management

This section covers some key
facts about the JPEG library's built-in memory
manager. For more info, please read structure.txt's section about the memory
manager, and consult the source code if necessary.

All memory and temporary file allocation within the library is done via the
memory manager. If necessary, you can replace the "back end" of the memory
manager to control allocation yourself (for example, if you don't want the
library to use malloc() and free() for some reason).

Some data is allocated "permanently" and will not be freed until the JPEG
object is destroyed. Most data is allocated "per image" and is freed by
jpeg_finish_compress, jpeg_finish_decompress, or jpeg_abort. You can call the
memory manager yourself to allocate structures that will automatically be
freed at these times. Typical code for this is
ptr = (*cinfo->mem->alloc_small) ((j_common_ptr) cinfo, JPOOL_IMAGE, size);
Use JPOOL_PERMANENT to get storage that lasts as long as the JPEG object.
Use alloc_large instead of alloc_small for
anything bigger than a few Kbytes.
There are also alloc_sarray and alloc_barray routines that automatically
build 2-D sample or block arrays.

The library's minimum space requirements to process an image depend on the
image's width, but not on its height, because the library ordinarily works
with "strip" buffers that are as wide as the image but just a few rows high.
Some operating modes (eg, two-pass color quantization) require full-image
buffers. Such buffers are treated as "virtual arrays": only the current strip
need be in memory, and the rest can be swapped out to a temporary file.

If you use the simplest memory manager back end (jmemnobs.c), then no
temporary files are used; virtual arrays are simply malloc()'d. Images bigger
than memory can be processed only if your system supports virtual memory.
The other memory manager back ends support temporary files of various flavors
and thus work in machines without virtual memory. They may also be useful on
Unix machines if you need
to process images that exceed available swap space.

When using temporary files, the library will make the in-memory buffers for
its virtual arrays just big enough to stay within a "maximum memory" setting.
Your application can set this limit by setting cinfo->mem->max_memory_to_use
after creating the JPEG object. (Of course, there is still a minimum size for
the buffers, so the max-memory setting is effective only if it is bigger than
the minimum space needed.) If you allocate any large structures yourself, you
must allocate them before jpeg_start_compress() or jpeg_start_decompress() in
order to have them counted against the max memory limit. Also keep in mind
that space allocated with alloc_small() is ignored, on the assumption that

it's too small to be worth worrying about; so a reasonable safety margin
should be left when setting max_memory_to_use.

If you use the jmemname.c or jmemdos.c memory manager back end, it is
important to clean up the JPEG object properly to ensure
 that the temporary
files get deleted. (This is especially crucial with jmemdos.c, where the
"temporary files" may be extended-memory segments; if they are not freed,
DOS will require a reboot to recover the memory.) Thus, with these memory
managers, it's a good idea to provide a signal handler that will trap any
early exit from your program. The handler should call either jpeg_abort()
or jpeg_destroy() for any active JPEG objects. A handler is not needed with
jmemnobs.c, and shouldn't be necessary with jmemansi.c or jmemmac.c either,
since the C library is supposed to take care of deleting files made with
tmpfile().

Memory usage

Working memory requirements while performing compression or decompression
depend on image dimensions, image characteristics (such as colorspace and
JPEG process), and operating mode (application-selected options).

As of v6b, the decompressor requires:
1. About 24K in more-or-less-fixed-size data. This varies a bit depending
   on operating
 mode and image characteristics (particularly color vs.
   grayscale), but it doesn't depend on image dimensions.
2. Strip buffers (of size proportional to the image width) for IDCT and
   upsampling results. The worst case for commonly used sampling factors
   is about 34 bytes * width in pixels for a color image. A grayscale image
   only needs about 8 bytes per pixel column.
3. A full-image DCT coefficient buffer is needed to decode a multi-scan JPEG
   file (including progressive JPEGs), or whenever you select buffered-image
   mode. This takes 2 bytes/coefficient. At typical 2x2 sampling, that's
   3 bytes per pixel for a color image. Worst case (1x1 sampling) requires
   6 bytes/pixel. For grayscale, figure 2 bytes/pixel.
4. To perform 2-pass color quantization, the decompressor also needs a
   128K color lookup table and a full-image pixel buffer (3 bytes/pixel).
This does not count any memory allocated by the application, such as a
buffer to hold the final
 output image.

The above figures are valid for 8-bit JPEG data precision and a machine with
32-bit ints. For 12-bit JPEG data, double the size of the strip buffers and
quantization pixel buffer. The "fixed-size" data will be somewhat smaller
with 16-bit ints, larger with 64-bit ints. Also, CMYK or other unusual

color spaces will require different amounts of space.

The full-image coefficient and pixel buffers, if needed at all, do not
have to be fully RAM resident; you can have the library use temporary
files instead when the total memory usage would exceed a limit you set.
(But if your OS supports virtual memory, it's probably better to just use
jmemnobs and let the OS do the swapping.)

The compressor's memory requirements are similar, except that it has no need
for color quantization. Also, it needs a full-image DCT coefficient buffer
if Huffman-table optimization is asked for, even if progressive mode is not
requested.

If you need more detailed information about memory usage in
 a particular
situation, you can enable the MEM_STATS code in jmemmgr.c.

Library compile-time options

A number of compile-time options are available by modifying jmorecfg.h.

The JPEG standard provides for both the baseline 8-bit DCT process and
a 12-bit DCT process. The IJG code supports 12-bit lossy JPEG if you define
BITS_IN_JSAMPLE as 12 rather than 8. Note that this causes JSAMPLE to be
larger than a char, so it affects the surrounding application's image data.
The sample applications cjpeg and djpeg can support 12-bit mode only for PPM
and GIF file formats; you must disable the other file formats to compile a
12-bit cjpeg or djpeg. (install.txt has more information about that.)
At present, a 12-bit library can handle *only* 12-bit images, not both
precisions. (If you need to include both 8- and 12-bit libraries in a single
application, you could probably do it by defining NEED_SHORT_EXTERNAL_NAMES
for just one of the copies. You'd have to access
 the 8-bit and 12-bit copies
from separate application source files. This is untested ... if you try it,
we'd like to hear whether it works!)

Note that a 12-bit library always compresses in Huffman optimization mode,
in order to generate valid Huffman tables. This is necessary because our
default Huffman tables only cover 8-bit data. If you need to output 12-bit
files in one pass, you'll have to supply suitable default Huffman tables.
You may also want to supply your own DCT quantization tables; the existing
quality-scaling code has been developed for 8-bit use, and probably doesn't
generate especially good tables for 12-bit.

The maximum number of components (color channels) in the image is determined
by MAX_COMPONENTS. The JPEG standard allows up to 255 components, but we

expect that few applications will need more than four or so.

On machines with unusual data type sizes, you may be able to improve
performance or reduce memory space by tweaking the various typedefs in
jmorecfg.h.
  In particular, on some RISC CPUs, access to arrays of "short"s
is quite slow; consider trading memory for speed by making JCOEF, INT16, and
UINT16 be "int" or "unsigned int". UINT8 is also a candidate to become int.
You probably don't want to make JSAMPLE be int unless you have lots of memory
to burn.

You can reduce the size of the library by compiling out various optional
functions. To do this, undefine xxx_SUPPORTED symbols as necessary.

You can also save a few K by not having text error messages in the library;
the standard error message table occupies about 5Kb. This is particularly
reasonable for embedded applications where there's no good way to display
a message anyway. To do this, remove the creation of the message table
(jpeg_std_message_table[]) from jerror.c, and alter format_message to do
something reasonable without it. You could output the numeric value of the
message code number, for example. If you do this, you can also save a couple
more K by modifying
 the TRACEMSn() macros in jerror.h to expand to nothing;
you don't need trace capability anyway, right?

Portability considerations

The JPEG library has been written to be extremely portable; the sample
applications cjpeg and djpeg are slightly less so. This section summarizes
the design goals in this area. (If you encounter any bugs that cause the
library to be less portable than is claimed here, we'd appreciate hearing
about them.)

The code works fine on ANSI C, C++, and pre-ANSI C compilers, using any of
the popular system include file setups, and some not-so-popular ones too.
See install.txt for configuration procedures.

The code is not dependent on the exact sizes of the C data types. As
distributed, we make the assumptions that
 char is at least 8 bits wide
 short is at least 16 bits wide
 int is at least 16 bits wide
 long is at least 32 bits wide
(These are the minimum requirements of the ANSI C standard.) Wider types will
work fine, although

memory may be used inefficiently if char is much larger
than 8 bits or short is much bigger than 16 bits. The code should work
equally well with 16- or 32-bit ints.

In a system where these assumptions are not met, you may be able to make the
code work by modifying the typedefs in jmorecfg.h. However, you will probably
have difficulty if int is less than 16 bits wide, since references to plain
int abound in the code.

char can be either signed or unsigned, although the code runs faster if an
unsigned char type is available. If char is wider than 8 bits, you will need
to redefine JOCTET and/or provide custom data source/destination managers so
that JOCTET represents exactly 8 bits of data on external storage.

The JPEG library proper does not assume ASCII representation of characters.
But some of the image file I/O modules in cjpeg/djpeg do have ASCII
dependencies in file-header manipulation; so does cjpeg's select_file_type()
routine.

The JPEG library does not rely heavily on the C
library. In particular, C
stdio is used only by the data source/destination modules and the error
handler, all of which are application-replaceable. (cjpeg/djpeg are more
heavily dependent on stdio.) malloc and free are called only from the memory
manager "back end" module, so you can use a different memory allocator by
replacing that one file.

The code generally assumes that C names must be unique in the first 15
characters. However, global function names can be made unique in the
first 6 characters by defining NEED_SHORT_EXTERNAL_NAMES.

More info about porting the code may be gleaned by reading jconfig.txt,
jmorecfg.h, and jinclude.h.

Notes for MS-DOS implementors

The IJG code is designed to work efficiently in 80x86 "small" or "medium"
memory models (i.e., data pointers are 16 bits unless explicitly declared
"far"; code pointers can be either size). You may be able to use small
model to compile cjpeg or djpeg by itself, but you will probably
have to use
medium model for any larger application. This won't make much difference in
performance. You *will* take a noticeable performance hit if you use a
large-data memory model (perhaps 10%-25%), and you should avoid "huge" model
if at all possible.

The JPEG library typically needs 2Kb-3Kb of stack space. It will also
malloc about 20K-30K of near heap space while executing (and lots of far
heap, but that doesn't count in this calculation). This figure will vary
depending on selected operating mode, and to a lesser extent on image size.
There is also about 5Kb-6Kb of constant data which will be allocated in the
near data segment (about 4Kb of this is the error message table).
Thus you have perhaps 20K available for other modules' static data and near
heap space before you need to go to a larger memory model. The C library's
static data will account for several K of this, but that still leaves a good
deal for your needs. (If you are tight on space, you could reduce the sizes
of
 the I/O buffers allocated by jdatasrc.c and jdatadst.c, say from 4K to
1K. Another possibility is to move the error message table to far memory;
this should be doable with only localized hacking on jerror.c.)

About 2K of the near heap space is "permanent" memory that will not be
released until you destroy the JPEG object. This is only an issue if you
save a JPEG object between compression or decompression operations.

Far data space may also be a tight resource when you are dealing with large
images. The most memory-intensive case is decompression with two-pass color
quantization, or single-pass quantization to an externally supplied color
map. This requires a 128Kb color lookup table plus strip buffers amounting
to about 40 bytes per column for typical sampling ratios (eg, about 25600
bytes for a 640-pixel-wide image). You may not be able to process wide
images if you have large data structures of your own.

Of course, all of these concerns vanish if you use a 32-bit flat-memory-model
compiler,
 such as DJGPP or Watcom C. We highly recommend flat model if you
can use it; the JPEG library is significantly faster in flat model.

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/libjpeg.txt
No license file was found, but licenses were detected in source scan.

/*
* jdapimin.c
*
* Copyright (C) 1994-1998, Thomas G. Lane.
* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains application interface code for the decompression half
* of the JPEG library. These are the "minimum" API routines that may be
* needed in either the normal full-decompression case or the
* transcoding-only case.

*
* Most of the routines intended to be called directly by an application
* are in this file or in jdapistd.c. But also see jcomapi.c for routines
* shared by compression and decompression, and jdtrans.c for the transcoding
* case.
*/

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/jdapimin.c
No license file was found, but licenses were detected in source scan.

/*
* jidctflt.c
*
* Copyright (C) 1994-1998, Thomas G. Lane.
* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains a floating-point implementation of the
* inverse DCT (Discrete Cosine Transform). In the IJG code, this routine
* must also perform dequantization of the input coefficients.
*
* This implementation should be more accurate than either of the integer
* IDCT implementations. However, it may not give the same results on all
* machines because of differences in roundoff behavior. Speed will depend
* on the hardware's floating point capacity.
*
* A 2-D IDCT can be done by 1-D IDCT on each column followed by 1-D IDCT
* on each row (or vice versa, but it's more convenient to emit a row at
* a time). Direct algorithms are also available, but they are much more
* complex and seem not to
 be any faster when reduced to code.
*
* This implementation is based on Arai, Agui, and Nakajima's algorithm for
* scaled DCT. Their original paper (Trans. IEICE E-71(11):1095) is in
* Japanese, but the algorithm is described in the Pennebaker & Mitchell
* JPEG textbook (see REFERENCES section in file README). The following code
* is based directly on figure 4-8 in P&M.
* While an 8-point DCT cannot be done in less than 11 multiplies, it is
* possible to arrange the computation so that many of the multiplies are
* simple scalings of the final outputs. These multiplies can then be
* folded into the multiplications or divisions by the JPEG quantization
* table entries. The AA&N method leaves only 5 multiplies and 29 adds
* to be done in the DCT itself.
* The primary disadvantage of this method is that with a fixed-point
* implementation, accuracy is lost due to imprecise representation of the
* scaled quantization values. However, that problem does not arise if

```
* we
 use floating point arithmetic.
*/
```

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/jidctflt.c
No license file was found, but licenses were detected in source scan.

```
/*
* jsimd.h
*
* Copyright 2009 Pierre Ossman <ossman@cendio.se> for Cendio AB
* Copyright 2011 D. R. Commander
*
* Based on the x86 SIMD extension for IJG JPEG library,
* Copyright (C) 1999-2006, MIYASAKA Masaru.
* For conditions of distribution and use, see copyright notice in jsimdext.inc
*
*/
```

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/jsimd.h
No license file was found, but licenses were detected in source scan.

```
/*
* jdatasrc.c
*
* This file was part of the Independent JPEG Group's software:
* Copyright (C) 1994-1996, Thomas G. Lane.
* Modified 2009-2011 by Guido Vollbeding.
* Modifications:
* Copyright (C) 2013, D. R. Commander.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains decompression data source routines for the case of
* reading JPEG data from memory or from a file (or any stdio stream).
* While these routines are sufficient for most applications,
* some will want to use a different source manager.
* IMPORTANT: we assume that fread() will correctly transcribe an array of
* JOCTETs from 8-bit-wide elements on external storage.  If char is wider
* than 8 bits on your machine, you may need to do some tweaking.
*/
```

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/jdatasrc.c

No license file was found, but licenses were detected in source scan.

```
/*
* jsimd_i386.c
*
* Copyright 2009 Pierre Ossman <ossman@cendio.se> for Cendio AB
* Copyright 2009-2011 D. R. Commander
*
* Based on the x86 SIMD extension for IJG JPEG library,
* Copyright (C) 1999-2006, MIYASAKA Masaru.
* For conditions of distribution and use, see copyright notice in jsimdext.inc
*
* This file contains the interface between the "normal" portions
* of the library and the SIMD implementations when running on a
* 32-bit x86 architecture.
*/
```

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/simd/jsimd_i386.c
No license file was found, but licenses were detected in source scan.

```
/*
* cjpeg.c
*
* This file was part of the Independent JPEG Group's software:
* Copyright (C) 1991-1998, Thomas G. Lane.
* Modified 2003-2011 by Guido Vollbeding.
* Modifications:
* Copyright (C) 2010, 2013, D. R. Commander.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains a command-line user interface for the JPEG compressor.
* It should work on any system with Unix- or MS-DOS-style command lines.
*
* Two different command line styles are permitted, depending on the
* compile-time switch TWO_FILE_COMMANDLINE:
* cjpeg [options]  inputfile outputfile
* cjpeg [options]  [inputfile]
* In the second style, output is always to standard output, which you'd
* normally redirect to a file or pipe to some other program.  Input is
* either from a named file or from standard input (typically redirected).
* The second style is convenient on Unix but is unhelpful
 on systems that
* don't support pipes.  Also, you MUST use the first style if your system
* doesn't do binary I/O to stdin/stdout.
* To simplify script writing, the "-outfile" switch is provided.  The syntax
* cjpeg [options]  -outfile outputfile  inputfile
```

* works regardless of which command line style is used.
*/

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/cjpeg.c
No license file was found, but licenses were detected in source scan.

License: IJG

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo.spec
No license file was found, but licenses were detected in source scan.

/*
* rdrle.c
*
* Copyright (C) 1991-1996, Thomas G. Lane.
* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains routines to read input images in Utah RLE format.
* The Utah Raster Toolkit library is required (version 3.1 or later).
*
* These routines may need modification for non-Unix environments or
* specialized applications. As they stand, they assume input from
* an ordinary stdio stream. They further assume that reading begins
* at the start of the file; start_input may need work if the
* user interface has already read some data (e.g., to determine that
* the file is indeed RLE format).
*
* Based on code contributed by Mike Lijewski,
* with updates from Robert Hutchinson.
*/

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/rdrle.c
No license file was found, but licenses were detected in source scan.

/*
* rdgif.c
*
* Copyright (C) 1991-1997, Thomas G. Lane.
* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains routines to read input images in GIF format.

```
*
**********************************************************************
* NOTE: to avoid entanglements with Unisys' patent on LZW compression,      *
* the ability to read GIF files has been removed from the IJG distribution. *
* Sorry about that.                                                         *
**********************************************************************
*
* We are required to state that
*    "The Graphics Interchange Format(c) is the Copyright property of
*    CompuServe Incorporated. GIF(sm) is a Service Mark property of
*    CompuServe Incorporated."
*/
```

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/rdgif.c
No license file was found, but licenses were detected in source scan.

```
/*
* jdatadst.c
*
* This file was part of the Independent JPEG Group's software:
* Copyright (C) 1994-1996, Thomas G. Lane.
* Modified 2009-2012 by Guido Vollbeding.
* Modifications:
* Copyright (C) 2013, D. R. Commander.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains compression data destination routines for the case of
* emitting JPEG data to memory or to a file (or any stdio stream).
* While these routines are sufficient for most applications,
* some will want to use a different destination manager.
* IMPORTANT: we assume that fwrite() will correctly transcribe an array of
* JOCTETs into 8-bit-wide elements on external storage.  If char is wider
* than 8 bits on your machine, you may need to do some tweaking.
*/
```

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/jdatadst.c
No license file was found, but licenses were detected in source scan.

```
/*
* jctrans.c
*
* Copyright (C) 1995-1998, Thomas G. Lane.
* Modified 2000-2009 by Guido Vollbeding.
* This file is part of the Independent JPEG Group's software.
```

* For conditions of distribution and use, see the accompanying README file.
*
* This file contains library routines for transcoding compression,
* that is, writing raw DCT coefficient arrays to an output JPEG file.
* The routines in jcapimin.c will also be needed by a transcoder.
*/

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/jctrans.c
No license file was found, but licenses were detected in source scan.

/*
* jidctint.c
*
* Copyright (C) 1991-1998, Thomas G. Lane.
* Modification developed 2002-2009 by Guido Vollbeding.
* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains a slow-but-accurate integer implementation of the
* inverse DCT (Discrete Cosine Transform). In the IJG code, this routine
* must also perform dequantization of the input coefficients.
*
* A 2-D IDCT can be done by 1-D IDCT on each column followed by 1-D IDCT
* on each row (or vice versa, but it's more convenient to emit a row at
* a time). Direct algorithms are also available, but they are much more
* complex and seem not to be any faster when reduced to code.
*
* This implementation is based on an algorithm described in
*   C. Loeffler, A. Ligtenberg and G. Moschytz, "Practical Fast 1-D DCT
*   Algorithms with 11 Multiplications",
 Proc. Int'l. Conf. on Acoustics,
*   Speech, and Signal Processing 1989 (ICASSP '89), pp. 988-991.
* The primary algorithm described there uses 11 multiplies and 29 adds.
* We use their alternate method with 12 multiplies and 32 adds.
* The advantage of this method is that no data path contains more than one
* multiplication; this allows a very simple and accurate implementation in
* scaled fixed-point arithmetic, with a minimal number of shifts.
*
* We also provide IDCT routines with various output sample block sizes for
* direct resolution reduction or enlargement without additional resampling:
* NxN (N=1...16) pixels for one 8x8 input DCT block.
*
* For N<8 we simply take the corresponding low-frequency coefficients of
* the 8x8 input DCT block and apply an NxN point IDCT on the sub-block
* to yield the downscaled outputs.
* This can be seen as direct low-pass downsampling from the DCT domain

* point of view rather than the usual spatial domain point of view,
* yielding significant computational savings and results at least
* as good as common bilinear (averaging) spatial downsampling.
*
* For N>8 we apply a partial NxN IDCT on the 8 input coefficients as
* lower frequencies and higher frequencies assumed to be zero.
* It turns out that the computational effort is similar to the 8x8 IDCT
* regarding the output size.
* Furthermore, the scaling and descaling is the same for all IDCT sizes.
*
* CAUTION: We rely on the FIX() macro except for the N=1,2,4,8 cases
* since there would be too many additional constants to pre-calculate.
*/

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/jidctint.c
No license file was found, but licenses were detected in source scan.

/*
* jcarith.c
*
* Developed 1997-2009 by Guido Vollbeding.
* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains portable arithmetic entropy encoding routines for JPEG
* (implementing the ISO/IEC IS 10918-1 and CCITT Recommendation ITU-T T.81).
*
* Both sequential and progressive modes are supported in this single module.
*
* Suspension is not currently supported in this module.
*/

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/jcarith.c
No license file was found, but licenses were detected in source scan.

/*
* rdcolmap.c
*
* Copyright (C) 1994-1996, Thomas G. Lane.
* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.
*
* This file implements djpeg's "-map file" switch. It reads a source image
* and constructs a colormap to be supplied to the JPEG decompressor.

```
*
* Currently, these file formats are supported for the map file:
*   GIF: the contents of the GIF's global colormap are used.
*   PPM (either text or raw flavor): the entire file is read and
*      each unique pixel value is entered in the map.
* Note that reading a large PPM file will be horrendously slow.
* Typically, a PPM-format map file should contain just one pixel
* of each desired color.  Such a file can be extracted from an
* ordinary image PPM file with ppmtomap(1).
*
* Rescaling a PPM that has a maxval unequal to MAXJSAMPLE is not
* currently implemented.
 */
/* Portions of this code are based on the PBMPLUS library, which is:
**
** Copyright (C) 1988 by Jef Poskanzer.
**
** Permission to use, copy, modify, and distribute this software and its
** documentation for any purpose and without fee is hereby granted, provided
** that the above copyright notice appear in all copies and that both that
** copyright notice and this permission notice appear in supporting
** documentation.  This software is provided "as is" without express or
** implied warranty.
*/
```

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/rdcolmap.c
No license file was found, but licenses were detected in source scan.

libjpeg-turbo note: This image was extracted from the 8-bit nightshot_iso_100
image. The original can be downloaded at the link below.

The New Image Compression Test Set - Jan 2008
http://www.imagecompression.info/test_images

The images historically used for compression research (lena, barbra, pepper etc...) have outlived their useful life and its about time they become a part of history only. They are too small, come from data sources too old and are available in only 8-bit precision.

These images have been carefully selected to aid in image compression algorithm research and evaluation. These are photographic images chosen to come from a wide variety of sources and each one picked to stress different aspects of algorithms. Images are available in 8-bit, 16-bit and 16-bit linear variations, RGB and gray.

Images are available without any prohibitive copyright restrictions.

These images are (c) there respective

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1. The origin of the pictures must not be misrepresented; you must not claim that you took the original pictures. If you use, publish or redistribute them, an acknowledgment would be appreciated but is not required.
2. Altered versions must be plainly marked as such, and must not be misinterpreted as being the originals.
3. No payment is required for distribution this material, it must be available freely under the conditions stated here. That is, it is prohibited to sell the material.
4. This notice may not be removed or altered from any distribution.

Acknowledgments: A lot of people contributed a lot of time and effort in making this test set possible. Thanks to everyone who voiced their opinion in any of the discussions online. Thanks to Axel Becker, Thomas Richter and Niels Frhling for their extensive help in picking images, running all the various tests etc... Thanks to Pete Fraser, Tony
Story, Wayne J. Cosshall, David Coffin, Bruce Lindbloom and raw.fotosite.pl for the images which make up this set.

Sachin Garg [India]
sachingarg@c10n.info

www.sachingarg.com | www.c10n.info | www.imagecompression.info

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/testimages/nightshot_iso_100.txt
No license file was found, but licenses were detected in source scan.

; For conditions of distribution and use, see copyright notice in jsimdext.inc

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/simd/jimmxred.asm
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/simd/jdclrss2-64.asm
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* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/simd/jdmermmx.asm
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* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/simd/jcqntsse.asm
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/simd/jiss2red-64.asm
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/simd/jf3dnflt.asm

* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/simd/jcgryss2.asm
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/simd/jcsamss2-64.asm
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* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/simd/jccolss2.asm
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/simd/jdsamss2.asm
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/simd/jcqnts2i.asm
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/simd/jcgryss2-64.asm
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/simd/jisseflt.asm
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* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/simd/jfsseflt.asm
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/simd/jccolss2-64.asm
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* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/simd/jdmerss2.asm
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/simd/jcgrymmx.asm
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/simd/jcgrass2.asm
*
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* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/simd/jiss2red.asm
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/simd/jcqnts2f-64.asm
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/simd/jdmrgmmx.asm
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*
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* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/simd/jcclrss2-64.asm
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/simd/jcqnts2i-64.asm
*
/libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/simd/jcclrmmx.asm
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/simd/jdclrmmx.asm
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/simd/ji3dnflt.asm
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/simd/jdcolss2-64.asm
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/simd/jcgrass2-64.asm
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/simd/jdcolmmx.asm
No license file was found, but licenses were detected in source scan.

```
/*
* jdcoefct.c
*
* This file was part of the Independent JPEG Group's software:
* Copyright (C) 1994-1997, Thomas G. Lane.
* Modifications:
* Copyright (C) 2010, D. R. Commander.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains the coefficient buffer controller for decompression.
```

* This controller is the top level of the JPEG decompressor proper.
* The coefficient buffer lies between entropy decoding and inverse-DCT steps.
*
* In buffered-image mode, this controller is the interface between
* input-oriented processing and output-oriented processing.
* Also, the input side (only) is used when reading a file for transcoding.
*/

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/jdcoefct.c
No license file was found, but licenses were detected in source scan.

1.2.90 (1.3 beta1)
==========

[1] Added support for additional scaling factors (3/8, 5/8, 3/4, 7/8, 9/8, 5/4, 11/8, 3/2, 13/8, 7/4, 15/8, and 2) when decompressing. Note that the IDCT will not be SIMD-accelerated when using any of these new scaling factors.

[2] The TurboJPEG dynamic library is now versioned. It was not strictly necessary to do so, because TurboJPEG uses versioned symbols, and if a function changes in an ABI-incompatible way, that function is renamed and a legacy function is provided to maintain backward compatibility. However, certain Linux distro maintainers will blindly reject any library that is not versioned, so this was an attempt to make them happy.

[3] Extended the TurboJPEG Java API so that it can be used to compress a JPEG image from and decompress a JPEG image to an arbitrary position in a large image buffer.

[4] The tjDecompressToYUV() function now supports the TJFLAG_FASTDCT flag.

[5] The 32-bit supplementary package for amd64 Debian systems now provides symlinks in /usr/lib/i386-linux-gnu for the TurboJPEG libraries in /usr/lib32. This allows those libraries to be used on MultiArch-compatible systems (such as Ubuntu 11 and later) without setting the linker path.

[6] The TurboJPEG Java wrapper should now find the JNI library on Mac systems without having to pass -Djava.library.path=/usr/lib to java.

[7] TJBench has been ported to Java to provide a convenient way of validating the performance of the TurboJPEG Java API. It can be run with 'java -cp turbojpeg.jar TJBench'.

[8] cjpeg can now be used to generate JPEG files with the RGB colorspace (feature ported from jpeg-8d.)

[9] The width and height in the -crop argument passed to jpegtran can now be suffixed with "f" to indicate that, when the upper left corner of the cropping region is automatically moved to the nearest iMCU boundary, the bottom right corner should be moved by the same amount. In other words, this feature causes jpegtran to strictly honor the specified width/height rather than the specified bottom right corner (feature ported from jpeg-8d.)

[10] JPEG files using the RGB colorspace can now be decompressed into grayscale images (feature ported from jpeg-8d.)

[11] Fixed a regression caused by 1.2.1[7] whereby the build would fail with multiple "Mismatch in operand sizes" errors when attempting to build the x86 SIMD code with NASM 0.98.

[12] The in-memory source/destination managers (jpeg_mem_src() and jpeg_mem_dest()) are now included by default when building libjpeg-turbo with libjpeg v6b or v7 emulation, so that programs can take advantage of these functions without requiring the use of the backward-incompatible libjpeg v8 ABI. The "age number" of the libjpeg-turbo library on Un*x systems has been incremented by 1 to reflect this. You can disable this feature with a configure/CMake switch in order to retain strict API/ABI compatibility with the libjpeg v6b or v7 API/ABI (or with previous versions of libjpeg-turbo.) See README-turbo.txt for more details.

[13] Added ARM v7s architecture to libjpeg.a and libturbojpeg.a in the official libjpeg-turbo binary package for OS X, so that those libraries can be used to build applications that leverage the faster CPUs in the iPhone 5 and iPad 4.

1.2.1
=====

[1] Creating or decoding a JPEG file that uses the RGB colorspace should now properly work when the input or output colorspace is one of the libjpeg-turbo colorspace extensions.

[2] When libjpeg-turbo was built without SIMD support and merged (non-fancy) upsampling was used along with an alpha-enabled colorspace during decompression, the unused byte of the decompressed pixels was not being set to 0xFF. This has been fixed. TJUnitTest has also been extended to test for the correct behavior of the colorspace extensions when merged upsampling is used.

[3] Fixed a bug whereby the libjpeg-turbo SSE2 SIMD code would not preserve the upper 64 bits

of xmm6 and xmm7 on Win64 platforms, which violated the Win64
calling conventions.

[4] Fixed a regression caused by 1.2.0[6] whereby decompressing corrupt JPEG
images (specifically, images in which the component count was erroneously set
to a large value) would cause libjpeg-turbo to segfault.

[5] Worked around a severe performance issue with "Bobcat" (AMD Embedded APU)
processors. The MASKMOVDQU instruction, which was used by the libjpeg-turbo
SSE2 SIMD code, is apparently implemented in microcode on AMD processors, and
it is painfully slow on Bobcat processors in particular. Eliminating the use
of this instruction improved performance by an order of magnitude on Bobcat
processors and by a small amount (typically 5%) on AMD desktop processors.

[6] Added SIMD acceleration for performing 4:2:2 upsampling on NEON-capable ARM
platforms. This speeds up the decompression of 4:2:2 JPEGs by 20-25% on such
platforms.

[7] Fixed a regression caused by 1.2.0[2] whereby, on Linux/x86 platforms
running
the 32-bit SSE2 SIMD code in libjpeg-turbo, decompressing a 4:2:0 or
4:2:2 JPEG image into a 32-bit (RGBX, BGRX, etc.) buffer without using fancy
upsampling would produce several incorrect columns of pixels at the right-hand
side of the output image if each row in the output image was not evenly
divisible by 16 bytes.

[8] Fixed an issue whereby attempting to build the SIMD extensions with Xcode
4.3 on OS X platforms would cause NASM to return numerous errors of the form
"'%define' expects a macro identifier".

[9] Added flags to the TurboJPEG API that allow the caller to force the use of
either the fast or the accurate DCT/IDCT algorithms in the underlying codec.

1.2.0
=====

[1] Fixed build issue with YASM on Unix systems (the libjpeg-turbo build system
was not adding the current directory to the assembler include path, so YASM
was not able to find jsimdcfg.inc.)

[2] Fixed out-of-bounds read in SSE2 SIMD code that occurred when decompressing
a JPEG image to a bitmap
buffer whose size was not a multiple of 16 bytes.
This was more of an annoyance than an actual bug, since it did not cause any
actual run-time problems, but the issue showed up when running libjpeg-turbo in
valgrind. See http://crbug.com/72399 for more information.

[3] Added a compile-time macro (LIBJPEG_TURBO_VERSION) that can be used to
check the version of libjpeg-turbo against which an application was compiled.

[4] Added new RGBA/BGRA/ABGR/ARGB colorspace extension constants (libjpeg API)
and pixel formats (TurboJPEG API), which allow applications to specify that,
when decompressing to a 4-component RGB buffer, the unused byte should be set
to 0xFF so that it can be interpreted as an opaque alpha channel.

[5] Fixed regression issue whereby DevIL failed to build against libjpeg-turbo
because libjpeg-turbo's distributed version of jconfig.h contained an INLINE
macro, which conflicted with a similar macro in DevIL. This macro is used only
internally when building libjpeg-turbo,
so it was moved into config.h.

[6] libjpeg-turbo will now correctly decompress erroneous CMYK/YCCK JPEGs whose
K component is assigned a component ID of 1 instead of 4. Although these files
are in violation of the spec, other JPEG implementations handle them
correctly.

[7] Added ARM v6 and ARM v7 architectures to libjpeg.a and libturbojpeg.a in
the official libjpeg-turbo binary package for OS X, so that those libraries can
be used to build both OS X and iOS applications.

1.1.90 (1.2 beta1)
==========

[1] Added a Java wrapper for the TurboJPEG API. See java/README for more
details.

[2] The TurboJPEG API can now be used to scale down images during
decompression.

[3] Added SIMD routines for RGB-to-grayscale color conversion, which
significantly improves the performance of grayscale JPEG compression from an
RGB source image.

[4] Improved the performance of the C color conversion routines, which are used
on platforms for which SIMD acceleration is not available.

[5] Added
a function to the TurboJPEG API that performs lossless transforms.
This function is implemented using the same back end as jpegtran, but it
performs transcoding entirely in memory and allows multiple transforms and/or
crop operations to be batched together, so the source coefficients only need to
be read once. This is useful when generating image tiles from a single source
JPEG.

[6] Added tests for the new TurboJPEG scaled decompression and lossless transform features to tjbench (the TurboJPEG benchmark, formerly called "jpgtest".)

[7] Added support for 4:4:0 (transposed 4:2:2) subsampling in TurboJPEG, which was necessary in order for it to read 4:2:2 JPEG files that had been losslessly transposed or rotated 90 degrees.

[8] All legacy VirtualGL code has been re-factored, and this has allowed libjpeg-turbo, in its entirety, to be re-licensed under a BSD-style license.

[9] libjpeg-turbo can now be built with YASM.

[10] Added SIMD acceleration for ARM Linux and iOS platforms that support NEON instructions.

[11] Refactored the TurboJPEG C API and documented it using Doxygen. The TurboJPEG 1.2 API uses pixel formats to define the size and component order of the uncompressed source/destination images, and it includes a more efficient version of TJBUFSIZE() that computes a worst-case JPEG size based on the level of chrominance subsampling. The refactored implementation of the TurboJPEG API now uses the libjpeg memory source and destination managers, which allows the TurboJPEG compressor to grow the JPEG buffer as necessary.

[12] Eliminated errors in the output of jpegtran on Windows that occurred when the application was invoked using I/O redirection (jpegtran <input.jpg >output.jpg).

[13] The inclusion of libjpeg v7 and v8 emulation as well as arithmetic coding support in libjpeg-turbo v1.1.0 introduced several new error constants in jerror.h, and these were mistakenly enabled for all emulation modes, causing the error enum in libjpeg-turbo to sometimes have different values than the same enum in libjpeg. This represents an ABI incompatibility, and it caused problems with rare applications that took specific action based on a particular error value. The fix was to include the new error constants conditionally based on whether libjpeg v7 or v8 emulation was enabled.

[14] Fixed an issue whereby Windows applications that used libjpeg-turbo would fail to compile if the Windows system headers were included before jpeglib.h. This issue was caused by a conflict in the definition of the INT32 type.

[15] Fixed 32-bit supplementary package for amd64 Debian systems, which was broken by enhancements to the packaging system in 1.1.

[16] When decompressing a JPEG image using an output colorspace of JCS_EXT_RGBX, JCS_EXT_BGRX, JCS_EXT_XBGR, or JCS_EXT_XRGB, libjpeg-turbo will

now set the unused byte to 0xFF, which allows applications to interpret that byte as an alpha channel (0xFF = opaque).

1.1.1
=====

[1] Fixed a 1-pixel error in row 0, column 21 of the luminance plane generated by tjEncodeYUV().

[2] libjpeg-turbo's accelerated Huffman decoder previously ignored unexpected markers found in the middle of the JPEG data stream during decompression. It will now hand off decoding of a particular block to the unaccelerated Huffman decoder if an unexpected marker is found, so that the unaccelerated Huffman decoder can generate an appropriate warning.

[3] Older versions of MinGW64 prefixed symbol names with underscores by default, which differed from the behavior of 64-bit Visual C++. MinGW64 1.0 has adopted the behavior of 64-bit Visual C++ as the default, so to accommodate this, the libjpeg-turbo SIMD function names are no longer prefixed with an underscore when building with MinGW64. This means that, when building libjpeg-turbo with older versions of MinGW64, you will now have to add -fno-leading-underscore to the CFLAGS.

[4] Fixed a regression bug in the NSIS script that caused the Windows installer build to fail when using the Visual Studio IDE.

[5] Fixed a bug in jpeg_read_coefficients() whereby it would not initialize cinfo->image_width and cinfo->image_height if libjpeg v7 or v8 emulation was enabled. This specifically caused the jpegoptim program to fail if it was linked against a version of libjpeg-turbo that was built with libjpeg v7 or v8 emulation.

[6] Eliminated excessive I/O overhead that occurred when reading BMP files in cjpeg.

[7] Eliminated errors in the output of cjpeg on Windows that occurred when the application was invoked using I/O redirection (cjpeg <inputfile >output.jpg).

1.1.0
=====

[1] The algorithm used by the SIMD quantization function cannot produce correct results when the JPEG quality is >= 98 and the fast integer forward DCT is used. Thus, the non-SIMD quantization function is now used for those cases,

and libjpeg-turbo should now produce identical output to libjpeg v6b in all
cases.

[2] Despite the above, the fast integer forward DCT still degrades somewhat for
JPEG
 qualities greater than 95, so the TurboJPEG wrapper will now automatically
use the slow integer forward DCT when generating JPEG images of quality 96 or
greater. This reduces compression performance by as much as 15% for these
high-quality images but is necessary to ensure that the images are perceptually
lossless. It also ensures that the library can avoid the performance pitfall
created by [1].

[3] Ported jpgtest.cxx to pure C to avoid the need for a C++ compiler.

[4] Fixed visual artifacts in grayscale JPEG compression caused by a typo in
the RGB-to-luminance lookup tables.

[5] The Windows distribution packages now include the libjpeg run-time programs
(cjpeg, etc.)

[6] All packages now include jpgtest.

[7] The TurboJPEG dynamic library now uses versioned symbols.

[8] Added two new TurboJPEG API functions, tjEncodeYUV() and
tjDecompressToYUV(), to replace the somewhat hackish TJ_YUV flag.

1.0.90 (1.1 beta1)
==========

[1] Added emulation of the libjpeg v7 and
 v8 APIs and ABIs. See
README-turbo.txt for more details. This feature was sponsored by CamTrace SAS.

[2] Created a new CMake-based build system for the Visual C++ and MinGW builds.

[3] Grayscale bitmaps can now be compressed from/decompressed to using the
TurboJPEG API.

[4] jpgtest can now be used to test decompression performance with existing
JPEG images.

[5] If the default install prefix (/opt/libjpeg-turbo) is used, then
'make install' now creates /opt/libjpeg-turbo/lib32 and
/opt/libjpeg-turbo/lib64 sym links to duplicate the behavior of the binary
packages.

[6] All symbols in the libjpeg-turbo dynamic library are now versioned, even
when the library is built with libjpeg v6b emulation.

[7] Added arithmetic encoding and decoding support (can be disabled with
configure or CMake options)

[8] Added a TJ_YUV flag to the TurboJPEG API, which causes both the compressor
and decompressor to output planar YUV images.

[9] Added an extended version of tjDecompressHeader() to the TurboJPEG
API,
which allows the caller to determine the type of subsampling used in a JPEG
image.

[10] Added further protections against invalid Huffman codes.

1.0.1
=====

[1] The Huffman decoder will now handle erroneous Huffman codes (for instance,
from a corrupt JPEG image.) Previously, these would cause libjpeg-turbo to
crash under certain circumstances.

[2] Fixed typo in SIMD dispatch routines that was causing 4:2:2 upsampling to
be used instead of 4:2:0 when decompressing JPEG images using SSE2 code.

[3] configure script will now automatically determine whether the
INCOMPLETE_TYPES_BROKEN macro should be defined.

1.0.0
=====

[1] 2983700: Further FreeBSD build tweaks (no longer necessary to specify
--host when configuring on a 64-bit system)

[2] Created symlinks in the Unix/Linux packages so that the TurboJPEG
include file can always be found in /opt/libjpeg-turbo/include, the 32-bit
static libraries can always be found in /opt/libjpeg-turbo/lib32, and the
64-bit static
libraries can always be found in /opt/libjpeg-turbo/lib64.

[3] The Unix/Linux distribution packages now include the libjpeg run-time
programs (cjpeg, etc.) and man pages.

[4] Created a 32-bit supplementary package for amd64 Debian systems, which
contains just the 32-bit libjpeg-turbo libraries.

[5] Moved the libraries from */lib32 to */lib in the i386 Debian package.

[6] Include distribution package for Cygwin

[7] No longer necessary to specify --without-simd on non-x86 architectures, and
unit tests now work on those architectures.

0.0.93
======

[1] 2982659, Fixed x86-64 build on FreeBSD systems

[2] 2988188: Added support for Windows 64-bit systems

0.0.91
======

[1] Added documentation to .deb packages

[2] 2968313: Fixed data corruption issues when decompressing large JPEG images
and/or using buffered I/O with the libjpeg-turbo decompressor

0.0.90
======

Initial release

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/ChangeLog.txt
No license file was found, but licenses were detected in source scan.

/*
* jdsample.c
*
* This file was part of the Independent JPEG Group's software:
* Copyright (C) 1991-1996, Thomas G. Lane.
* Modifications:
* Copyright 2009 Pierre Ossman <ossman@cendio.se> for Cendio AB
* Copyright (C) 2010, D. R. Commander.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains upsampling routines.
*

```
* Upsampling input data is counted in "row groups".  A row group
* is defined to be (v_samp_factor * DCT_scaled_size / min_DCT_scaled_size)
* sample rows of each component.  Upsampling will normally produce
* max_v_samp_factor pixel rows from each row group (but this could vary
* if the upsampler is applying a scale factor of its own).
*
* An excellent reference for image resampling is
*   Digital Image Warping, George Wolberg, 1990.
*   Pub. by IEEE Computer Society Press, Los Alamitos, CA. ISBN 0-8186-8944-7.
*/
```

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/jdsample.c
No license file was found, but licenses were detected in source scan.

```
;
; jdct.inc - private declarations for forward & reverse DCT subsystems
;
; Copyright 2009 Pierre Ossman <ossman@cendio.se> for Cendio AB
;
; Based on
; x86 SIMD extension for IJG JPEG library
; Copyright (C) 1999-2006, MIYASAKA Masaru.
; For conditions of distribution and use, see copyright notice in jsimdext.inc
;
; [TAB8]

; Each IDCT routine is responsible for range-limiting its results and
; converting them to unsigned form (0..MAXJSAMPLE).  The raw outputs could
; be quite far out of range if the input data is corrupt, so a bulletproof
; range-limiting step is required.  We use a mask-and-table-lookup method
; to do the combined operations quickly.
;
%define RANGE_MASK  (MAXJSAMPLE * 4 + 3)  ; 2 bits wider than legal samples

%define ROW(n,b,s)  ((b)+(n)*(s))
%define COL(n,b,s)  ((b)+(n)*(s)*DCTSIZE)

%define DWBLOCK(m,n,b,s) ((b)+(m)*DCTSIZE*(s)+(n)*SIZEOF_DWORD)
%define MMBLOCK(m,n,b,s) ((b)+(m)*DCTSIZE*(s)+(n)*SIZEOF_MMWORD)
%define
 XMMBLOCK(m,n,b,s) ((b)+(m)*DCTSIZE*(s)+(n)*SIZEOF_XMMWORD)

; --------------------------------------------------------------------------
```

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-

archive-C8ga4kAj/libjpeg-turbo-1.2.90/simd/jdct.inc
No license file was found, but licenses were detected in source scan.

```
/*
* djpeg.c
*
* This file was part of the Independent JPEG Group's software:
* Copyright (C) 1991-1997, Thomas G. Lane.
* Modifications:
* Copyright (C) 2010-2011, 2013, D. R. Commander.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains a command-line user interface for the JPEG decompressor.
* It should work on any system with Unix- or MS-DOS-style command lines.
*
* Two different command line styles are permitted, depending on the
* compile-time switch TWO_FILE_COMMANDLINE:
* djpeg [options]  inputfile outputfile
* djpeg [options]  [inputfile]
* In the second style, output is always to standard output, which you'd
* normally redirect to a file or pipe to some other program.  Input is
* either from a named file or from standard input (typically redirected).
* The second style is convenient on Unix but is unhelpful on systems that
* don't support pipes.
  Also, you MUST use the first style if your system
* doesn't do binary I/O to stdin/stdout.
* To simplify script writing, the "-outfile" switch is provided.  The syntax
* djpeg [options]  -outfile outputfile  inputfile
* works regardless of which command line style is used.
*/
```

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/djpeg.c
No license file was found, but licenses were detected in source scan.

```
/*
* jsimd_arm.c
*
* Copyright 2009 Pierre Ossman <ossman@cendio.se> for Cendio AB
* Copyright 2009-2011 D. R. Commander
*
* Based on the x86 SIMD extension for IJG JPEG library,
* Copyright (C) 1999-2006, MIYASAKA Masaru.
* For conditions of distribution and use, see copyright notice in jsimdext.inc
*
* This file contains the interface between the "normal" portions
* of the library and the SIMD implementations when running on
```

```
* ARM architecture.
*
* Based on the stubs from 'jsimd_none.c'
*/
```

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/simd/jsimd_arm.c
No license file was found, but licenses were detected in source scan.

```
/*
* jerror.h
*
* Copyright (C) 1994-1997, Thomas G. Lane.
* Modified 1997-2009 by Guido Vollbeding.
* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.
*
* This file defines the error and message codes for the JPEG library.
* Edit this file to add new codes, or to translate the message strings to
* some other language.
* A set of error-reporting macros are defined too.  Some applications using
* the JPEG library may wish to include this file to get the error codes
* and/or the macros.
*/
```

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/jerror.h
No license file was found, but licenses were detected in source scan.

```
/*
* jdapistd.c
*
* This file was part of the Independent JPEG Group's software:
* Copyright (C) 1994-1996, Thomas G. Lane.
* Modifications:
* Copyright (C) 2010, D. R. Commander.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains application interface code for the decompression half
* of the JPEG library.  These are the "standard" API routines that are
* used in the normal full-decompression case.  They are not used by a
* transcoding-only application.  Note that if an application links in
* jpeg_start_decompress, it will end up linking in the entire decompressor.
* We thus must separate this file from jdapimin.c to avoid linking the
* whole decompression library into a transcoder.
*/
```

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/jdapistd.c
No license file was found, but licenses were detected in source scan.

```
/*
* jquant2.c
*
* This file was part of the Independent JPEG Group's software:
* Copyright (C) 1991-1996, Thomas G. Lane.
* Modifications:
* Copyright (C) 2009, D. R. Commander.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains 2-pass color quantization (color mapping) routines.
* These routines provide selection of a custom color map for an image,
* followed by mapping of the image to that color map, with optional
* Floyd-Steinberg dithering.
* It is also possible to use just the second pass to map to an arbitrary
* externally-given color map.
*
* Note: ordered dithering is not supported, since there isn't any fast
* way to compute intercolor distances; it's unclear that ordered dither's
* fundamental assumptions even hold with an irregularly spaced color map.
*/
```

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/jquant2.c
No license file was found, but licenses were detected in source scan.

```
/*
* cdjpeg.c
*
* Copyright (C) 1991-1997, Thomas G. Lane.
* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains common support routines used by the IJG application
* programs (cjpeg, djpeg, jpegtran).
*/
```

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/cdjpeg.c
No license file was found, but licenses were detected in source scan.

```
/*
* rdtarga.c
*
* Copyright (C) 1991-1996, Thomas G. Lane.
* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains routines to read input images in Targa format.
*
* These routines may need modification for non-Unix environments or
* specialized applications.  As they stand, they assume input from
* an ordinary stdio stream.  They further assume that reading begins
* at the start of the file; start_input may need work if the
* user interface has already read some data (e.g., to determine that
* the file is indeed Targa format).
*
* Based on code contributed by Lee Daniel Crocker.
*/
```

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/rdtarga.c
No license file was found, but licenses were detected in source scan.

```
; For conditions of distribution and use, see copyright notice in jsimdext.inc
; more details.
```

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/simd/jfss2int-64.asm
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/simd/jfss2int.asm
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/simd/jiss2int.asm
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/simd/jiss2int-64.asm
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/simd/jimmxint.asm
*
 /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/simd/jfmmxint.asm
No license file was found, but licenses were detected in source scan.

```
/*
* jcmaster.c
*
* This file was part of the Independent JPEG Group's software:
* Copyright (C) 1991-1997, Thomas G. Lane.
```

* Modified 2003-2010 by Guido Vollbeding.
* Modifications:
* Copyright (C) 2010, D. R. Commander.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains master control logic for the JPEG compressor.
* These routines are concerned with parameter validation, initial setup,
* and inter-pass control (determining the number of passes and the work
* to be done in each pass).
*/

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/jcmaster.c
No license file was found, but licenses were detected in source scan.

/*
* jfdctfst.c
*
* Copyright (C) 1994-1996, Thomas G. Lane.
* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains a fast, not so accurate integer implementation of the
* forward DCT (Discrete Cosine Transform).
*
* A 2-D DCT can be done by 1-D DCT on each row followed by 1-D DCT
* on each column. Direct algorithms are also available, but they are
* much more complex and seem not to be any faster when reduced to code.
*
* This implementation is based on Arai, Agui, and Nakajima's algorithm for
* scaled DCT. Their original paper (Trans. IEICE E-71(11):1095) is in
* Japanese, but the algorithm is described in the Pennebaker & Mitchell
* JPEG textbook (see REFERENCES section in file README). The following code
* is based directly on figure 4-8 in P&M.
* While an 8-point DCT cannot be done in less
 than 11 multiplies, it is
* possible to arrange the computation so that many of the multiplies are
* simple scalings of the final outputs. These multiplies can then be
* folded into the multiplications or divisions by the JPEG quantization
* table entries. The AA&N method leaves only 5 multiplies and 29 adds
* to be done in the DCT itself.
* The primary disadvantage of this method is that with fixed-point math,
* accuracy is lost due to imprecise representation of the scaled
* quantization values. The smaller the quantization table entry, the less
* precise the scaled value, so this implementation does worse with high-
* quality-setting files than with low-quality ones.
*/

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/jfdctfst.c
No license file was found, but licenses were detected in source scan.

```
/*
* jmorecfg.h
*
* This file was part of the Independent JPEG Group's software:
* Copyright (C) 1991-1997, Thomas G. Lane.
* Modifications:
* Copyright (C) 2009, 2011, D. R. Commander.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains additional configuration options that customize the
* JPEG software for special applications or support machine-dependent
* optimizations.  Most users will not need to touch this file.
*/
```

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/jmorecfg.h
No license file was found, but licenses were detected in source scan.

```
/*
* jsimddct.h
*
* Copyright 2009 Pierre Ossman <ossman@cendio.se> for Cendio AB
*
* Based on the x86 SIMD extension for IJG JPEG library,
* Copyright (C) 1999-2006, MIYASAKA Masaru.
* For conditions of distribution and use, see copyright notice in jsimdext.inc
*
*/
```

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/jsimddct.h
No license file was found, but licenses were detected in source scan.

```
/*
* jaricom.c
*
* Developed 1997-2009 by Guido Vollbeding.
* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.
*
```

* This file contains probability estimation tables for common use in
* arithmetic entropy encoding and decoding routines.
*
* This data represents Table D.2 in the JPEG spec (ISO/IEC IS 10918-1
* and CCITT Recommendation ITU-T T.81) and Table 24 in the JBIG spec
* (ISO/IEC IS 11544 and CCITT Recommendation ITU-T T.82).
*/

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/jaricom.c
No license file was found, but licenses were detected in source scan.

/*
* Copyright (C)2009-2012 D. R. Commander. All Rights Reserved.
*
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* modification, are permitted provided that the following conditions are met:
*
* - Redistributions of source code must retain the above copyright notice,
*   this list of conditions and the following disclaimer.
* - Redistributions in binary form must reproduce the above copyright notice,
*   this list of conditions and the following disclaimer in the documentation
*   and/or other materials provided with the distribution.
* - Neither the name of the libjpeg-turbo Project nor the names of its
*   contributors may be used to endorse or promote products derived from this
*   software without specific prior written permission.
*
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* SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS
* INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN
* CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE)
* ARISING IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE
* POSSIBILITY OF SUCH DAMAGE.
*/

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/turbojpeg.h
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/turbojpeg.c
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-

archive-C8ga4kAj/libjpeg-turbo-1.2.90/java/TJBench.java
*
/libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/tjunittest.c
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/tjbench.c
No license file was found, but licenses were detected in source scan.

Package: {__PKGNAME}
Version: {__VERSION}-{__BUILD}
Section: misc
Priority: optional
Architecture: {__ARCH}
Essential: no
Maintainer: The libjpeg-turbo Project [http://www.libjpeg-turbo.org]
Description: A SIMD-accelerated JPEG codec that provides both the libjpeg and TurboJPEG APIs
libjpeg-turbo is a JPEG image codec that uses SIMD instructions (MMX, SSE2,
NEON) to accelerate baseline JPEG compression and decompression on x86,
x86-64, and ARM systems. On such systems, libjpeg-turbo is generally 2-4x as
fast as libjpeg, all else being equal. On other types of systems,
libjpeg-turbo can still outperform libjpeg by a significant amount, by virtue
of its highly-optimized Huffman coding routines. In many cases, the
performance of libjpeg-turbo rivals that of proprietary high-speed JPEG
codecs.
.
libjpeg-turbo implements both the traditional libjpeg API as well as the less
powerful but more straightforward TurboJPEG
API. libjpeg-turbo also features
colorspace extensions that allow it to compress from/decompress to 32-bit and
big-endian pixel buffers (RGBX, XBGR, etc.), as well as a full-featured Java
interface.
.
libjpeg-turbo was originally based on libjpeg/SIMD, an MMX-accelerated
derivative of libjpeg v6b developed by Miyasaka Masaru. The TigerVNC and
VirtualGL projects made numerous enhancements to the codec in 2009, and in
early 2010, libjpeg-turbo spun off into an independent project, with the goal
of making high-speed JPEG compression/decompression technology available to a
broader range of users and developers.

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/release/deb-control.tmpl
No license file was found, but licenses were detected in source scan.

/*
* jsimd_x86_64.c
*
* Copyright 2009 Pierre Ossman <ossman@cendio.se> for Cendio AB

* Copyright 2009-2011 D. R. Commander
*
* Based on the x86 SIMD extension for IJG JPEG library,
* Copyright (C) 1999-2006, MIYASAKA Masaru.
* For conditions of distribution and use, see copyright notice in jsimdext.inc
*
* This file contains the interface between the "normal" portions
* of the library and the SIMD implementations when running on a
* x86_64 architecture.
*/

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/simd/jsimd_x86_64.c
No license file was found, but licenses were detected in source scan.

; For conditions of distribution and use, see copyright notice in jsimdext.inc
; for more details.

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/simd/jfss2fst-64.asm
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/simd/jimmxfst.asm
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/simd/jfmmxfst.asm
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/simd/jfss2fst.asm
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/simd/jiss2fst.asm
*
 /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/simd/jiss2fst-64.asm
No license file was found, but licenses were detected in source scan.

/*
* jcparam.c
*
* This file was part of the Independent JPEG Group's software:
* Copyright (C) 1991-1998, Thomas G. Lane.
* Modified 2003-2008 by Guido Vollbeding.
* Modifications:
* Copyright (C) 2009-2011, D. R. Commander.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains optional default-setting code for the JPEG compressor.
* Applications do not have to use this file, but those that don't use it
* must know a lot more about the innards of the JPEG code.

*/

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/jcparam.c
No license file was found, but licenses were detected in source scan.

/*
* jpeglib.h
*
* This file was part of the Independent JPEG Group's software:
* Copyright (C) 1991-1998, Thomas G. Lane.
* Modified 2002-2009 by Guido Vollbeding.
* Modifications:
* Copyright (C) 2009-2011, 2013, D. R. Commander.
* For conditions of distribution and use, see the accompanying README file.
*
* This file defines the application interface for the JPEG library.
* Most applications using the library need only include this file,
* and perhaps jerror.h if they want to know the exact error codes.
*/

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/jpeglib.h
No license file was found, but licenses were detected in source scan.

/*
* jmemmgr.c
*
* Copyright (C) 1991-1997, Thomas G. Lane.
* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains the JPEG system-independent memory management
* routines. This code is usable across a wide variety of machines; most
* of the system dependencies have been isolated in a separate file.
* The major functions provided here are:
*   * pool-based allocation and freeing of memory;
*   * policy decisions about how to divide available memory among the
*   virtual arrays;
*   * control logic for swapping virtual arrays between main memory and
*   backing storage.
* The separate system-dependent file provides the actual backing-storage
* access code, and it contains the policy decision about how much total
* main memory to use.
* This file is system-dependent in the sense that some of

```
 its functions
* are unnecessary in some systems.  For example, if there is enough virtual
* memory so that backing storage will never be used, much of the virtual
* array control logic could be removed.  (Of course, if you have that much
* memory then you shouldn't care about a little bit of unused code...)
*/
```

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/jmemmgr.c
No license file was found, but licenses were detected in source scan.

```
/*
* jccolext.c
*
* This file was part of the Independent JPEG Group's software:
* Copyright (C) 1991-1996, Thomas G. Lane.
* Modifications:
* Copyright (C) 2009-2012, D. R. Commander.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains input colorspace conversion routines.
*/
```

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/jccolext.c
No license file was found, but licenses were detected in source scan.

```
%ifarch x86_64
%define __lib lib64
%else
%define __lib lib
%endif

Summary: A SIMD-accelerated JPEG codec that provides both the libjpeg and TurboJPEG APIs
Name: @PACKAGE_NAME@
Version: @VERSION@
Vendor: The libjpeg-turbo Project
URL: http://www.libjpeg-turbo.org
Group: System Environment/Libraries
#-->Source0: http://prdownloads.sourceforge.net/libjpeg-turbo/libjpeg-turbo-%{version}.tar.gz
Release: @BUILD@
License: BSD-style
BuildRoot: %{_blddir}/%{name}-buildroot-%{version}-%{release}
Prereq: /sbin/ldconfig
%ifarch x86_64
Provides: %{name} = %{version}-%{release}, turbojpeg = 2.00, libturbojpeg.so()(64bit)
```

```
%else
Provides: %{name} = %{version}-%{release}, turbojpeg = 2.00, libturbojpeg.so
%endif
Obsoletes: turbojpeg

%description
libjpeg-turbo is a JPEG image codec that uses SIMD instructions (MMX, SSE2,
NEON) to accelerate baseline JPEG compression and decompression on x86, x86-64,
and ARM systems.  On such systems,
 libjpeg-turbo is generally 2-4x as fast as
libjpeg, all else being equal.  On other types of systems, libjpeg-turbo can
still outperform libjpeg by a significant amount, by virtue of its
highly-optimized Huffman coding routines.  In many cases, the performance of
libjpeg-turbo rivals that of proprietary high-speed JPEG codecs.

libjpeg-turbo implements both the traditional libjpeg API as well as the less
powerful but more straightforward TurboJPEG API.  libjpeg-turbo also features
colorspace extensions that allow it to compress from/decompress to 32-bit and
big-endian pixel buffers (RGBX, XBGR, etc.), as well as a full-featured Java
interface.

libjpeg-turbo was originally based on libjpeg/SIMD, an MMX-accelerated
derivative of libjpeg v6b developed by Miyasaka Masaru.  The TigerVNC and
VirtualGL projects made numerous enhancements to the codec in 2009, and in
early 2010, libjpeg-turbo spun off into an independent project, with the goal
of making high-speed JPEG compression/decompression
 technology available to a
broader range of users and developers.

#-->%prep
#-->%setup -q

#-->%build
#-->./configure libdir=/opt/%{name}/%{__lib} mandir=/opt/%{name}/man
JPEG_LIB_VERSION=@JPEG_LIB_VERSION@ SO_MAJOR_VERSION=@SO_MAJOR_VERSION@
SO_MINOR_VERSION=@SO_MINOR_VERSION@ --with-pic @RPM_CONFIG_ARGS@
#-->make DESTDIR=$RPM_BUILD_ROOT libdir=/opt/%{name}/%{__lib} mandir=/opt/%{name}/man

%install

rm -rf $RPM_BUILD_ROOT
make install DESTDIR=$RPM_BUILD_ROOT libdir=/opt/%{name}/%{__lib} mandir=/opt/%{name}/man
docdir=/opt/%{name}/doc exampledir=/opt/%{name}/doc
rm -f $RPM_BUILD_ROOT/opt/%{name}/%{__lib}/*.la
mkdir -p $RPM_BUILD_ROOT/usr/%{__lib}
mv $RPM_BUILD_ROOT/opt/%{name}/%{__lib}/libturbojpeg.* $RPM_BUILD_ROOT/usr/%{__lib}
/sbin/ldconfig -n $RPM_BUILD_ROOT/opt/%{name}/%{__lib}
/sbin/ldconfig -n $RPM_BUILD_ROOT/usr/%{__lib}
```

```
mkdir -p $RPM_BUILD_ROOT/usr/include
mv $RPM_BUILD_ROOT/opt/%{name}/include/turbojpeg.h $RPM_BUILD_ROOT/usr/include
ln -fs /usr/include/turbojpeg.h $RPM_BUILD_ROOT/opt/%{name}/include/
ln
 -fs /usr/%{__lib}/libturbojpeg.a $RPM_BUILD_ROOT/opt/%{name}/%{__lib}/
mkdir -p $RPM_BUILD_ROOT%{_defaultdocdir}
mv $RPM_BUILD_ROOT/opt/%{name}/doc $RPM_BUILD_ROOT%{_defaultdocdir}/%{name}-%{version}

%post -p /sbin/ldconfig

%postun -p /sbin/ldconfig

%clean
rm -rf $RPM_BUILD_ROOT

%files
%defattr(-,root,root)
%dir %{_defaultdocdir}/%{name}-%{version}
%doc %{_defaultdocdir}/%{name}-%{version}/*
%dir /opt/%{name}
%dir /opt/%{name}/bin
/opt/%{name}/bin/cjpeg
/opt/%{name}/bin/djpeg
/opt/%{name}/bin/jpegtran
/opt/%{name}/bin/tjbench
/opt/%{name}/bin/rdjpgcom
/opt/%{name}/bin/wrjpgcom
%dir /opt/%{name}/%{__lib}
%ifarch x86_64
%else
/opt/%{name}/lib32
%endif
/opt/%{name}/%{__lib}/libjpeg.so.@SO_MAJOR_VERSION@.@SO_AGE@.@SO_MINOR_VERSION@
/opt/%{name}/%{__lib}/libjpeg.so.@SO_MAJOR_VERSION@
/opt/%{name}/%{__lib}/libjpeg.so
/opt/%{name}/%{__lib}/libjpeg.a
/opt/%{name}/%{__lib}/libturbojpeg.a
/usr/%{__lib}/libturbojpeg.so.0.0.0
/usr/%{__lib}/libturbojpeg.so.0
/usr/%{__lib}/libturbojpeg.so
/usr/%{__lib}/libturbojpeg.a
/usr/include/turbojpeg.h
%dir
 /opt/%{name}/include
/opt/%{name}/include/jconfig.h
/opt/%{name}/include/jerror.h
/opt/%{name}/include/jmorecfg.h
/opt/%{name}/include/jpeglib.h
```

/opt/%{name}/include/turbojpeg.h
%dir /opt/%{name}/man
%dir /opt/%{name}/man/man1
/opt/%{name}/man/man1/cjpeg.1*
/opt/%{name}/man/man1/djpeg.1*
/opt/%{name}/man/man1/jpegtran.1*
/opt/%{name}/man/man1/rdjpgcom.1*
/opt/%{name}/man/man1/wrjpgcom.1*
@JAVA_RPM_CONTENTS_1@
@JAVA_RPM_CONTENTS_2@

%changelog

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/release/libjpeg-turbo.spec.in
No license file was found, but licenses were detected in source scan.

/*
* Copyright (C)2011 D. R. Commander. All Rights Reserved.
*
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*
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*   contributors may be used to endorse or promote products derived from this
*   software without specific prior written permission.
*
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* CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE)
* ARISING IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE
* POSSIBILITY OF SUCH DAMAGE.
*/

Found in path(s):

* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/bmp.h
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/java/org/libjpegturbo/turbojpeg/TJScalingFactor.java
*
/libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/jcstest.c
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/tjutil.h
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/bmp.c
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/java/org/libjpegturbo/turbojpeg/TJCustomFilter.java
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/java/org/libjpegturbo/turbojpeg/TJTransform.java
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/java/org/libjpegturbo/turbojpeg/TJTransformer.java
*
/libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/tjutil.c
No license file was found, but licenses were detected in source scan.

/*
* jdarith.c
*
* Developed 1997-2009 by Guido Vollbeding.
* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains portable arithmetic entropy decoding routines for JPEG
* (implementing the ISO/IEC IS 10918-1 and CCITT Recommendation ITU-T T.81).
*
* Both sequential and progressive modes are supported in this single module.
*
* Suspension is not currently supported in this module.
*/

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/jdarith.c
No license file was found, but licenses were detected in source scan.

/*
* jpegcomp.h
*
* Copyright (C) 2010, D. R. Commander
* For conditions of distribution and use, see the accompanying README file.
*

```
* JPEG compatibility macros
* These declarations are considered internal to the JPEG library; most
* applications using the library shouldn't need to include this file.
*/
```

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/jpegcomp.h
No license file was found, but licenses were detected in source scan.

```
/*
* transupp.h
*
* Copyright (C) 1997-2011, Thomas G. Lane, Guido Vollbeding.
* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains declarations for image transformation routines and
* other utility code used by the jpegtran sample application.  These are
* NOT part of the core JPEG library.  But we keep these routines separate
* from jpegtran.c to ease the task of maintaining jpegtran-like programs
* that have other user interfaces.
*
* NOTE: all the routines declared here have very specific requirements
* about when they are to be executed during the reading and writing of the
* source and destination files.  See the comments in transupp.c, or see
* jpegtran.c for an example of correct usage.
*/
```

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/transupp.h
No license file was found, but licenses were detected in source scan.

```
/*
* jdatadst-tj.c
*
* This file was part of the Independent JPEG Group's software:
* Copyright (C) 1994-1996, Thomas G. Lane.
* Modified 2009-2012 by Guido Vollbeding.
* Modifications:
* Copyright (C) 2011, D. R. Commander.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains compression data destination routines for the case of
* emitting JPEG data to memory or to a file (or any stdio stream).
* While these routines are sufficient for most applications,
* some will want to use a different destination manager.
```

* IMPORTANT: we assume that fwrite() will correctly transcribe an array of
* JOCTETs into 8-bit-wide elements on external storage. If char is wider
* than 8 bits on your machine, you may need to do some tweaking.
*/

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/jdatadst-tj.c
No license file was found, but licenses were detected in source scan.

/*
* simd/jsimd.h
*
* Copyright 2009 Pierre Ossman <ossman@cendio.se> for Cendio AB
* Copyright 2011 D. R. Commander
*
* Based on the x86 SIMD extension for IJG JPEG library,
* Copyright (C) 1999-2006, MIYASAKA Masaru.
* For conditions of distribution and use, see copyright notice in jsimdext.inc
*
*/

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/simd/jsimd.h
No license file was found, but licenses were detected in source scan.

libjpeg-turbo note: This file has been modified by The libjpeg-turbo Project
to include only information relevant to libjpeg-turbo, to wordsmith certain
sections, and to remove impolitic language that existed in the libjpeg v8
README. It is included only for reference. Please see README-turbo.txt for
information specific to libjpeg-turbo.

The Independent JPEG Group's JPEG software
==

This distribution contains a release of the Independent JPEG Group's free JPEG
software. You are welcome to redistribute this software and to use it for any
purpose, subject to the conditions under LEGAL ISSUES, below.

This software is the work of Tom Lane, Guido Vollbeding, Philip Gladstone,
Bill Allombert, Jim Boucher, Lee Crocker, Bob Friesenhahn, Ben Jackson,
Julian Minguillon, Luis Ortiz, George Phillips, Davide Rossi, Ge' Weijers,
and other members of the Independent JPEG Group.

IJG

is not affiliated with the ISO/IEC JTC1/SC29/WG1 standards committee
(also known as JPEG, together with ITU-T SG16).

DOCUMENTATION ROADMAP
=====================

This file contains the following sections:

OVERVIEW General description of JPEG and the IJG software.
LEGAL ISSUES Copyright, lack of warranty, terms of distribution.
REFERENCES Where to learn more about JPEG.
ARCHIVE LOCATIONS Where to find newer versions of this software.
FILE FORMAT WARS Software *not* to get.
TO DO Plans for future IJG releases.

Other documentation files in the distribution are:

User documentation:
install.txt How to configure and install the IJG software.
usage.txt Usage instructions for cjpeg, djpeg, jpegtran,
rdjpgcom, and wrjpgcom.
*.1 Unix-style man pages for programs (same info as usage.txt).
wizard.txt Advanced usage instructions for JPEG wizards only.
change.log Version-to-version
change highlights.
Programmer and internal documentation:
libjpeg.txt How to use the JPEG library in your own programs.
example.c Sample code for calling the JPEG library.
structure.txt Overview of the JPEG library's internal structure.
coderules.txt Coding style rules --- please read if you contribute code.

Please read at least the files install.txt and usage.txt. Some information
can also be found in the JPEG FAQ (Frequently Asked Questions) article. See
ARCHIVE LOCATIONS below to find out where to obtain the FAQ article.

If you want to understand how the JPEG code works, we suggest reading one or
more of the REFERENCES, then looking at the documentation files (in roughly
the order listed) before diving into the code.

OVERVIEW
========

This package contains C software to implement JPEG image encoding, decoding,
and transcoding. JPEG (pronounced "jay-peg") is a standardized compression
method for full-color and gray-scale images. JPEG's strong

suit is compressing
photographic images or other types of images that have smooth color and brightness transitions between neighboring pixels. Images with sharp lines or other abrupt features may not compress well with JPEG, and a higher JPEG quality may have to be used to avoid visible compression artifacts with such images.

JPEG is lossy, meaning that the output pixels are not necessarily identical to the input pixels. However, on photographic content and other "smooth" images, very good compression ratios can be obtained with no visible compression artifacts, and extremely high compression ratios are possible if you are willing to sacrifice image quality (by reducing the "quality" setting in the compressor.)

This software implements JPEG baseline, extended-sequential, and progressive compression processes. Provision is made for supporting all variants of these processes, although some uncommon parameter settings aren't implemented yet. We have made no provision for supporting
the hierarchical or lossless
processes defined in the standard.

We provide a set of library routines for reading and writing JPEG image files, plus two sample applications "cjpeg" and "djpeg", which use the library to perform conversion between JPEG and some other popular image file formats. The library is intended to be reused in other applications.

In order to support file conversion and viewing software, we have included considerable functionality beyond the bare JPEG coding/decoding capability; for example, the color quantization modules are not strictly part of JPEG decoding, but they are essential for output to colormapped file formats or colormapped displays. These extra functions can be compiled out of the library if not required for a particular application.

We have also included "jpegtran", a utility for lossless transcoding between different JPEG processes, and "rdjpgcom" and "wrjpgcom", two simple applications for inserting and extracting textual comments in JFIF files.

The
emphasis in designing this software has been on achieving portability and flexibility, while also making it fast enough to be useful. In particular, the software is not intended to be read as a tutorial on JPEG. (See the REFERENCES section for introductory material.) Rather, it is intended to be reliable, portable, industrial-strength code. We do not claim to have achieved that goal in every aspect of the software, but we strive for it.

We welcome the use of this software as a component of commercial products. No royalty is required, but we do ask for an acknowledgement in product documentation, as described under LEGAL ISSUES.

LEGAL ISSUES
==========

In plain English:

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please let us know!)
2. You can use this software for whatever you want. You don't have to pay us.
3. You may not pretend that you wrote this software. If you use it in a
program, you must acknowledge somewhere in your documentation
that
you've used the IJG code.

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(2) If only executable code is distributed, then the accompanying
documentation
must state that "this software is based in part on the work of
the Independent JPEG Group".
(3) Permission for use of this software is granted only if the user accepts
full responsibility for any undesirable consequences; the authors accept
NO LIABILITY for damages of any kind.

These conditions apply to any software derived from or based on the IJG code,
not just to the unmodified library. If you use our work, you ought to
acknowledge us.

Permission is NOT granted for the use of any IJG author's name or company name
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it. This software may be referred to only as "the Independent JPEG Group's
software".

We specifically permit and encourage the use of this software as the basis of commercial products, provided that all warranty or liability claims are assumed by the product vendor.

The Unix configuration script "configure" was produced with GNU Autoconf.
It is copyright by the Free Software Foundation but
is freely distributable.
The same holds for its supporting scripts (config.guess, config.sub, ltmain.sh). Another support script, install-sh, is copyright by X Consortium but is also freely distributable.

The IJG distribution formerly included code to read and write GIF files. To avoid entanglement with the Unisys LZW patent, GIF reading support has been removed altogether, and the GIF writer has been simplified to produce "uncompressed GIFs". This technique does not use the LZW algorithm; the resulting GIF files are larger than usual, but are readable by all standard GIF decoders.

We are required to state that
"The Graphics Interchange Format(c) is the Copyright property of CompuServe Incorporated. GIF(sm) is a Service Mark property of CompuServe Incorporated."

REFERENCES
==========

We recommend reading one or more of these references before trying to understand the innards of the JPEG software.

The best short technical introduction to the JPEG compression algorithm
is
Wallace, Gregory K. "The JPEG Still Picture Compression Standard",
Communications of the ACM, April 1991 (vol. 34 no. 4), pp. 30-44.
(Adjacent articles in that issue discuss MPEG motion picture compression, applications of JPEG, and related topics.) If you don't have the CACM issue handy, a PostScript file containing a revised version of Wallace's article is available at http://www.ijg.org/files/wallace.ps.gz. The file (actually a preprint for an article that appeared in IEEE Trans. Consumer Electronics) omits the sample images that appeared in CACM, but it includes corrections and some added material. Note: the Wallace article is copyright ACM and IEEE, and it may not be used for commercial purposes.

A somewhat less technical, more leisurely introduction to JPEG can be found in "The Data Compression Book" by Mark Nelson and Jean-loup Gailly, published by M&T Books (New York), 2nd ed. 1996, ISBN 1-55851-434-1. This book provides

good explanations and example C code for
a multitude of compression methods
including JPEG. It is an excellent source if you are comfortable reading C code but don't know much about data compression in general. The book's JPEG sample code is far from industrial-strength, but when you are ready to look at a full implementation, you've got one here...

The best currently available description of JPEG is the textbook "JPEG Still Image Data Compression Standard" by William B. Pennebaker and Joan L. Mitchell, published by Van Nostrand Reinhold, 1993, ISBN 0-442-01272-1. Price US$59.95, 638 pp. The book includes the complete text of the ISO JPEG standards (DIS 10918-1 and draft DIS 10918-2).

The original JPEG standard is divided into two parts, Part 1 being the actual specification, while Part 2 covers compliance testing methods. Part 1 is titled "Digital Compression and Coding of Continuous-tone Still Images, Part 1: Requirements and guidelines" and has document numbers ISO/IEC IS 10918-1, ITU-T T.81. Part 2 is titled "Digital
Compression and Coding of
Continuous-tone Still Images, Part 2: Compliance testing" and has document numbers ISO/IEC IS 10918-2, ITU-T T.83.

The JPEG standard does not specify all details of an interchangeable file format. For the omitted details we follow the "JFIF" conventions, revision 1.02. JFIF 1.02 has been adopted as an Ecma International Technical Report and thus received a formal publication status. It is available as a free download in PDF format from
http://www.ecma-international.org/publications/techreports/E-TR-098.htm.
A PostScript version of the JFIF document is available at
http://www.ijg.org/files/jfif.ps.gz. There is also a plain text version at
http://www.ijg.org/files/jfif.txt.gz, but it is missing the figures.

The TIFF 6.0 file format specification can be obtained by FTP from
ftp://ftp.sgi.com/graphics/tiff/TIFF6.ps.gz. The JPEG incorporation scheme found in the TIFF 6.0 spec of 3-June-92 has a number of serious problems.
IJG does not recommend use of the
TIFF 6.0 design (TIFF Compression tag 6).
Instead, we recommend the JPEG design proposed by TIFF Technical Note #2 (Compression tag 7). Copies of this Note can be obtained from
http://www.ijg.org/files/. It is expected that the next revision
of the TIFF spec will replace the 6.0 JPEG design with the Note's design.
Although IJG's own code does not support TIFF/JPEG, the free libtiff library uses our library to implement TIFF/JPEG per the Note.

ARCHIVE LOCATIONS
==========

The "official" archive site for this software is www.ijg.org.
The most recent released version can always be found there in
directory "files". This particular version will be archived as
http://www.ijg.org/files/jpegsrc.v8d.tar.gz, and in Windows-compatible
"zip" archive format as http://www.ijg.org/files/jpegsr8d.zip.

The JPEG FAQ (Frequently Asked Questions) article is a source of some
general information about JPEG.
It is available on the World Wide Web at http://www.faqs.org/faqs/jpeg-faq/
and other
 news.answers archive sites, including the official news.answers
archive at rtfm.mit.edu: ftp://rtfm.mit.edu/pub/usenet/news.answers/jpeg-faq/.
If you don't have Web or FTP access, send e-mail to mail-server@rtfm.mit.edu
with body
 send usenet/news.answers/jpeg-faq/part1
 send usenet/news.answers/jpeg-faq/part2

FILE FORMAT WARS
================

The ISO/IEC JTC1/SC29/WG1 standards committee (also known as JPEG, together
with ITU-T SG16) currently promotes different formats containing the name
"JPEG" which are incompatible with original DCT-based JPEG. IJG therefore does
not support these formats (see REFERENCES). Indeed, one of the original
reasons for developing this free software was to help force convergence on
common, interoperable format standards for JPEG files.
Don't use an incompatible file format!
(In any case, our decoder will remain capable of reading existing JPEG
image files indefinitely.)

TO DO
=====

Please send bug reports, offers of help, etc. to jpeg-info@jpegclub.org.

Found
 in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/README
No license file was found, but licenses were detected in source scan.

/*
* jdinput.c
*
* This file was part of the Independent JPEG Group's software:
* Copyright (C) 1991-1997, Thomas G. Lane.

* Modifications:
* Copyright (C) 2010, D. R. Commander.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains input control logic for the JPEG decompressor.
* These routines are concerned with controlling the decompressor's input
* processing (marker reading and coefficient decoding). The actual input
* reading is done in jdmarker.c, jdhuff.c, and jdphuff.c.
*/

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/jdinput.c
No license file was found, but licenses were detected in source scan.

/*
* jsimd_none.c
*
* Copyright 2009 Pierre Ossman <ossman@cendio.se> for Cendio AB
* Copyright 2009-2011 D. R. Commander
*
* Based on the x86 SIMD extension for IJG JPEG library,
* Copyright (C) 1999-2006, MIYASAKA Masaru.
* For conditions of distribution and use, see copyright notice in jsimdext.inc
*
* This file contains stubs for when there is no SIMD support available.
*/

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/jsimd_none.c
No license file was found, but licenses were detected in source scan.

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* 2. Altered source versions must be plainly marked as such, and must not be
* 3. This notice may not be removed or altered from any source distribution.

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/simd/jsimd_arm_neon.S
No license file was found, but licenses were detected in source scan.

/*
* jquant1.c
*
* This file was part of the Independent JPEG Group's software:

* Copyright (C) 1991-1996, Thomas G. Lane.
* Modifications:
* Copyright (C) 2009, D. R. Commander
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains 1-pass color quantization (color mapping) routines.
* These routines provide mapping to a fixed color map using equally spaced
* color values. Optional Floyd-Steinberg or ordered dithering is available.
*/

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/jquant1.c
No license file was found, but licenses were detected in source scan.

/*
* jcdctmgr.c
*
* This file was part of the Independent JPEG Group's software:
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* Modifications:
* Copyright (C) 1999-2006, MIYASAKA Masaru.
* Copyright 2009 Pierre Ossman <ossman@cendio.se> for Cendio AB
* Copyright (C) 2011 D. R. Commander
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains the forward-DCT management logic.
* This code selects a particular DCT implementation to be used,
* and it performs related housekeeping chores including coefficient
* quantization.
*/

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/jcdctmgr.c
No license file was found, but licenses were detected in source scan.

/*
* jdmrgext.c
*
* This file was part of the Independent JPEG Group's software:
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* Modifications:
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* For conditions of distribution and use, see the accompanying README file.
*
* This file contains code for merged upsampling/color conversion.
*/

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/jdmrgext.c
No license file was found, but licenses were detected in source scan.

```
/*
* jconfig.txt
*
* Copyright (C) 1991-1994, Thomas G. Lane.
* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.
*
* This file documents the configuration options that are required to
* customize the JPEG software for a particular system.
*
* The actual configuration options for a particular installation are stored
* in jconfig.h.  On many machines, jconfig.h can be generated automatically
* or copied from one of the "canned" jconfig files that we supply.  But if
* you need to generate a jconfig.h file by hand, this file tells you how.
*
* DO NOT EDIT THIS FILE --- IT WON'T ACCOMPLISH ANYTHING.
* EDIT A COPY NAMED JCONFIG.H.
*/



/*
* These symbols indicate the properties of your machine or compiler.
* #define the symbol if yes, #undef it if no.
*/

/* Does your compiler support function prototypes?
* (If not,
 you also need to use ansi2knr, see install.txt)
*/
#define HAVE_PROTOTYPES

/* Does your compiler support the declaration "unsigned char" ?
* How about "unsigned short" ?
*/
#define HAVE_UNSIGNED_CHAR
#define HAVE_UNSIGNED_SHORT

/* Define "void" as "char" if your compiler doesn't know about type void.
* NOTE: be sure to define void such that "void *" represents the most general
* pointer type, e.g., that returned by malloc().
*/
/* #define void char */
```

```
/* Define "const" as empty if your compiler doesn't know the "const" keyword.
*/
/* #define const */

/* Define this if an ordinary "char" type is unsigned.
* If you're not sure, leaving it undefined will work at some cost in speed.
* If you defined HAVE_UNSIGNED_CHAR then the speed difference is minimal.
*/
#undef CHAR_IS_UNSIGNED

/* Define this if your system has an ANSI-conforming <stddef.h> file.
*/
#define HAVE_STDDEF_H

/* Define this if your system has an ANSI-conforming <stdlib.h> file.
*/
#define HAVE_STDLIB_H

/*
 Define this if your system does not have an ANSI/SysV <string.h>,
* but does have a BSD-style <strings.h>.
*/
#undef NEED_BSD_STRINGS

/* Define this if your system does not provide typedef size_t in any of the
* ANSI-standard places (stddef.h, stdlib.h, or stdio.h), but places it in
* <sys/types.h> instead.
*/
#undef NEED_SYS_TYPES_H

/* For 80x86 machines, you need to define NEED_FAR_POINTERS,
* unless you are using a large-data memory model or 80386 flat-memory mode.
* On less brain-damaged CPUs this symbol must not be defined.
* (Defining this symbol causes large data structures to be referenced through
* "far" pointers and to be allocated with a special version of malloc.)
*/
#undef NEED_FAR_POINTERS

/* Define this if your linker needs global names to be unique in less
* than the first 15 characters.
*/
#undef NEED_SHORT_EXTERNAL_NAMES

/* Although a real ANSI C compiler can deal perfectly well with pointers to
* unspecified structures (see "incomplete types" in the
 spec), a few pre-ANSI
* and pseudo-ANSI compilers get confused.  To keep one of these bozos happy,
```

```
* define INCOMPLETE_TYPES_BROKEN.  This is not recommended unless you
* actually get "missing structure definition" warnings or errors while
* compiling the JPEG code.
*/
#undef INCOMPLETE_TYPES_BROKEN

/* Define "boolean" as unsigned char, not int, on Windows systems.
*/
#ifdef _WIN32
#ifndef __RPCNDR_H__  /* don't conflict if rpcndr.h already read */
typedef unsigned char boolean;
#endif
#define HAVE_BOOLEAN  /* prevent jmorecfg.h from redefining it */
#endif


/*
* The following options affect code selection within the JPEG library,
* but they don't need to be visible to applications using the library.
* To minimize application namespace pollution, the symbols won't be
* defined unless JPEG_INTERNALS has been defined.
*/

#ifdef JPEG_INTERNALS

/* Define this if your compiler implements ">>" on signed values as a logical
* (unsigned) shift; leave it undefined if ">>" is a
 signed (arithmetic) shift,
* which is the normal and rational definition.
*/
#undef RIGHT_SHIFT_IS_UNSIGNED


#endif /* JPEG_INTERNALS */


/*
* The remaining options do not affect the JPEG library proper,
* but only the sample applications cjpeg/djpeg (see cjpeg.c, djpeg.c).
* Other applications can ignore these.
*/

#ifdef JPEG_CJPEG_DJPEG

/* These defines indicate which image (non-JPEG) file formats are allowed. */

#define BMP_SUPPORTED  /* BMP image file format */
#define GIF_SUPPORTED  /* GIF image file format */
```

```
#define PPM_SUPPORTED  /* PBMPLUS PPM/PGM image file format */
#undef RLE_SUPPORTED  /* Utah RLE image file format */
#define TARGA_SUPPORTED  /* Targa image file format */

/* Define this if you want to name both input and output files on the command
* line, rather than using stdout and optionally stdin.  You MUST do this if
* your system can't cope with binary I/O to stdin/stdout.  See comments at
* head of cjpeg.c or djpeg.c.
*/
#undef TWO_FILE_COMMANDLINE

/*
 Define this if your system needs explicit cleanup of temporary files.
* This is crucial under MS-DOS, where the temporary "files" may be areas
* of extended memory; on most other systems it's not as important.
*/
#undef NEED_SIGNAL_CATCHER

/* By default, we open image files with fopen(...,"rb") or fopen(...,"wb").
* This is necessary on systems that distinguish text files from binary files,
* and is harmless on most systems that don't.  If you have one of the rare
* systems that complains about the "b" spec, define this symbol.
*/
#undef DONT_USE_B_MODE

/* Define this if you want percent-done progress reports from cjpeg/djpeg.
*/
#undef PROGRESS_REPORT


#endif /* JPEG_CJPEG_DJPEG */
```

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/jconfig.txt
No license file was found, but licenses were detected in source scan.

IJG JPEG LIBRARY: SYSTEM ARCHITECTURE

Copyright (C) 1991-2012, Thomas G. Lane, Guido Vollbeding.
This file was part of the Independent JPEG Group's software.
It was modified by The libjpeg-turbo Project to include only information
relevant to libjpeg-turbo.
For conditions of distribution and use, see the accompanying README file.

This file provides an overview of the architecture of the IJG JPEG software;
that is, the functions of the various modules in the system and the interfaces

between modules. For more precise details about any data structure or calling convention, see the include files and comments in the source code.

We assume that the reader is already somewhat familiar with the JPEG standard. The README file includes references for learning about JPEG. The file libjpeg.txt describes the library from the viewpoint of an application programmer using the library; it's best to read that file before this one.
Also, the file coderules.txt describes the coding style conventions we use.

In this document, JPEG-specific terminology follows the JPEG standard:
A "component" means a color channel, e.g., Red or Luminance.
A "sample" is a single component value (i.e., one number in the image data).
A "coefficient" is a frequency coefficient (a DCT transform output number).
A "block" is an 8x8 group of samples or coefficients.
An "MCU" (minimum coded unit) is an interleaved set of blocks of size determined by the sampling factors, or a single block in a noninterleaved scan.
We do not use the terms "pixel" and "sample" interchangeably. When we say pixel, we mean an element of the full-size image, while a sample is an element of the downsampled image. Thus the number of samples may vary across components while the number of pixels does not. (This terminology is not used rigorously throughout the code, but it is used in places where confusion would otherwise result.)

*** System features
***

The IJG distribution contains two parts:
* A subroutine library for JPEG compression and decompression.
* cjpeg/djpeg, two sample applications that use the library to transform JFIF JPEG files to and from several other image formats.
cjpeg/djpeg are of no great intellectual complexity: they merely add a simple command-line user interface and I/O routines for several uncompressed image formats. This document concentrates on the library itself.

We desire the library to be capable of supporting all JPEG baseline, extended sequential, and progressive DCT processes. Hierarchical processes are not supported.

The library does not support the lossless (spatial) JPEG process. Lossless JPEG shares little or no code with lossy JPEG, and would normally be used without the extensive pre- and post-processing provided by this library.
We feel that lossless JPEG is better handled by a separate library.

Within these limits, any set of compression parameters allowed by the JPEG spec

should be readable for decompression. (We can be more restrictive about what formats we can generate.) Although the system design allows for all parameter values, some uncommon settings are not yet implemented and may never be; nonintegral sampling ratios are the prime example. Furthermore, we treat 8-bit vs. 12-bit data precision as a compile-time switch, not a run-time option, because most machines can store 8-bit pixels much more compactly than 12-bit.

By itself, the library handles only interchange JPEG datastreams --- in particular the widely used JFIF file format. The library can be used by surrounding code to process interchange or abbreviated JPEG datastreams that are embedded in more complex file formats. (For example, libtiff uses this library to implement JPEG compression within the TIFF file format.)

The library includes a substantial amount of code that is not covered by the JPEG standard but is necessary for typical applications of JPEG. These functions preprocess
the image before JPEG compression or postprocess it after decompression. They include colorspace conversion, downsampling/upsampling, and color quantization. This code can be omitted if not needed.

A wide range of quality vs. speed tradeoffs are possible in JPEG processing, and even more so in decompression postprocessing. The decompression library provides multiple implementations that cover most of the useful tradeoffs, ranging from very-high-quality down to fast-preview operation. On the compression side we have generally not provided low-quality choices, since compression is normally less time-critical. It should be understood that the low-quality modes may not meet the JPEG standard's accuracy requirements; nonetheless, they are useful for viewers.

*** Portability issues ***

Portability is an essential requirement for the library. The key portability issues that show up at the level of system architecture are:

1. Memory usage. We want the code to be able to run
on PC-class machines
with limited memory. Images should therefore be processed sequentially (in strips), to avoid holding the whole image in memory at once. Where a full-image buffer is necessary, we should be able to use either virtual memory or temporary files.

2. Near/far pointer distinction. To run efficiently on 80x86 machines, the code should distinguish "small" objects (kept in near data space) from "large" ones (kept in far data space). This is an annoying restriction, but fortunately it does not impact code quality for less brain-damaged machines, and the source code clutter turns out to be minimal with sufficient use of

pointer typedefs.

3. Data precision. We assume that "char" is at least 8 bits, "short" and "int" at least 16, "long" at least 32. The code will work fine with larger data sizes, although memory may be used inefficiently in some cases. However, the JPEG compressed datastream must ultimately appear on external storage as a sequence of 8-bit bytes if it
is to conform to the standard. This may pose a
problem on machines where char is wider than 8 bits. The library represents compressed data as an array of values of typedef JOCTET. If no data type exactly 8 bits wide is available, custom data source and data destination modules must be written to unpack and pack the chosen JOCTET datatype into 8-bit external representation.

*** System overview ***

The compressor and decompressor are each divided into two main sections: the JPEG compressor or decompressor proper, and the preprocessing or postprocessing functions. The interface between these two sections is the image data that the official JPEG spec regards as its input or output: this data is in the colorspace to be used for compression, and it is downsampled to the sampling factors to be used. The preprocessing and postprocessing steps are responsible for converting a normal image representation to or from this form. (Those few applications that want to deal with YCbCr downsampled data
can skip the preprocessing or postprocessing step.)

Looking more closely, the compressor library contains the following main elements:

Preprocessing:
* Color space conversion (e.g., RGB to YCbCr).
* Edge expansion and downsampling. Optionally, this step can do simple smoothing --- this is often helpful for low-quality source data.

JPEG proper:
* MCU assembly, DCT, quantization.
* Entropy coding (sequential or progressive, Huffman or arithmetic).

In addition to these modules we need overall control, marker generation, and support code (memory management & error handling). There is also a module responsible for physically writing the output data --- typically this is just an interface to fwrite(), but some applications may need to do something else with the data.

The decompressor library contains the following main elements:

JPEG proper:

  * Entropy decoding (sequential or progressive, Huffman or arithmetic).
  * Dequantization, inverse DCT,
MCU disassembly.
Postprocessing:
  * Upsampling. Optionally, this step may be able to do more general
    rescaling of the image.
  * Color space conversion (e.g., YCbCr to RGB). This step may also
    provide gamma adjustment [currently it does not].
  * Optional color quantization (e.g., reduction to 256 colors).
  * Optional color precision reduction (e.g., 24-bit to 15-bit color).
    [This feature is not currently implemented.]

We also need overall control, marker parsing, and a data source module.
The support code (memory management & error handling) can be shared with
the compression half of the library.

There may be several implementations of each of these elements, particularly
in the decompressor, where a wide range of speed/quality tradeoffs is very
useful. It must be understood that some of the best speedups involve
merging adjacent steps in the pipeline. For example, upsampling, color space
conversion, and color quantization might all be done at
 once when using a
low-quality ordered-dither technique. The system architecture is designed to
allow such merging where appropriate.

Note: it is convenient to regard edge expansion (padding to block boundaries)
as a preprocessing/postprocessing function, even though the JPEG spec includes
it in compression/decompression. We do this because downsampling/upsampling
can be simplified a little if they work on padded data: it's not necessary to
have special cases at the right and bottom edges. Therefore the interface
buffer is always an integral number of blocks wide and high, and we expect
compression preprocessing to pad the source data properly. Padding will occur
only to the next block (8-sample) boundary. In an interleaved-scan situation,
additional dummy blocks may be used to fill out MCUs, but the MCU assembly and
disassembly logic will create or discard these blocks internally. (This is
advantageous for speed reasons, since we avoid DCTing the dummy blocks.
It also permits a
 small reduction in file size, because the compressor can
choose dummy block contents so as to minimize their size in compressed form.
Finally, it makes the interface buffer specification independent of whether
the file is actually interleaved or not.) Applications that wish to deal
directly with the downsampled data must provide similar buffering and padding
for odd-sized images.

*** Poor man's object-oriented programming ***

It should be clear by now that we have a lot of quasi-independent processing steps, many of which have several possible behaviors. To avoid cluttering the code with lots of switch statements, we use a simple form of object-style programming to separate out the different possibilities.

For example, two different color quantization algorithms could be implemented as two separate modules that present the same external interface; at runtime, the calling code will access the proper module indirectly through an "object".

We can get the limited features we need while
staying within portable C.
The basic tool is a function pointer. An "object" is just a struct containing one or more function pointer fields, each of which corresponds to a method name in real object-oriented languages. During initialization we fill in the function pointers with references to whichever module we have determined we need to use in this run. Then invocation of the module is done by indirecting through a function pointer; on most machines this is no more expensive than a switch statement, which would be the only other way of making the required run-time choice. The really significant benefit, of course, is keeping the source code clean and well structured.

We can also arrange to have private storage that varies between different implementations of the same kind of object. We do this by making all the module-specific object structs be separately allocated entities, which will be accessed via pointers in the master compression or decompression struct. The "public"
fields or methods for a given kind of object are specified by a commonly known struct. But a module's initialization code can allocate a larger struct that contains the common struct as its first member, plus additional private fields. With appropriate pointer casting, the module's internal functions can access these private fields. (For a simple example, see jdatadst.c, which implements the external interface specified by struct jpeg_destination_mgr, but adds extra fields.)

(Of course this would all be a lot easier if we were using C++, but we are not yet prepared to assume that everyone has a C++ compiler.)

An important benefit of this scheme is that it is easy to provide multiple versions of any method, each tuned to a particular case. While a lot of precalculation might be done to select an optimal implementation of a method, the cost per invocation is constant. For example, the upsampling step might have a "generic" method, plus one or more "hardwired" methods for the most popular
sampling factors; the hardwired methods would be faster because they'd use straight-line code instead of for-loops. The cost to determine which method to use is paid only once, at startup, and the selection criteria are hidden from the callers of the method.

This plan differs a little bit from usual object-oriented structures, in that only one instance of each object class will exist during execution. The reason for having the class structure is that on different runs we may create different instances (choose to execute different modules). You can think of the term "method" as denoting the common interface presented by a particular set of interchangeable functions, and "object" as denoting a group of related methods, or the total shared interface behavior of a group of modules.

*** Overall control structure ***

We previously mentioned the need for overall control logic in the compression and decompression libraries. In IJG implementations prior to v5, overall control was
mostly provided by "pipeline control" modules, which proved to be large, unwieldy, and hard to understand. To improve the situation, the control logic has been subdivided into multiple modules. The control modules consist of:

1. Master control for module selection and initialization. This has two responsibilities:

1A. Startup initialization at the beginning of image processing.
The individual processing modules to be used in this run are selected and given initialization calls.

1B. Per-pass control. This determines how many passes will be performed and calls each active processing module to configure itself appropriately at the beginning of each pass. End-of-pass processing, where necessary, is also invoked from the master control module.

Method selection is partially distributed, in that a particular processing module may contain several possible implementations of a particular method, which it will select among when given
its initialization call. The master
control code need only be concerned with decisions that affect more than one module.

2. Data buffering control. A separate control module exists for each inter-processing-step data buffer. This module is responsible for invoking the processing steps that write or read that data buffer.

Each buffer controller sees the world as follows:

input data => processing step A => buffer => processing step B => output data
| | |
---------- controller ----------

The controller knows the dataflow requirements of steps A and B: how much data they want to accept in one chunk and how much they output in one chunk. Its function is to manage its buffer and call A and B at the proper times.

A data buffer control module may itself be viewed as a processing step by a higher-level control module; thus the control modules form a binary tree with elementary processing steps at
the leaves of the tree.

The control modules are objects. A considerable amount of flexibility can be had by replacing implementations of a control module. For example:
* Merging of adjacent steps in the pipeline is done by replacing a control module and its pair of processing-step modules with a single processing-step module. (Hence the possible merges are determined by the tree of control modules.)
* In some processing modes, a given interstep buffer need only be a "strip" buffer large enough to accommodate the desired data chunk sizes. In other modes, a full-image buffer is needed and several passes are required. The control module determines which kind of buffer is used and manipulates virtual array buffers as needed. One or both processing steps may be unaware of the multi-pass behavior.

In theory, we might be able to make all of the data buffer controllers interchangeable and provide just one set of implementations for all. In practice, each one contains
considerable special-case processing for its
particular job. The buffer controller concept should be regarded as an overall system structuring principle, not as a complete description of the task performed by any one controller.

*** Compression object structure ***

Here is a sketch of the logical structure of the JPEG compression library:

```
                                |-- Colorspace conversion
            |-- Preprocessing controller --|
            |                   |-- Downsampling
Main controller --|
            |                   |-- Forward DCT, quantize
            |-- Coefficient controller --|
                                |-- Entropy encoding
```

This sketch also describes the flow of control (subroutine calls) during typical image data processing. Each of the components shown in the diagram is an "object" which may have several different implementations available. One or more source code files

contain the actual implementation(s) of each object.

The objects shown above are:

* Main controller: buffer controller for the subsampled-data buffer, which
holds the preprocessed input data. This controller invokes preprocessing to
fill the subsampled-data buffer, and JPEG compression to empty it. There is
usually no need for a full-image buffer here; a strip buffer is adequate.

* Preprocessing controller: buffer controller for the downsampling input data
buffer, which lies between colorspace conversion and downsampling. Note
that a unified conversion/downsampling module would probably replace this
controller entirely.

* Colorspace conversion: converts application image data into the desired
JPEG color space; also changes the data from pixel-interleaved layout to
separate component planes. Processes one pixel row at a time.

* Downsampling: performs reduction of chroma components as required.
Optionally may perform pixel-level smoothing as well. Processes
a "row
group" at a time, where a row group is defined as Vmax pixel rows of each
component before downsampling, and Vk sample rows afterwards (remember Vk
differs across components). Some downsampling or smoothing algorithms may
require context rows above and below the current row group; the
preprocessing controller is responsible for supplying these rows via proper
buffering. The downsampler is responsible for edge expansion at the right
edge (i.e., extending each sample row to a multiple of 8 samples); but the
preprocessing controller is responsible for vertical edge expansion (i.e.,
duplicating the bottom sample row as needed to make a multiple of 8 rows).

* Coefficient controller: buffer controller for the DCT-coefficient data.
This controller handles MCU assembly, including insertion of dummy DCT
blocks when needed at the right or bottom edge. When performing
Huffman-code optimization or emitting a multiscan JPEG file, this
controller is responsible
for buffering the full image. The equivalent of
one fully interleaved MCU row of subsampled data is processed per call,
even when the JPEG file is noninterleaved.

* Forward DCT and quantization: Perform DCT, quantize, and emit coefficients.
Works on one or more DCT blocks at a time. (Note: the coefficients are now
emitted in normal array order, which the entropy encoder is expected to
convert to zigzag order as necessary. Prior versions of the IJG code did
the conversion to zigzag order within the quantization step.)

* Entropy encoding: Perform Huffman or arithmetic entropy coding and emit the
coded data to the data destination module. Works on one MCU per call.

For progressive JPEG, the same DCT blocks are fed to the entropy coder during each pass, and the coder must emit the appropriate subset of coefficients.

In addition to the above objects, the compression library includes these objects:

* Master control: determines the number of passes required, controls overall and per-pass initialization of the other modules.

* Marker writing: generates JPEG markers (except for RSTn, which is emitted by the entropy encoder when needed).

* Data destination manager: writes the output JPEG datastream to its final destination (e.g., a file). The destination manager supplied with the library knows how to write to a stdio stream or to a memory buffer; for other behaviors, the surrounding application may provide its own destination manager.

* Memory manager: allocates and releases memory, controls virtual arrays (with backing store management, where required).

* Error handler: performs formatting and output of error and trace messages; determines handling of nonfatal errors. The surrounding application may override some or all of this object's methods to change error handling.

* Progress monitor: supports output of "percent-done" progress reports. This object represents an optional callback to the surrounding application: if wanted, it must be supplied by the application.

The error handler, destination manager, and progress monitor objects are defined as separate objects in order to simplify application-specific customization of the JPEG library. A surrounding application may override individual methods or supply its own all-new implementation of one of these objects. The object interfaces for these objects are therefore treated as part of the application interface of the library, whereas the other objects are internal to the library.

The error handler and memory manager are shared by JPEG compression and decompression; the progress monitor, if used, may be shared as well.

*** Decompression object structure ***

Here is a sketch of the logical structure of the JPEG decompression library:

```
                                |-- Entropy decoding
              |-- Coefficient controller --|
              |                 |-- Dequantize, Inverse DCT
Main controller --|
              |                  |-- Upsampling
              |-- Postprocessing controller --|  |-- Colorspace conversion
                                |-- Color quantization
                                |-- Color precision reduction
```

As before, this diagram also represents typical control flow. The objects shown are:

* Main controller: buffer controller for the subsampled-data buffer, which holds the output of JPEG decompression proper. This controller's primary task is to feed the postprocessing procedure. Some upsampling algorithms may require context rows above and below the current row group; when this is true, the main controller is responsible for managing its buffer so as to make context rows available. In the current design, the main buffer is always a strip buffer; a full-image buffer is never required.

* Coefficient controller: buffer controller for the DCT-coefficient data. This controller handles MCU disassembly, including deletion of any dummy DCT blocks at the right or bottom edge. When reading a multiscan JPEG file, this controller is responsible for buffering the full image. (Buffering DCT coefficients, rather than samples, is necessary to support progressive JPEG.) The equivalent of one fully interleaved MCU row of subsampled data is processed per call, even when the source JPEG file is noninterleaved.

* Entropy decoding: Read coded data from the data source module and perform Huffman or arithmetic entropy decoding. Works on one MCU per call. For progressive JPEG decoding, the coefficient controller supplies the prior coefficients of each MCU (initially all zeroes), which the entropy decoder modifies in each scan.

* Dequantization and inverse DCT: like it says. Note that the coefficients buffered by the coefficient controller have NOT been dequantized; we merge dequantization and inverse DCT into a single step for speed reasons. When scaled-down output is asked for, simplified DCT algorithms may be used that emit fewer samples per DCT block, not the full 8x8. Works on one DCT block at a time.

* Postprocessing controller: buffer controller for the color quantization input buffer, when quantization is in use. (Without quantization, this controller just calls the upsampler.) For two-pass quantization, this controller is responsible for buffering the full-image data.

* Upsampling: restores chroma components to full size. (May support more general output rescaling, too. Note that if undersized DCT outputs have been emitted by the DCT module, this module must adjust so that properly sized outputs are created.) Works on one row group at a time. This module also calls the color conversion module, so its top level is effectively a buffer controller for the upsampling->color conversion buffer. However, in all but the highest-quality operating modes, upsampling and color conversion are likely
to be merged into a single step.

* Colorspace conversion: convert from JPEG color space to output color space, and change data layout from separate component planes to pixel-interleaved. Works on one pixel row at a time.

* Color quantization: reduce the data to colormapped form, using either an externally specified colormap or an internally generated one. This module is not used for full-color output. Works on one pixel row at a time; may require two passes to generate a color map. Note that the output will always be a single component representing colormap indexes. In the current design, the output values are JSAMPLEs, so an 8-bit compilation cannot quantize to more than 256 colors. This is unlikely to be a problem in practice.

* Color reduction: this module handles color precision reduction, e.g., generating 15-bit color (5 bits/primary) from JPEG's 24-bit output. Not quite clear yet how this should be handled... should we merge it with colorspace conversion???

Note
that some high-speed operating modes might condense the entire postprocessing sequence to a single module (upsample, color convert, and quantize in one step).

In addition to the above objects, the decompression library includes these objects:

* Master control: determines the number of passes required, controls overall and per-pass initialization of the other modules. This is subdivided into input and output control: jdinput.c controls only input-side processing, while jdmaster.c handles overall initialization and output-side control.

* Marker reading: decodes JPEG markers (except for RSTn).

* Data source manager: supplies the input JPEG datastream. The source manager supplied with the library knows how to read from a stdio stream or from a memory buffer; for other behaviors, the surrounding application may provide its own source manager.

* Memory manager: same as for compression library.

* Error handler: same as for compression library.

* Progress
monitor: same as for compression library.

As with compression, the data source manager, error handler, and progress monitor are candidates for replacement by a surrounding application.

*** Decompression input and output separation ***

To support efficient incremental display of progressive JPEG files, the decompressor is divided into two sections that can run independently:

1. Data input includes marker parsing, entropy decoding, and input into the coefficient controller's DCT coefficient buffer. Note that this processing is relatively cheap and fast.

2. Data output reads from the DCT coefficient buffer and performs the IDCT and all postprocessing steps.

For a progressive JPEG file, the data input processing is allowed to get arbitrarily far ahead of the data output processing. (This occurs only if the application calls jpeg_consume_input(); otherwise input and output run in lockstep, since the input section is called only when the output section needs more data.) In
this way the application can avoid making
extra display passes when data is arriving faster than the display pass can run. Furthermore, it is possible to abort an output pass without losing anything, since the coefficient buffer is read-only as far as the output section is concerned. See libjpeg.txt for more detail.

A full-image coefficient array is only created if the JPEG file has multiple scans (or if the application specifies buffered-image mode anyway). When reading a single-scan file, the coefficient controller normally creates only a one-MCU buffer, so input and output processing must run in lockstep in this case. jpeg_consume_input() is effectively a no-op in this situation.

The main impact of dividing the decompressor in this fashion is that we must be very careful with shared variables in the cinfo data structure. Each variable that can change during the course of decompression must be classified as belonging to data input or data output, and each section must look only
at its own variables. For example, the data output section may not depend on any of the variables that describe the current scan in the JPEG

file, because these may change as the data input section advances into a new scan.

The progress monitor is (somewhat arbitrarily) defined to treat input of the file as one pass when buffered-image mode is not used, and to ignore data input work completely when buffered-image mode is used. Note that the library has no reliable way to predict the number of passes when dealing with a progressive JPEG file, nor can it predict the number of output passes in buffered-image mode. So the work estimate is inherently bogus anyway.

No comparable division is currently made in the compression library, because there isn't any real need for it.

*** Data formats ***

Arrays of pixel sample values use the following data structure:

```
typedef something JSAMPLE;  a pixel component value, 0..MAXJSAMPLE
typedef JSAMPLE *JSAMPROW;  ptr to a row of samples
 typedef JSAMPROW *JSAMPARRAY; ptr to a list of rows
typedef JSAMPARRAY *JSAMPIMAGE; ptr to a list of color-component arrays
```

The basic element type JSAMPLE will typically be one of unsigned char, (signed) char, or short. Short will be used if samples wider than 8 bits are to be supported (this is a compile-time option). Otherwise, unsigned char is used if possible. If the compiler only supports signed chars, then it is necessary to mask off the value when reading. Thus, all reads of JSAMPLE values must be coded as "GETJSAMPLE(value)", where the macro will be defined as "((value) & 0xFF)" on signed-char machines and "((int) (value))" elsewhere.

With these conventions, JSAMPLE values can be assumed to be >= 0. This helps simplify correct rounding during downsampling, etc. The JPEG standard's specification that sample values run from -128..127 is accommodated by subtracting 128 from the sample value in the DCT step. Similarly, during decompression the output of the IDCT
step will be immediately shifted back to
0..255. (NB: different values are required when 12-bit samples are in use.
The code is written in terms of MAXJSAMPLE and CENTERJSAMPLE, which will be defined as 255 and 128 respectively in an 8-bit implementation, and as 4095 and 2048 in a 12-bit implementation.)

We use a pointer per row, rather than a two-dimensional JSAMPLE array. This choice costs only a small amount of memory and has several benefits:
* Code using the data structure doesn't need to know the allocated width of
 the rows. This simplifies edge expansion/compression, since we can work
 in an array that's wider than the logical picture width.
* Indexing doesn't require multiplication; this is a performance win on many

machines.
* Arrays with more than 64K total elements can be supported even on machines
where malloc() cannot allocate chunks larger than 64K.
* The rows forming a component array may be allocated at different times
without extra copying. This trick allows
some speedups in smoothing steps
that need access to the previous and next rows.

Note that each color component is stored in a separate array; we don't use the
traditional layout in which the components of a pixel are stored together.
This simplifies coding of modules that work on each component independently,
because they don't need to know how many components there are. Furthermore,
we can read or write each component to a temporary file independently, which
is helpful when dealing with noninterleaved JPEG files.

In general, a specific sample value is accessed by code such as
GETJSAMPLE(image[colorcomponent][row][col])
where col is measured from the image left edge, but row is measured from the
first sample row currently in memory. Either of the first two indexings can
be precomputed by copying the relevant pointer.

Since most image-processing applications prefer to work on images in which
the components of a pixel are stored together, the data passed to or from the
surrounding
application uses the traditional convention: a single pixel is
represented by N consecutive JSAMPLE values, and an image row is an array of
(# of color components)*(image width) JSAMPLEs. One or more rows of data can
be represented by a pointer of type JSAMPARRAY in this scheme. This scheme is
converted to component-wise storage inside the JPEG library. (Applications
that want to skip JPEG preprocessing or postprocessing will have to contend
with component-wise storage.)

Arrays of DCT-coefficient values use the following data structure:

```
typedef short JCOEF;  a 16-bit signed integer
typedef JCOEF JBLOCK[DCTSIZE2]; an 8x8 block of coefficients
typedef JBLOCK *JBLOCKROW;  ptr to one horizontal row of 8x8 blocks
typedef JBLOCKROW *JBLOCKARRAY; ptr to a list of such rows
typedef JBLOCKARRAY *JBLOCKIMAGE; ptr to a list of color component arrays
```

The underlying type is at least a 16-bit signed integer; while "short" is big
enough on all machines of interest,
on some machines it is preferable to use
"int" for speed reasons, despite the storage cost. Coefficients are grouped
into 8x8 blocks (but we always use #defines DCTSIZE and DCTSIZE2 rather than
"8" and "64").

The contents of a coefficient block may be in either "natural" or zigzagged
order, and may be true values or divided by the quantization coefficients,
depending on where the block is in the processing pipeline. In the current
library, coefficient blocks are kept in natural order everywhere; the entropy
codecs zigzag or dezigzag the data as it is written or read. The blocks
contain quantized coefficients everywhere outside the DCT/IDCT subsystems.
(This latter decision may need to be revisited to support variable
quantization a la JPEG Part 3.)

Notice that the allocation unit is now a row of 8x8 blocks, corresponding to
eight rows of samples. Otherwise the structure is much the same as for
samples, and for the same reasons.

On machines where malloc() can't handle a request
 bigger than 64Kb, this data
structure limits us to rows of less than 512 JBLOCKs, or a picture width of
4000+ pixels. This seems an acceptable restriction.

On 80x86 machines, the bottom-level pointer types (JSAMPROW and JBLOCKROW)
must be declared as "far" pointers, but the upper levels can be "near"
(implying that the pointer lists are allocated in the DS segment).
We use a #define symbol FAR, which expands to the "far" keyword when
compiling on 80x86 machines and to nothing elsewhere.

*** Suspendable processing ***

In some applications it is desirable to use the JPEG library as an
incremental, memory-to-memory filter. In this situation the data source or
destination may be a limited-size buffer, and we can't rely on being able to
empty or refill the buffer at arbitrary times. Instead the application would
like to have control return from the library at buffer overflow/underrun, and
then resume compression or decompression at a later time.

This scenario is supported for simple
 cases. (For anything more complex, we
recommend that the application "bite the bullet" and develop real multitasking
capability.) The libjpeg.txt file goes into more detail about the usage and
limitations of this capability; here we address the implications for library
structure.

The essence of the problem is that the entropy codec (coder or decoder) must
be prepared to stop at arbitrary times. In turn, the controllers that call
the entropy codec must be able to stop before having produced or consumed all
the data that they normally would handle in one call. That part is reasonably
straightforward: we make the controller call interfaces include "progress

counters" which indicate the number of data chunks successfully processed, and
we require callers to test the counter rather than just assume all of the data
was processed.

Rather than trying to restart at an arbitrary point, the current Huffman
codecs are designed to restart at the beginning of the current MCU after a
suspension
due to buffer overflow/underrun. At the start of each call, the
codec's internal state is loaded from permanent storage (in the JPEG object
structures) into local variables. On successful completion of the MCU, the
permanent state is updated. (This copying is not very expensive, and may even
lead to *improved* performance if the local variables can be registerized.)
If a suspension occurs, the codec simply returns without updating the state,
thus effectively reverting to the start of the MCU. Note that this implies
leaving some data unprocessed in the source/destination buffer (ie, the
compressed partial MCU). The data source/destination module interfaces are
specified so as to make this possible. This also implies that the data buffer
must be large enough to hold a worst-case compressed MCU; a couple thousand
bytes should be enough.

In a successive-approximation AC refinement scan, the progressive Huffman
decoder has to be able to undo assignments of newly nonzero coefficients
if it
suspends before the MCU is complete, since decoding requires distinguishing
previously-zero and previously-nonzero coefficients. This is a bit tedious
but probably won't have much effect on performance. Other variants of Huffman
decoding need not worry about this, since they will just store the same values
again if forced to repeat the MCU.

This approach would probably not work for an arithmetic codec, since its
modifiable state is quite large and couldn't be copied cheaply. Instead it
would have to suspend and resume exactly at the point of the buffer end.

The JPEG marker reader is designed to cope with suspension at an arbitrary
point. It does so by backing up to the start of the marker parameter segment,
so the data buffer must be big enough to hold the largest marker of interest.
Again, a couple KB should be adequate. (A special "skip" convention is used
to bypass COM and APPn markers, so these can be larger than the buffer size
without causing problems; otherwise a
64K buffer would be needed in the worst
case.)

The JPEG marker writer currently does *not* cope with suspension.
We feel that this is not necessary; it is much easier simply to require
the application to ensure there is enough buffer space before starting. (An
empty 2K buffer is more than sufficient for the header markers; and ensuring
there are a dozen or two bytes available before calling jpeg_finish_compress()
will suffice for the trailer.) This would not work for writing multi-scan

JPEG files, but we simply do not intend to support that capability with suspension.

*** Memory manager services ***

The JPEG library's memory manager controls allocation and deallocation of memory, and it manages large "virtual" data arrays on machines where the operating system does not provide virtual memory. Note that the same memory manager serves both compression and decompression operations.

In all cases, allocated objects are tied to a particular compression or decompression master record,
and they will be released when that master
record is destroyed.

The memory manager does not provide explicit deallocation of objects. Instead, objects are created in "pools" of free storage, and a whole pool can be freed at once. This approach helps prevent storage-leak bugs, and it speeds up operations whenever malloc/free are slow (as they often are). The pools can be regarded as lifetime identifiers for objects. Two pools/lifetimes are defined:
* JPOOL_PERMANENT lasts until master record is destroyed
* JPOOL_IMAGE lasts until done with image (JPEG datastream)
Permanent lifetime is used for parameters and tables that should be carried across from one datastream to another; this includes all application-visible parameters. Image lifetime is used for everything else. (A third lifetime, JPOOL_PASS = one processing pass, was originally planned. However it was dropped as not being worthwhile. The actual usage patterns are such that the peak memory usage would be about the same
anyway; and having per-pass storage
substantially complicates the virtual memory allocation rules --- see below.)

The memory manager deals with three kinds of object:
1. "Small" objects. Typically these require no more than 10K-20K total.
2. "Large" objects. These may require tens to hundreds of K depending on image size. Semantically they behave the same as small objects, but we distinguish them for two reasons:
   * On MS-DOS machines, large objects are referenced by FAR pointers, small objects by NEAR pointers.
   * Pool allocation heuristics may differ for large and small objects.
   Note that individual "large" objects cannot exceed the size allowed by type size_t, which may be 64K or less on some machines.
3. "Virtual" objects. These are large 2-D arrays of JSAMPLEs or JBLOCKs (typically large enough for the entire image being processed). The memory manager provides stripwise access to these arrays. On machines without virtual memory, the rest

of the array may be swapped out to a
temporary file.

(Note: JSAMPARRAY and JBLOCKARRAY data structures are a combination of large
objects for the data proper and small objects for the row pointers. For
convenience and speed, the memory manager provides single routines to create
these structures. Similarly, virtual arrays include a small control block
and a JSAMPARRAY or JBLOCKARRAY working buffer, all created with one call.)

In the present implementation, virtual arrays are only permitted to have image
lifespan. (Permanent lifespan would not be reasonable, and pass lifespan is
not very useful since a virtual array's raison d'etre is to store data for
multiple passes through the image.) We also expect that only "small" objects
will be given permanent lifespan, though this restriction is not required by
the memory manager.

In a non-virtual-memory machine, some performance benefit can be gained by
making the in-memory buffers for virtual arrays be as large as possible.
(For small
images, the buffers might fit entirely in memory, so blind
swapping would be very wasteful.) The memory manager will adjust the height
of the buffers to fit within a prespecified maximum memory usage. In order
to do this in a reasonably optimal fashion, the manager needs to allocate all
of the virtual arrays at once. Therefore, there isn't a one-step allocation
routine for virtual arrays; instead, there is a "request" routine that simply
allocates the control block, and a "realize" routine (called just once) that
determines space allocation and creates all of the actual buffers. The
realize routine must allow for space occupied by non-virtual large objects.
(We don't bother to factor in the space needed for small objects, on the
grounds that it isn't worth the trouble.)

To support all this, we establish the following protocol for doing business
with the memory manager:
1. Modules must request virtual arrays (which may have only image lifespan)
during the initial setup
phase, i.e., in their jinit_xxx routines.
2. All "large" objects (including JSAMPARRAYs and JBLOCKARRAYs) must also be
allocated during initial setup.
3. realize_virt_arrays will be called at the completion of initial setup.
The above conventions ensure that sufficient information is available
for it to choose a good size for virtual array buffers.
Small objects of any lifespan may be allocated at any time. We expect that
the total space used for small objects will be small enough to be negligible
in the realize_virt_arrays computation.

In a virtual-memory machine, we simply pretend that the available space is
infinite, thus causing realize_virt_arrays to decide that it can allocate all
the virtual arrays as full-size in-memory buffers. The overhead of the

virtual-array access protocol is very small when no swapping occurs.

A virtual array can be specified to be "pre-zeroed"; when this flag is set,
never-yet-written sections of the array are set to zero before being
made
available to the caller. If this flag is not set, never-written sections
of the array contain garbage. (This feature exists primarily because the
equivalent logic would otherwise be needed in jdcoefct.c for progressive
JPEG mode; we may as well make it available for possible other uses.)

The first write pass on a virtual array is required to occur in top-to-bottom
order; read passes, as well as any write passes after the first one, may
access the array in any order. This restriction exists partly to simplify
the virtual array control logic, and partly because some file systems may not
support seeking beyond the current end-of-file in a temporary file. The main
implication of this restriction is that rearrangement of rows (such as
converting top-to-bottom data order to bottom-to-top) must be handled while
reading data out of the virtual array, not while putting it in.

*** Memory manager internal structure ***

To isolate system dependencies as much as possible, we have broken
the
memory manager into two parts. There is a reasonably system-independent
"front end" (jmemmgr.c) and a "back end" that contains only the code
likely to change across systems. All of the memory management methods
outlined above are implemented by the front end. The back end provides
the following routines for use by the front end (none of these routines
are known to the rest of the JPEG code):

jpeg_mem_init, jpeg_mem_term system-dependent initialization/shutdown

jpeg_get_small, jpeg_free_small interface to malloc and free library routines
(or their equivalents)

jpeg_get_large, jpeg_free_large interface to FAR malloc/free in MSDOS machines;
else usually the same as
jpeg_get_small/jpeg_free_small

jpeg_mem_available estimate available memory

jpeg_open_backing_store create a backing-store object

read_backing_store, manipulate a backing-store object
write_backing_store,
close_backing_store

On some systems there will be more than one type of backing-store object
(specifically,
 in MS-DOS a backing store file might be an area of extended
memory as well as a disk file). jpeg_open_backing_store is responsible for
choosing how to implement a given object. The read/write/close routines
are method pointers in the structure that describes a given object; this
lets them be different for different object types.

It may be necessary to ensure that backing store objects are explicitly
released upon abnormal program termination. For example, MS-DOS won't free
extended memory by itself. To support this, we will expect the main program
or surrounding application to arrange to call self_destruct (typically via
jpeg_destroy) upon abnormal termination. This may require a SIGINT signal
handler or equivalent. We don't want to have the back end module install its
own signal handler, because that would pre-empt the surrounding application's
ability to control signal handling.

The IJG distribution includes several memory manager back end implementations.
Usually
 the same back end should be suitable for all applications on a given
system, but it is possible for an application to supply its own back end at
need.

*** Implications of DNL marker ***

Some JPEG files may use a DNL marker to postpone definition of the image
height (this would be useful for a fax-like scanner's output, for instance).
In these files the SOF marker claims the image height is 0, and you only
find out the true image height at the end of the first scan.

We could read these files as follows:
1. Upon seeing zero image height, replace it by 65535 (the maximum allowed).
2. When the DNL is found, update the image height in the global image
  descriptor.
This implies that control modules must avoid making copies of the image
height, and must re-test for termination after each MCU row. This would
be easy enough to do.

In cases where image-size data structures are allocated, this approach will
result in very inefficient use of virtual memory or much-larger-than-necessary
temporary
 files. This seems acceptable for something that probably won't be a
mainstream usage. People might have to forgo use of memory-hogging options
(such as two-pass color quantization or noninterleaved JPEG files) if they
want efficient conversion of such files. (One could improve efficiency by
demanding a user-supplied upper bound for the height, less than 65536; in most
cases it could be much less.)

The standard also permits the SOF marker to overestimate the image height,
with a DNL to give the true, smaller height at the end of the first scan.
This would solve the space problems if the overestimate wasn't too great.
However, it implies that you don't even know whether DNL will be used.

This leads to a couple of very serious objections:
1. Testing for a DNL marker must occur in the inner loop of the decompressor's
  Huffman decoder; this implies a speed penalty whether the feature is used
  or not.
2. There is no way to hide the last-minute change in image height from
 an
  application using the decoder. Thus *every* application using the IJG
  library would suffer a complexity penalty whether it cared about DNL or
  not.
We currently do not support DNL because of these problems.

A different approach is to insist that DNL-using files be preprocessed by a
separate program that reads ahead to the DNL, then goes back and fixes the SOF
marker. This is a much simpler solution and is probably far more efficient.
Even if one wants piped input, buffering the first scan of the JPEG file needs
a lot smaller temp file than is implied by the maximum-height method. For
this approach we'd simply treat DNL as a no-op in the decompressor (at most,
check that it matches the SOF image height).

We will not worry about making the compressor capable of outputting DNL.
Something similar to the first scheme above could be applied if anyone ever
wants to make that work.

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/structure.txt
No license file was found, but licenses were detected in source scan.

```
/*
* cdjpeg.h
*
* Copyright (C) 1994-1997, Thomas G. Lane.
* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains common declarations for the sample applications
* cjpeg and djpeg.  It is NOT used by the core JPEG library.
*/
```

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/cdjpeg.h

No license file was found, but licenses were detected in source scan.

```
/*
* jmemnobs.c
*
* Copyright (C) 1992-1996, Thomas G. Lane.
* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.
*
* This file provides a really simple implementation of the system-
* dependent portion of the JPEG memory manager.  This implementation
* assumes that no backing-store files are needed: all required space
* can be obtained from malloc().
* This is very portable in the sense that it'll compile on almost anything,
* but you'd better have lots of main memory (or virtual memory) if you want
* to process big images.
* Note that the max_memory_to_use option is ignored by this implementation.
*/
```

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/jmemnobs.c
No license file was found, but licenses were detected in source scan.

```
/*
* cderror.h
*
* Copyright (C) 1994-1997, Thomas G. Lane.
* Modified 2009 by Guido Vollbeding.
* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.
*
* This file defines the error and message codes for the cjpeg/djpeg
* applications.  These strings are not needed as part of the JPEG library
* proper.
* Edit this file to add new codes, or to translate the message strings to
* some other language.
*/
```

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/cderror.h
No license file was found, but licenses were detected in source scan.

```
/*
* jcsample.c
*
* Copyright (C) 1991-1996, Thomas G. Lane.
```

```
* Copyright 2009 Pierre Ossman <ossman@cendio.se> for Cendio AB
* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains downsampling routines.
*
* Downsampling input data is counted in "row groups".  A row group
* is defined to be max_v_samp_factor pixel rows of each component,
* from which the downsampler produces v_samp_factor sample rows.
* A single row group is processed in each call to the downsampler module.
*
* The downsampler is responsible for edge-expansion of its output data
* to fill an integral number of DCT blocks horizontally.  The source buffer
* may be modified if it is helpful for this purpose (the source buffer is
* allocated wide enough to correspond to the desired output width).
* The caller (the prep controller) is
 responsible for vertical padding.
*
* The downsampler may request "context rows" by setting need_context_rows
* during startup.  In this case, the input arrays will contain at least
* one row group's worth of pixels above and below the passed-in data;
* the caller will create dummy rows at image top and bottom by replicating
* the first or last real pixel row.
*
* An excellent reference for image resampling is
*   Digital Image Warping, George Wolberg, 1990.
*   Pub. by IEEE Computer Society Press, Los Alamitos, CA. ISBN 0-8186-8944-7.
*
* The downsampling algorithm used here is a simple average of the source
* pixels covered by the output pixel.  The hi-falutin sampling literature
* refers to this as a "box filter".  In general the characteristics of a box
* filter are not very good, but for the specific cases we normally use (1:1
* and 2:1 ratios) the box is equivalent to a "triangle filter" which is not
* nearly so bad.  If you intend to use other sampling ratios,
 you'd be well
* advised to improve this code.
*
* A simple input-smoothing capability is provided.  This is mainly intended
* for cleaning up color-dithered GIF input files (if you find it inadequate,
* we suggest using an external filtering program such as pnmconvol).  When
* enabled, each input pixel P is replaced by a weighted sum of itself and its
* eight neighbors.  P's weight is 1-8*SF and each neighbor's weight is SF,
* where SF = (smoothing_factor / 1024).
* Currently, smoothing is only supported for 2h2v sampling factors.
*/
```

Found in path(s):

* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-

archive-C8ga4kAj/libjpeg-turbo-1.2.90/jcsample.c
No license file was found, but licenses were detected in source scan.

```
/*
* jdcolext.c
*
* This file was part of the Independent JPEG Group's software:
* Copyright (C) 1991-1997, Thomas G. Lane.
* Modifications:
* Copyright (C) 2009, 2011, D. R. Commander.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains output colorspace conversion routines.
*/
```

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/jdcolext.c
No license file was found, but licenses were detected in source scan.

```
/*
* Copyright (C)2011-2012 D. R. Commander.  All Rights Reserved.
*
* Redistribution and use in source and binary forms, with or without
* modification, are permitted provided that the following conditions are met:
*
* - Redistributions of source code must retain the above copyright notice,
*   this list of conditions and the following disclaimer.
* - Redistributions in binary form must reproduce the above copyright notice,
*   this list of conditions and the following disclaimer in the documentation
*   and/or other materials provided with the distribution.
* - Neither the name of the libjpeg-turbo Project nor the names of its
*   contributors may be used to endorse or promote products derived from this
*   software without specific prior written permission.
*
* THIS SOFTWARE IS PROVIDED BY THE COPYRIGHT HOLDERS AND CONTRIBUTORS "AS IS",
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* LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR
* CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF
* SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS
* INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN
* CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE)
* ARISING IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE
* POSSIBILITY OF SUCH DAMAGE.
*/
```

Found in path(s):
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/java/org/libjpegturbo/turbojpeg/TJLoader.java
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/java/TJUnitTest.java
*
/libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/java/org/libjpegturbo/turbojpeg/TJCompressor.java
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/java/org/libjpegturbo/turbojpeg/TJ.java
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/turbojpeg-jni.c
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/java/TJExample.java
* /libjpeg-turbo-1.2.90-5.el7-1.src.rpm-cosi-expand-archive-UWi7FaRf/libjpeg-turbo-1.2.90.tar.gz-cosi-expand-archive-C8ga4kAj/libjpeg-turbo-1.2.90/java/org/libjpegturbo/turbojpeg/TJDecompressor.java

1.99 linenoise 1.0

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1.100 shared-mime-info 1.6

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1.103 mpdecimal 2.4.2

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1.104 libpciaccess 0.11.0

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1.106 libdrm 2.4.45

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1.107 freerdp 2.1.2

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1.108 luxon 1.25.1

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1.109 rrule 2.6.8

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rrule.js: Library for working with recurrence rules for calendar dates.
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1.110 react-zoom-pan-pinch 1.6.1

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1.111 react-day-picker 7.4.8

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1.112 libgcrypt 1.7.3

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1.113 open-ldap 2.4.58

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1.115 golang 1.8

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1.117 nginx 1.18.0

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1.120 @tensorflow/tfjs-core 3.11.0

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==\n
*/\n\nimport {backend_util, FusedDepthwiseConv2D, FusedDepthwiseConv2DAttrs,
FusedDepthwiseConv2DInputs, KernelConfig, KernelFunc, Tensor4D} from '@tensorflow/tfjs-core';\n\nimport
{BackendWasm} from '../backend_wasm';\n\nimport {FusableActivation} from './types';\n\nlet
wasmFusedDepthwiseConv2d:\n (xId: number, batchSize: number, inputHeight: number, inputWidth: number,\n
filterId: number, filterHeight: number, filterWidth: number,\n biasId: number, padTop: number, padRight:
number, padBottom: number,\n padLeft: number, isSamePad: number, dilationHeight: number,\n
dilationWidth: number, strideHeight: number, strideWidth: number,\n inputChannels: number, outputChannels:
number, activation: number,\n preluActivationWeightsId:
 number, leakyreluAlpha: number, outId: number) =>\n void;\n\nfunction setup(backend: BackendWasm) {\n
wasmFusedDepthwiseConv2d =\n backend.wasm.cwrap(FusedDepthwiseConv2D, null /* void */, [\n
'number', // xId\n 'number', // batchSize\n 'number', // inputHeight\n 'number', // inputWidth\n
'number', // filterId\n 'number', // filterHeight\n 'number', // filterWidth\n 'number', // biasId\n
'number', // padTop\n 'number', // padRight\n 'number', // padBottom\n 'number', // padLeft\n
'number', // isSamePad\n 'number', // dilationHeight\n 'number', // dilationWidth\n 'number', //
strideHeight\n 'number', // strideWidth\n 'number', // inputChannels\n 'number', // outputChannels\n
 'number', // activation\n 'number', // preluActivationWeightsId\n 'number', // leakyreluAlpha\n
'number',
 // outId\n]);\n}\n\nfunction fusedDepthwiseConv2d(args: {\n inputs: FusedDepthwiseConv2DInputs,\n
backend: BackendWasm,\n attrs: FusedDepthwiseConv2DAttrs\n}) {\n const {inputs, attrs, backend} = args;\n
const {x, filter, bias, preluActivationWeights} = inputs;\n const {\n strides,\n pad,\n dilations,\n
dataFormat,\n dimRoundingMode,\n activation,\n leakyreluAlpha\n } = attrs;\n\n const convInfo =
backend_util.computeConv2DInfo(\n (x as Tensor4D).shape, (filter as Tensor4D).shape, strides, dilations,\n
pad, dimRoundingMode, true /* depthwise */);\n\n const fusedActivation =\n FusableActivation[activation as {}
as keyof typeof FusableActivation];\n if (fusedActivation == null) {\n throw new Error(\n `${activation}
activation not yet supported for FusedDepthwiseConv2D ` +\n `in the wasm backend.`);\n }\n\n const xId =
backend.dataIdMap.get(x.dataId).id;\n const filterId = backend.dataIdMap.get(filter.dataId).id;\n\n
 const outputChannels = convInfo.outChannels;\n\n let biasId = 0;\n if (bias != null) {\n const biasData =
backend.dataIdMap.get(bias.dataId);\n if (biasData.shape.length !== 1) {\n throw new Error(\n
`FusedDepthwiseConv2D only supports rank-1 bias but got ` +\n `rank ${biasData.shape.length}.`);\n }\n
if (biasData.shape[0] !== outputChannels) {\n throw new Error(\n `FusedDepthwiseConv2D bias shape
(${biasData.shape}) does not ` +\n `match the number of output channels (${outputChannels})`);\n }\n
biasId = biasData.id;\n }\n\n const filterHeight = convInfo.filterHeight;\n const filterWidth =
convInfo.filterWidth;\n const padTop = convInfo.padInfo.top;\n const padRight = convInfo.padInfo.right;\n const
padBottom = convInfo.padInfo.bottom;\n const padLeft = convInfo.padInfo.left;\n const dilationHeight =

convInfo.dilationHeight;\n const dilationWidth = convInfo.dilationWidth;\n const strideHeight = convInfo.strideHeight;\n
  const strideWidth = convInfo.strideWidth;\n const inputChannels = convInfo.inChannels;\n const isSamePad = convInfo.padInfo.type === 'SAME' ? 1 : 0;\n const batchSize = convInfo.batchSize;\n const inHeight = convInfo.inHeight;\n const inWidth = convInfo.inWidth;\n\n if (dataFormat !== 'NHWC') {\n   throw new Error(\n   `wasm backend FusedDepthwiseConv2D does not support dataFormat:'` +\n   `${dataFormat}'. Please use 'NHWC'.`);\n }\n\n const out = backend.makeOutput(convInfo.outShape, 'float32');\n const outId = backend.dataIdMap.get(out.dataId).id;\n const preluActivationWeightsId = preluActivationWeights == null ?\n   0 :\n   backend.dataIdMap.get(preluActivationWeights.dataId).id;\n\n wasmFusedDepthwiseConv2d(\n   xId, batchSize, inHeight, inWidth, filterId, filterHeight, filterWidth,\n   biasId, padTop, padRight, padBottom, padLeft, isSamePad, dilationHeight,\n   dilationWidth, strideHeight, strideWidth, inputChannels, outputChannels,\n   fusedActivation, preluActivationWeightsId, leakyreluAlpha || 0, outId);\n\n return out;\n}\n\nexport const fusedDepthwiseConv2DConfig: KernelConfig = {\n kernelName: FusedDepthwiseConv2D,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: fusedDepthwiseConv2d as {} as KernelFunc\n};\n"]}

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Found in path(s):
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*/\nimport {GreaterEqual, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from './binary_kernel';\n\nconst supportsFullBroadcast = false;\nexport const greaterEqualConfig: KernelConfig =\n createBinaryKernelConfig(GreaterEqual, supportsFullBroadcast, 'bool');\n"]}

Found in path(s):
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* /tfjs-backend-wasm-zip/tfjs-backend-wasm/src/cc/kernels/Maximum.cc
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*** */
/**
* @deprecated Use `setWasmPaths` instead.
* Sets the path to the `.wasm` file which will be fetched when the wasm
* backend is initialized. See
* https://github.com/tensorflow/tfjs/blob/master/tfjs-backend-wasm/README.md#using-bundlers
* for more details.
* @param path wasm file path or url
* @param
 usePlatformFetch optional boolean to use platform fetch to download
*   the wasm file, default to false.
*
* @doc {heading: 'Environment', namespace: 'wasm'}
*/

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==========\n */\nimport {Equal, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from './binary_kernel';\n\nconst supportsFullBroadcast = false;\nexport const equalConfig: KernelConfig =\n createBinaryKernelConfig(Equal, supportsFullBroadcast, 'bool');\n"]}

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==========\n */\nimport {KernelConfig, Sub} from '@tensorflow/tfjs-core';\nimport {createBinaryKernelConfig} from './binary_kernel';\nconst supportsFullBroadcast = true;\nexport const subConfig: KernelConfig =\n createBinaryKernelConfig(Sub, supportsFullBroadcast);\n"]}

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shapeInfo = backend_util.segment_util.collectGatherOpShapeInfo(\n x as Tensor, indices as Tensor, parsedAxis, batchDims);\n\n const flattenX = reshape({\n inputs: {x},\n attrs: {\n shape: [\n shapeInfo.batchSize, shapeInfo.outerSize, shapeInfo.dimSize,\n shapeInfo.sliceSize\n]\n },\n backend\n });\n const indicesSize = util.sizeFromShape(indices.shape);\n const flattenIndex = reshape({\n inputs: {x: indices},\n attrs: {shape: [shapeInfo.batchSize, indicesSize / shapeInfo.batchSize]},\n backend\n });\n const flattenOutputShape = [\n shapeInfo.batchSize, shapeInfo.outerSize, indicesSize / shapeInfo.batchSize,\n shapeInfo.sliceSize\n];\n\n const out = backend.makeOutput(flattenOutputShape, x.dtype);\n if (util.sizeFromShape(x.shape) === 0) {\n return out;\n }\n const stridesSize = flattenX.shape.length - 1;\n\n const xData = backend.dataIdMap.get(flattenX.dataId);\n const xId = xData.id;\n\n const indicesData = backend.dataIdMap.get(flattenIndex.dataId);\n const indicesId = indicesData.id;\n\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n const xStridesBytes = new Uint8Array(\n new Int32Array(util.computeStrides(flattenX.shape)).buffer);\n const outStridesBytes = new Uint8Array(\n new Int32Array(util.computeStrides(flattenOutputShape)).buffer);\n\n wasmGather(\n xId, CppDType[x.dtype], xStridesBytes, stridesSize, indicesId,\n shapeInfo.batchSize, outStridesBytes, outId);\n\n backend.disposeData(flattenX.dataId);\n backend.disposeData(flattenIndex.dataId);\n\n // reshape\n out.shape = shapeInfo.outputShape;\n return out;\n}\n\nexport const gatherV2Config: KernelConfig = {\n kernelName: GatherV2,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: gatherV2 as {} as KernelFunc\n};\n"]}

Found in path(s):
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernels/GatherV2.js.map
No license file was found, but licenses were detected in source scan.

{"version":3,"file":"StridedSlice.js","sourceRoot":"","sources":["../../src/kernels/StridedSlice.ts"],"names":[],"mappings":"AAAA;;;;;;;;;;;;;;GAeG;AAEH,OAAO,EAA2B,UAAU,EAAE,YAAY,EAAqD,IAAI,EAAC,MAAM,uBAAuB,CAAC;AAGlJ,OAAO,EAAC,OAAO,EAAC,OAAO,EAAC,MAAM,WAAW,CAAC;AAClC,OAAO,EAAC,OAAO,EAAC,KAAK,EAAC,MAAM,SAAS,EAAC,OAAO,EAAC,KAAK,EAAC,MAAM,WAAW,CAAC;AAE9B,IAAI,gBAAI8C,CAAC;AAEnD,OAAO,EAAC,OAAO,EAAC,CAAC,EAAC,IAAI,EAAC,CAAC,EAAC,KAAK,EAAC,CAAC,EAAC,YAAY,EAAC,IAAI,EAAC,CAAC,EAAC,QAAQ,EAAC,IAAI,EAAC;QACjE,OAAO;QACP,QAAQ;QACR,OAAO;QACP,OAAO;QACP,OAAO;QACP,OAAO;QACP,QAAQ;QACR,OAAO;QACP,QAAQ;QACR,QAAQ;KACT,CAAC,CAAC;AACL,CAAC;AAED,MAAM,UAAU,YAAY,CAAC,IAAI5B;IAAI,EAAC,MAAM,EAAC,OAAO,EAAC,MAAM,EAAC,OAAO,EAAC,MAAM,EAAC,OAAO

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stridesBytes = new Uint8Array(new Int32Array($strides).buffer);\n\n   const outputShapeBytes =\n   new Uint8Array(new Int32Array(finalShapeSparse).buffer);\n   const outStridesBytes = new Uint8Array(\n   new Int32Array(util.computeStrides(finalShapeSparse)).buffer);\n   const outId = backend.dataIdMap.get(out.dataId).id;\n\n   wasmStridedSlice(\n   xId, xStridesBytes, x.shape.length, beginBytes, endBytes, stridesBytes,\n   outputShapeBytes, outStridesBytes, finalShapeSparse.length, outId);\n\n   result = reshape({inputs: {x: out}, backend, attrs: {shape: finalShape}});\n\n backend.disposeData(out.dataId);\n }\n\n return result;\n}\n\nexport const stridedSliceConfig: KernelConfig = {\n kernelName: StridedSlice,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: stridedSlice as {} as KernelFunc\n};\n"]}

Found in path(s):
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernels/StridedSlice.js.map
No license file was found, but licenses were detected in source scan.

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law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n
 * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {backend_util, BinaryInputs, DataType, KernelConfig, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {CppDType} from './types';\n\nexport function createBinaryKernelConfig(\n kernelName: string, supportsFullBroadcast: boolean,\n dtype?: DataType): KernelConfig {\n let wasmFunc:\n   (aId: number, aShape: Uint8Array, aShapeLen: number, bId: number,\n   bShape: Uint8Array, bShapeLen: number, dtype: number, outId: number) =>\n   void;\n\n function setupFunc(backend: BackendWasm): void {\n   wasmFunc = backend.wasm.cwrap(kernelName, null /* void */, [\n   'number', // a_id,\n   'array',   // a_shape\n   'number', // a_shape.length\n   'number', // b_id\n   'array',   // b_shape\n   'number',
  // b_shape.length\n   'number', // dtype\n   'number'   // out_id\n   ]);\n }\n\n function kernelFunc(args: {backend: BackendWasm, inputs: BinaryInputs}):\n   TensorInfo {\n   const {backend, inputs} = args;\n   const {a, b} = inputs;\n   const aId = backend.dataIdMap.get(a.dataId).id;\n   const bId = backend.dataIdMap.get(b.dataId).id;\n\n   const outputType = dtype != null ? dtype : a.dtype;\n   const newShape = backend_util.assertAndGetBroadcastShape(a.shape, b.shape);\n   const out = backend.makeOutput(newShape, outputType);\n\n   // Short-circuit zero-sized tensors.\n   if (util.sizeFromShape(newShape) === 0) {\n   return out;\n   }\n\n   const aShapeBytes = new Uint8Array(new Int32Array(a.shape).buffer);\n   const bShapeBytes = new Uint8Array(new Int32Array(b.shape).buffer);\n   const outId = backend.dataIdMap.get(out.dataId).id;\n   const kernelFunc = () => wasmFunc(\n   aId, aShapeBytes, a.shape.length, bId, bShapeBytes, b.shape.length,\n   CppDType[a.dtype], outId);\n\n   // Currently only some float operations support full broadcast.\n   if (supportsFullBroadcast && a.dtype === 'float32') {\n   kernelFunc();\n   return out;\n   }\n\n   const aBroadcastDims = backend_util.getBroadcastDims(a.shape, newShape);\n   const bBroadcastDims = backend_util.getBroadcastDims(b.shape, newShape);\n   const loopsOverAllOfA = aBroadcastDims.every((v, i) => v === i);\n   const loopsOverAllOfB = bBroadcastDims.every((v, i) => v === i);\n   if (loopsOverAllOfA && loopsOverAllOfB) {\n   kernelFunc();\n   return out;\n   } else {\n   throw new Error(\n   `Broadcasting along outer dims is not yet ` +\n   `supported for ${a.dtype} ${kernelName}.`);\n   }\n }\n\n return {kernelName, backendName: 'wasm', setupFunc, kernelFunc};\n}\n"]}

Found in path(s):
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernels/binary_kernel.js.map
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'maxPoolWithArgmax' // Not yet implemented.\n\n]\n },\n {include: 'cropAndResize'},\n {\n include: 'resizeBilinear',\n excludes: [\n 'gradients', // Not yet implemented.\n]\n },\n {\n include: 'matmul ',\n excludes: [\n 'valueAndGradients',
// Gradients not defined yet\n 'gradient', // Gradients not defined yet\n 'zero in its shape', // Zero in shapes aren't supported yet\n 'matmul followed by mul', // mul not supported yet\n 'upcasts', // Upcasting not supported yet.\n 'fused A x B with 2d bias', // Fused matMul with 2D bias not yet\n // supported.\n]\n },\n {\n include: 'depthwiseConv2D ',\n excludes: [\n 'broadcasted bias', // Broadcasted bias not yet supported.\n 'gradient', // Gradients not defined yet.\n 'NCHW', // xnn pack does not support channels first.\n]\n },\n {\n include: 'conv2d ',\n excludes: [\n 'broadcasted bias', // Broadcasted bias not yet supported.\n 'gradient', // Gradients not defined yet.\n 'backProp input x=[2,3,3,1] f=[2,2,1,1] s=1 p=0', // Gradients not\n // defined.\n 'NCHW', // xnn pack does not support channels first.\n // Issue: https://github.com/tensorflow/tfjs/issues/3104.\n // Actual != expected.\n 'relu bias stride 2 x=[1,8,8,16] f=[3,3,16,1] s=[2,2] d=8 p=same',\n 'prelu bias stride 2 x=[1,8,8,16] f=[3,3,16,1] s=[2,2] d=8 p=same',\n]\n },\n {include: 'conv2dTranspose ', excludes: ['gradient']},\n {\n include: 'prelu ',\n excludes: [\n 'gradient', // Gradient is missing.\n 'derivative' // Missing gradient.\n]\n },\n {\n include: ' cast ',\n excludes: [\n 'complex', // Complex numbers not yet implemented.\n 'shallow slice an input that was cast' // Slice is not implemented.\n]\n },\n {\n include: 'gather',\n excludes: [\n 'gradient' // Not yet implemented.\n]\n },\n {\n include: 'sigmoid ',\n excludes: [\n 'sigmoidCrossEntropy', // Not yet implemented.\n 'gradient' // Not
yet implemented.\n]\n },\n {include: 'scatterND '},\n {\n include: 'abs ',\n excludes: [\n 'gradient', // Not yet implemented.\n 'complex' // Complex numbers not supported yet.\n]\n },\n {\n include: 'sub ',\n excludes: [\n 'complex', // Complex numbers not yet implemented.\n 'gradient', // Not yet implemented.\n 'upcasts', // Upcasting not supported yet.\n]\n },\n {\n include: 'mul ',\n excludes: [\n 'complex', // Complex numbers not yet supported.\n 'gradient', // Gradient not defined yet.\n]\n },\n {\n include: 'div ',\n excludes: [\n 'gradient', // Gradient not defined yet.\n 'upcasts', // Cast not supported yet.\n 'divNoNan' // divNoNan not yet implemented.\n]\n },\n {\n include: 'batchNorm',\n excludes: [\n 'gradient' // Gradient is missing.\n]\n },\n {include: 'slice '},\n {include: 'stridedSlice '},\n {include: 'rotate '},\n {include: 'rotateWithOffset'},\n
{include: 'flipLeftRight '},\n {include: 'square '},\n {include: 'squaredDifference'},\n {\n startsWith: 'min ',\n excludes: [\n '2D, axis=0', // Permuted axes requires transpose, which is not yet\n // implemented.\n 'index corresponds to start of a non-initial window', // argMin not yet\n // implemented.,\n 'gradient' // Gradients not yet implemented\n]\n },\n {\n startsWith: 'max ',\n excludes: [\n 'gradient' // Gradients not yet implemented\n]\n },\n {\n include: 'concat',\n excludes: [\n 'complex', // Complex numbers not supported yet\n 'gradient' // Split is not yet implemented\n]\n },\n {include: 'transpose'},\n {include: 'oneHot'},\n {include: 'split'},\n {include: 'pad ', excludes: ['complex', 'zerosLike']},\n {\n include: 'clip',\n excludes: [\n 'gradient',\n 'propagates NaNs' // clip
delegates to XNNPACK which does not make\n // guarantees about behavior of nans.\n]\n },\n {include: 'addN'},\n {include: 'nonMaxSuppression'},\n {include: 'argmax', excludes: ['gradient']},\n {include: 'exp '},\n {\n include: 'elu',\n excludes: [\n 'derivative', // Not yet implemented.\n 'gradient', // Not yet implemented.\n 'selu' // Not yet implemented.\n]\n },\n {include: 'unstack'},\n {\n include: 'minimum',\n excludes: [\n 'gradient', // Not yet implemented.\n 'broadcasts 2x1 Tensor2D and 2x2 Tensor2D' // Broadcasting along inner\n // dims not supported yet.\n]\n },\n {\n include: 'maximum',\n excludes: [\n 'gradient', // Not yet implemented.\n 'broadcasts 2x1 Tensor2D and 2x2 Tensor2D' // Broadcasting along inner\n

// dims not supported yet.\n]\n },\n {\n include: 'log ',\n },\n {\n startsWith: 'equal ',\n excludes: [\n 'broadcasting Tensor2D shapes', // Broadcasting along outer dims not\n // supported

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Found in path(s):
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/setup_test.js.map
No license file was found, but licenses were detected in source scan.

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*/\n\nimport {backend_util, BatchToSpaceND, BatchToSpaceNDAttrs, BatchToSpaceNDInputs, KernelConfig, KernelFunc} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {reshape} from './Reshape';\nimport {slice} from './Slice';\nimport {transpose} from './Transpose';\n\nfunction batchToSpaceND(args: {\n inputs: BatchToSpaceNDInputs,\n backend: BackendWasm,\n attrs: BatchToSpaceNDAttrs\n}) {\n const {inputs, backend, attrs} = args;\n const {x} = inputs;\n const {blockShape, crops} = attrs;\n\n const prod = blockShape.reduce((a, b) => a * b);\n\n const reshaped = backend_util.getReshaped(x.shape, blockShape, prod);\n const permuted = backend_util.getPermuted(reshaped.length, blockShape.length);\n const reshapedPermuted =\n backend_util.getReshapedPermuted(x.shape, blockShape, prod);\n const sliceBeginCoords =\n backend_util.getSliceBeginCoords(crops, blockShape.length);\n const sliceSize =\n backend_util.getSliceSize(reshapedPermuted, crops, blockShape.length);\n\n const xReshaped = reshape({inputs: {x}, backend, attrs: {shape: reshaped}});\n const xTransposed =\n   transpose({inputs: {x: xReshaped}, backend, attrs: {perm: permuted}});\n const xTransposedReshaped = reshape(\n   {inputs: {x: xTransposed}, backend, attrs: {shape: reshapedPermuted}});\n const result = slice({\n   inputs: {x: xTransposedReshaped},\n   backend,\n   attrs: {begin: sliceBeginCoords, size: sliceSize}\n });\n\n backend.disposeData(xReshaped.dataId);\n backend.disposeData(xTransposed.dataId);\n backend.disposeData(xReshaped.dataId);\n\n return result;\n}\n\nexport const batchToSpaceNDConfig: KernelConfig = {\n kernelName: BatchToSpaceND,\n backendName: 'wasm',\n kernelFunc: batchToSpaceND as {} as KernelFunc\n};\n"]}

Found in path(s):
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernels/BatchToSpaceND.js.map
No license file was found, but licenses were detected in source scan.

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{permuteAxesAndTranspose} from './kernel_utils';\n\nlet wasmMean: (xId: number, reduceSize: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n wasmMean =\n backend.wasm.cwrap(Mean, null /*void*/, ['number, number, number']);\n}\n\nexport function mean(\n   args: {backend: BackendWasm, inputs: MeanInputs, attrs: MeanAttrs}):\n   TensorInfo {\n const {backend, inputs, attrs} = args;\n const
 {axis, keepDims} = attrs;\n const {x} = inputs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n let inputId = xId;\n let input = x;\n\n const {transposed, axes, originalAxes, inputWasTransposed} =\n permuteAxesAndTranspose(x, axis, backend);\n\n let reductionAxes = axes;\n if (inputWasTransposed) {\n   const transposedId = backend.dataIdMap.get(transposed.dataId).id;\n   if (transposedId !== xId) {\n   // transpose was not a no-op. We will need to dispose of this\n   // once we are done.\n   input = transposed;\n   inputId = transposedId;\n   reductionAxes = backend_util.getInnerMostAxes(\n   reductionAxes.length, input.shape.length);\n   }\n }\n\n backend_util.assertAxesAreInnerMostDims(\n   'mean', reductionAxes, input.shape.length);\n const [outShape, reduceShape] =\n backend_util.computeOutAndReduceShapes(input.shape, reductionAxes);\n const reduceSize = util.sizeFromShape(reduceShape);\n let castedInput = input;\n if (input.dtype
 !== 'float32') {\n   castedInput =\n   cast({backend, inputs: {x: input}, attrs: {dtype: 'float32'}});\n   inputId = backend.dataIdMap.get(castedInput.dataId).id;\n }\n\n const out = backend.makeOutput(outShape, 'float32');\n if (util.sizeFromShape(input.shape) !== 0) {\n   const outId = backend.dataIdMap.get(out.dataId).id;\n wasmMean(inputId, reduceSize, outId);\n }\n\n if (inputWasTransposed) {\n   // dispose of the transposed tensor.\n   backend.disposeData(transposed.dataId);\n }\n\n if (keepDims) {\n   // reshape\n   const newShape = backend_util.expandShapeToKeepDim(out.shape, originalAxes);\n   out.shape = newShape;\n }\n\n if (input.dtype !== 'float32') {\n   backend.disposeData(castedInput.dataId);\n }\n\n return out;\n}\n\nexport const meanConfig: KernelConfig = {\n kernelName: Mean,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: mean as {} as KernelFunc\n};\n"]}

Found in path(s):
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernels/Mean.js.map
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* distributed under the License is distributed on an "AS IS" BASIS,
* WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.
* See the License for the specific language governing permissions and
* limitations under the License.
* ===
*/
/**
* @deprecated Use `setWasmPaths` instead.
* Sets the path to the `.wasm` file which will be fetched when the wasm

* backend is initialized. See
* https://github.com/tensorflow/tfjs/blob/master/tfjs-backend-wasm/README.md#using-bundlers
 * for more details.
* @param path wasm file path or url
* @param usePlatformFetch optional boolean to use platform fetch to download
*   the wasm file, default to false.
*
* @doc {heading: 'Environment', namespace: 'wasm'}
*/

Found in path(s):
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/src/backend_wasm.ts
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No license file was found, but licenses were detected in source scan.

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const outId = backend.dataIdMap.get(out.dataId).id;\n wasmFunc(inputIdsBytes, inputIds.length, CppDType[out.dtype], outId);\n\n return out;\n}\n\nexport const addNConfig: KernelConfig = {\n kernelName: AddN,\n backendName: 'wasm',\n setupFunc,\n kernelFunc: addn as {} as KernelFunc,\n};\n"]}

Found in path(s):
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernels/AddN.js.map
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except in compliance with the License.\n * You may obtain a copy of the License at\n *\n *
http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing,
software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES
OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language
governing permissions and\n * limitations under the License.\n *
==========================================================================\n
*/\n\nimport * as tf from '@tensorflow/tfjs-core';\nimport {registerBackend, removeBackend, test_util, util} from
'@tensorflow/tfjs-core';\n// tslint:disable-next-line:no-imports-from-dist\nimport {ALL_ENVS, BROWSER_ENVS,
describeWithFlags} from '@tensorflow/tfjs-core/dist/jasmine_util';\n\nimport {init, resetWasmPath} from
'./backend_wasm';\nimport
 {BackendWasm, setWasmPath, setWasmPaths} from './index';\n\n/**\n * Tests specific to the wasm backend. The
name of these tests must start with\n * 'wasm' so that they are always included in the test runner. See\n *
`env.specFilter` in `setup_test.ts` for details.\n */\ndescribeWithFlags('wasm read/write', ALL_ENVS, () => {\n
it('write and read values', async () => {\n    const x = tf.tensor1d([1, 2, 3]);\n    test_util.expectArraysClose([1, 2, 3],
await x.data());\n  });\n\n  it('allocate repetitively and confirm reuse of heap space', () => {\n    const backend =
tf.backend() as BackendWasm;\n    const size = 100;\n    // Allocate for the first time, record the memory offset and
dispose.\n    const t1 = tf.zeros([size]);\n    const memOffset1 = backend.getMemoryOffset(t1.dataId);\n
t1.dispose();\n\n    // Allocate again and make sure the offset is the same (memory was reused).\n    const t2 =
tf.zeros([size]);\n    const memOffset2 = backend.getMemoryOffset(t2.dataId);\n
    // This should fail in case of a memory leak.\n    expect(memOffset1).toBe(memOffset2);\n  });\n\n  it('allocates
buffers with byteOffsets', async () => {\n    const data = [-0.5, 0.5, 3.14];\n    const buffer = new ArrayBuffer(32);\n
 const view = new Float32Array(buffer, 8, data.length);\n\n    // Write values to buffer.\n    for (let i = 0; i <
data.length; ++i) {\n      view[i] = data[i];\n    }\n\n    const t = tf.tensor(view);\n    // Tensor values should match.\n
test_util.expectArraysClose(await t.data(), view);\n  });\n});\n\ndescribeWithFlags('wasm init', BROWSER_ENVS,
() => {\n  beforeEach(() => {\n    registerBackend('wasm-test', async () => {\n      const {wasm} = await init();\n
return new BackendWasm(wasm);\n    }, 100);\n\n    // Silences backend registration warnings.\n    spyOn(console,
'warn');\n    spyOn(console, 'log');\n  });\n\n  afterEach(() => {\n    resetWasmPath();\n    removeBackend('wasm-
test');\n  });\n\n  it('backend init fails when the
 path is invalid', async () => {\n    setWasmPath('invalid/path');\n    let wasmPath: string;\n    const realFetch =
fetch;\n    spyOn(self, 'fetch').and.callFake((path: string) => {\n      wasmPath = path;\n      return realFetch(path);\n
});\n    expect(await tf.setBackend('wasm-test')).toBe(false);\n    expect(wasmPath).toBe('invalid/path');\n  });\n\n
it('backend init fails when setWasmPaths is called with ' +\n        'an invalid prefix',\n    async () => {\n
setWasmPaths('invalid/prefix/');\n      let wasmPath: string;\n      const realFetch = fetch;\n      spyOn(self,
'fetch').and.callFake((path: string) => {\n        wasmPath = path;\n        return realFetch(path);\n      });\n
expect(await tf.setBackend('wasm-test')).toBe(false);\n      expect(wasmPath).toContain('invalid/prefix');\n    });\n\n
it('backend init fails when setWasmPaths is called with ' +\n        'an invalid fileMap',\n    async () => {\n
setWasmPaths({\n        'tfjs-backend-wasm.wasm':
 'invalid/path',\n        'tfjs-backend-wasm-simd.wasm': 'invalid/path',\n        'tfjs-backend-wasm-threaded-
simd.wasm': 'invalid/path'\n      });\n      let wasmPathPrefix: string;\n      const realFetch = fetch;\n      spyOn(self,
'fetch').and.callFake((path: string) => {\n        wasmPathPrefix = path;\n        return realFetch(path);\n      });\n
expect(await tf.setBackend('wasm-test')).toBe(false);\n      expect(wasmPathPrefix).toBe('invalid/path');\n    });\n\n
it('setWasmPaths throws error when called without specifying a path for ' +\n        'each binary',\n    async () => {\n
    expect(() => {\n        setWasmPaths({\n          'tfjs-backend-wasm.wasm': '/base/wasm-out/tfjs-backend-
wasm.wasm'\n        });\n      }).toThrow();\n    });\n\n  it('backend init works when the path is valid and use
platform fetch',\n    async () => {\n      const usePlatformFetch = true;\n      const validPrefix = '/base/wasm-out/';\n
    setWasmPaths(validPrefix,
```

usePlatformFetch);\n let wasmPath: string;\n const realFetch = util.fetch;\n spyOn(util, 'fetch').and.callFake((path: string) => {\n wasmPath = path;\n return realFetch(path);\n });\n expect(await tf.setBackend('wasm-test')).toBe(true);\n const validPaths = new Set([\n validPrefix + 'tfjs-backend-wasm.wasm',\n validPrefix + 'tfjs-backend-wasm-simd.wasm',\n validPrefix + 'tfjs-backend-wasm-threaded-simd.wasm',\n]);\n expect(validPaths).toContain(wasmPath);\n });\n\n it('backend init works when the wasm paths overrides map is valid and ' +\n 'using platform fetch',\n async () => {\n const usePlatformFetch = true;\n const validPrefix = '/base/wasm-out/';\n setWasmPaths(\n {\n 'tfjs-backend-wasm.wasm': '/base/wasm-out/tfjs-backend-wasm.wasm',\n 'tfjs-backend-wasm-simd.wasm':\n '/base/wasm-out/tfjs-backend-wasm-simd.wasm',\n 'tfjs-backend-wasm-threaded-simd.wasm':\n '/base/wasm-out/tfjs-backend-wasm-threaded-simd.wasm'\n },\n usePlatformFetch);\n let wasmPath: string;\n const realFetch = util.fetch;\n spyOn(util, 'fetch').and.callFake((path: string) => {\n wasmPath = path;\n return realFetch(path);\n });\n expect(await tf.setBackend('wasm-test')).toBe(true);\n const validPaths = new Set([\n validPrefix + 'tfjs-backend-wasm.wasm',\n validPrefix + 'tfjs-backend-wasm-simd.wasm',\n validPrefix + 'tfjs-backend-wasm-threaded-simd.wasm',\n]);\n expect(validPaths).toContain(wasmPath);\n });\n\n it('backend init works when the path is valid and use platform fetch',\n async () => {\n const usePlatformFetch = true;\n const validPath = '/base/wasm-out/tfjs-backend-wasm.wasm';\n setWasmPath(validPath, usePlatformFetch);\n let wasmPath:
string;\n const realFetch = util.fetch;\n spyOn(util, 'fetch').and.callFake((path: string) => {\n wasmPath = path;\n return realFetch(path);\n });\n expect(await tf.setBackend('wasm-test')).toBe(true);\n expect(wasmPath).toBe(validPath);\n });\n\n // Disabling this test because it intermittently times out on CI.\n // tslint:disable-next-line: ban\n xit('backend init fails when the path is invalid and use platform fetch',\n async () => {\n const usePlatformFetch = true;\n setWasmPath('invalid/path', usePlatformFetch);\n let wasmPath: string;\n const realFetch = util.fetch;\n spyOn(util, 'fetch').and.callFake((path: string) => {\n wasmPath = path;\n return realFetch(path);\n });\n expect(await tf.setBackend('wasm-test')).toBe(false);\n expect(wasmPath).toBe('invalid/path');\n });\n\n it('backend init succeeds with default path', async () => {\n expect(await
tf.setBackend('wasm-test')).toBe(true);\n });\n\n it('setWasmPath called too late', async () => {\n // Set an invalid path.\n setWasmPath('invalid/path');\n await tf.setBackend('wasm-test');\n\n // Setting the path too late.\n expect(() => setWasmPath('too/late'))\n .toThrowError(/The WASM backend was already initialized. Make sure/);\n });\n});\n"]}

Found in path(s):
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/index_test.js.map
No license file was found, but licenses were detected in source scan.

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==========\n */\n\nimport {KernelConfig, KernelFunc} from '@tensorflow/tfjs-core';\nimport {Fill, FillAttrs} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nexport function fill(args: {attrs: FillAttrs, backend: BackendWasm}) {\n const {attrs: {shape, value, dtype}, backend} = args;\n const out = backend.makeOutput(shape, dtype);\n const outVals = backend.typedArrayFromHeap(out);\n outVals.fill(value as number);\n return out;\n}\n\nexport const fillConfig: KernelConfig = {\n kernelName: Fill,\n backendName: 'wasm',\n kernelFunc: fill as {} as KernelFunc,\n};\n"]}

Found
in path(s):
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernels/Fill.js.map
No license file was found, but licenses were detected in source scan.

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Found in path(s):
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernels/Sum.js.map
No license file was found, but licenses were detected in source scan.

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 * ===\n
*/\nimport {Elu, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\n\nexport const eluConfig: KernelConfig = createUnaryKernelConfig(Elu);\n"]}

Found in path(s):
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernels/Elu.js.map
No license file was found, but licenses were detected in source scan.

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Found in path(s):
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernels/ExpandDims.js.map
No license file was found, but licenses were detected in source scan.

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Found in path(s):
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernels/Exp.js.map
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 * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.
 * See the License for the specific language governing permissions and
 * limitations under the License.
 * =============================================================================
 */
/**
 * @deprecated Use `setWasmPaths`
instead.
 * Sets the path to the `.wasm` file which will be fetched when the wasm
 * backend is initialized. See
 * https://github.com/tensorflow/tfjs/blob/master/tfjs-backend-wasm/README.md#using-bundlers
 * for more details.
 * @param path wasm file path or url
 * @param usePlatformFetch optional boolean to use platform fetch to download
 *     the wasm file, default to false.
 *
```

* @doc {heading: 'Environment', namespace: 'wasm'}
*/

Found in path(s):
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/tf-backend-wasm.es2017.js
No license file was found, but licenses were detected in source scan.

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 and\n * limitations under the License.\n *
==\n
*/\nimport {KernelConfig, Pow} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from
'./binary_kernel';\nconst supportsFullBroadcast = false;\nexport const powConfig: KernelConfig =\n
createBinaryKernelConfig(Pow, supportsFullBroadcast);\n"]}

Found in path(s):
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernels/Pow.js.map
No license file was found, but licenses were detected in source scan.

{"version":3,"file":"index.js","sources":["../../src/kernels/types.ts","../../src/kernels/_FusedMatMul.ts","../../src/kernels/unary_kernel.ts","../../src/kernels/Abs.ts","../../src/kernels/binary_kernel.ts","../../src/kernels/Add.ts","../../src/kernels/AddN.ts","../../src/kernels/Identity.ts","../../src/kernels/Transpose.ts","../../src/kernels/kernel_utils.ts","../../src/kernels/All.ts","../../src/kernels/Any.ts","../../src/kernels/ArgMax.ts","../../src/kernels/AvgPool.ts","../../src/kernels/Reshape.ts","../../src/kernels/BatchMatMul.ts","../../node_modules/@tensorflow/tfjs-backend-cpu/dist/kernels/Concat_impl.js","../../node_modules/@tensorflow/tfjs-backend-cpu/dist/kernels/Range_impl.js","../../node_modules/@tensorflow/tfjs-backend-cpu/dist/kernels/Slice.js","../../src/kernels/Slice.ts","../../src/kernels/BatchToSpaceND.ts","../../src/kernels/Cast.ts","../../src/kernels/Ceil.ts","../../src/kernels/ClipByValue.ts","../../src/kernels/Concat.ts","../../src/kernels/Conv2D.ts","../../src/kernels/Conv2DBackpropInput.ts","../../src/kernels/Cos.ts","../../src/kernels/Cosh.ts","../../src/kernels/CropAndResize.ts","../../src/kernels/Cumsum.ts","../../src/kernels/DepthToSpace.ts","../../src/kernels/DepthwiseConv2dNative.ts","../../src/kernels/Elu.ts","../../src/kernels/Equal.ts","../../src/kernels/Exp.ts","../../src/kernels/ExpandDims.ts","../../src/kernels/Fill.ts","../../src/kernels/FlipLeftRight.ts","../../src/kernels/Floor.ts","../../src/kernels/FloorDiv.ts","../../src/kernels/FusedBatchNorm.ts","../../src/kernels/FusedConv2D.ts","../../src/kernels/FusedDepthwiseConv2D.ts","../../src/kernels/GatherNd.ts","../../src/kernels/GatherV2.ts","../../src/kernels/Greater.ts","../../src/kernels/GreaterEqual.ts","../../src/kernels/LeakyRelu.ts","../../src/kernels/Less.ts","../../src/kernels/LessEqual.ts","../../src/kernels/Log.ts","../../src/kernels/LogicalAnd.ts","../../src/kernels/Max.ts","../../src/kernels/Maximum.ts","../../src/kernels/MaxPool.ts","../../src/kernels/Mean.ts","../../src/kernels/Min.ts","../../src/kernels/Minimum.ts","../../src/kernels/MirrorPad.ts","../../src/kernels/Multiply.ts","../../src/kernels/Neg.ts","../../src/kernels/NonMaxSuppression_util.ts","../../src/kernels/NonMaxSuppressionV3.ts","../../src/kernels/NonMaxSuppressionV4.ts","../../src/kernels/NonMaxSuppressionV5.ts","../../src/kernels/NotEqual.ts","../../src/kernels/OneHot.ts","../../src/kernels/OnesLike.ts","../../src/kernels/Pack.ts","../../src/kernels/Pow.ts","../../src/kernels/Prelu.ts","../../src/kernels/Prod.ts","../../src/kernels/Range.ts","../../src/kernels/Real.ts","../../src/kernels/RealDiv.ts","../../src/kernels/Relu.ts","../../src/kernels/Relu6.ts","../../src/kernels/ResizeBilinear.ts","../../src/kernels/ResizeNearestNeighbor.ts","../../src/kernels/Reverse.ts","../../src/kernels/Rotate.ts","../../src/kernels/Rsqrt.ts","../../src/kernels/ScatterNd.ts","../../src/kernels/SelectV2.ts","../../src/kernels/Sigmoid.ts","../../src/kernels/Sin.ts","../../src/kernels/Softmax.ts","../../src/kernels/Softplus.ts","../../src/kernels/SpaceToBatchND.ts","../../src/kernels/SparseToDense.ts","../../src/kernels/SplitV.ts","../../src/kernels/Sqrt.ts","../../src/kernels/Square.ts","../../src/kernels/SquaredDifference.ts","../../src/kernels/Step.ts","../../src/kernels/StridedSlice.ts","../../src/kernels/Sub.ts","../../src/kernels/Tan.ts","../../src/kernels/Tanh.ts","../../src/kernels/Tile.ts","../../src/kernels/TopK.ts","../../src/kernels/Transform.ts","../../src/kernels/Unique.ts","../../src/kernels/Unpack.ts","../../src/kernels/UnsortedSegmentSum.ts","../../src/kernels/ZerosLike.ts","../../src/kernels/backend_kernel_registry.ts","../../src/kernels/register_all_kernels.ts","../../src/index.ts"],"names":[],"mappings":"AAAA;;;;;;;;;;;;;GAaG;AAEH,OAAO,EAAC,GAAG,EAAC,MAAM,uBAAuB,CAAC;AAC1C,OAAO,EAAC,wBAAwB,EAAC,MAAM,iBAAiB,CAAC;AACzD,OAAO,EAAC,qBAAqB,EAAC,MAAM,cAAc,CAAC;AACnD,OAAO,EAAC,kBAAkB,EAAC,MAAM,WAAW,CAAC;AAC7C,OAAO,EAAC,wBAAwB,EAAC,MAAM,iBAAiB,CAAC;AAEzD,MAAM,UAAU,GAAG,CAAC,CAAS,EAAE,CAAS,EAAE,EAAE;IAC1C,OAAO,wBAAwB,CAAC,GAAG,EAAE,qBAAqB,CAAC,CAAC;AAC9D,CAAC,CAAC","sourcesContent":["/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions
 and\n * limitations under the License.\n *
==\n
*/\n\nimport {Pow} from '@tensorflow/tfjs-core';\nimport {createBinaryKernelConfig} from
'./binary_kernel';\nconst supportsFullBroadcast = false;\nexport const powConfig =\n
createBinaryKernelConfig(Pow, supportsFullBroadcast);\n"]}

ls/PadV2.ts","../../src/kernels/Pow.ts","../../src/kernels/Prelu.ts","../../src/kernels/Prod.ts","../../src/kernels/Range.ts","../../src/kernels/RealDiv.ts","../../src/kernels/Relu.ts","../../src/kernels/Relu6.ts","../../src/kernels/ResizeBilinear.ts","../../src/kernels/Reverse.ts","../../src/kernels/RotateWithOffset.ts","../../src/kernels/Round.ts","../../src/kernels/Rsqrt.ts","../../src/kernels/ScatterNd.ts","../../src/kernels/Select.ts","../../src/kernels/Sigmoid.ts","../../src/kernels/Sin.ts","../../src/kernels/Softmax.ts","../../src/kernels/SpaceToBatchND.ts","../../src/kernels/SplitV.ts","../../src/kernels/Sqrt.ts","../../src/kernels/Square.ts","../../src/kernels/SquaredDifference.ts","../../src/kernels/Step.ts","../../src/kernels/StridedSlice.ts","../../src/kernels/Sub.ts","../../src/kernels/Sum.ts","../../src/kernels/Tan.ts","../../src/kernels/Tanh.ts","../../src/kernels/Tile.ts","../../src/kernels/TopK.ts","../../src/kernels/Transform.ts","../../src/kernels/Unpack.ts","../../src/kernels/ZerosLike.ts","../../src/register_all_kernels.ts","../../src/flags_wasm.ts","../../wasm-out/tfjs-backend-wasm-threaded-simd.js","../../wasm-out/tfjs-backend-wasm-threaded-simd.worker.js","../../wasm-out/tfjs-backend-wasm.js","../../src/backend_wasm.ts","../../src/version.ts","../../src/base.ts"],"sourcesContent":["/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n *
you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n */\n\n// This enum must align with the enum defined in cc/backend.h.\nexport enum CppDType {\n float32 = 0,\n int32 = 1,\n bool = 2,\n string = 3,\n complex64 = 4\n}\n\n// Must match enum in cc/fusable_activations.h.\nexport enum FusableActivation {\n linear = 0,\n relu = 1,\n relu6 = 2,\n prelu = 3,\n leakyrelu = 4,\n sigmoid = 5,\n elu = 6\n}\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n */\n\nimport {_FusedMatMul, _FusedMatMulAttrs, _FusedMatMulInputs, KernelConfig, KernelFunc} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {FusableActivation} from './types';\n\nlet wasmFusedMatMul:\n (aId: number, aShape: Uint8Array, aShapeSize: number, bId: number,\n bShape: Uint8Array, bShapeSize:
number, transposeA: boolean,\n transposeB: boolean, activation: number, biasId: number,\n preluActivationWeightsId: number, leakyreluAlpha: number, outId: number) =>\n void;\n\nfunction setup(backend: BackendWasm) {\n wasmFusedMatMul = backend.wasm.cwrap(_FusedMatMul, null /* void */, [\n 'number', // a_id\n 'array', // a_shape\n 'number', // a_shape.length\n 'number', // b_id\n 'array', // b_shape\n 'number', // b_shape.length\n 'number', // transpose_a\n 'number', // transpose_b\n 'number', // activation\n 'number', // biasId\n 'number', // preluActivationWeightsId\n 'number', // leakyreluAlpha\n 'number' // out_id\n]);\n}\n\nfunction fusedBatchMatMul(args: {\n inputs: _FusedMatMulInputs,\n backend: BackendWasm,\n attrs: _FusedMatMulAttrs\n}) {\n const {inputs, backend, attrs} = args;\n const {a, b, bias, preluActivationWeights} = inputs;\n\n if (a.dtype !== 'float32' || b.dtype !== 'float32') {\n throw new Error(\n `_FusedMatMul for non non-float32 tensors not yet supported.`);\n }\n\n const {transposeA, transposeB, activation, leakyreluAlpha} = attrs;\n const aId = backend.dataIdMap.get(a.dataId).id;\n const bId = backend.dataIdMap.get(b.dataId).id;\n\n let biasId = 0;\n if (bias != null) {\n const biasData = backend.dataIdMap.get(bias.dataId);\n if (biasData.shape.length !== 1) {\n throw new Error(\n `_FusedMatMul only supports rank-1 bias but got ` +\n `rank ${biasData.shape.length}.`);\n }\n biasId =

biasData.id;\n }\n const preluActivationWeightsId = preluActivationWeights == null ?\n   0 :\n backend.dataIdMap.get(preluActivationWeights.dataId).id;\n const fusedActivation =\n FusableActivation[activation as {} as keyof typeof FusableActivation];\n if (fusedActivation == null) {\n   throw new Error(\n   `${activation} activation not yet supported for FusedConv2D ` +\n   `in the wasm backend.`);\n }\n\n const leftDim = transposeA ? a.shape[2] : a.shape[1];\n const rightDim = transposeB ? b.shape[1] : b.shape[2];\n const batchDim = a.shape[0];\n\n const out = backend.makeOutput([batchDim, leftDim, rightDim], a.dtype);\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n const aShapeBytes = new Uint8Array(new Int32Array(a.shape).buffer);\n const bShapeBytes = new Uint8Array(new Int32Array(b.shape).buffer);\n\n wasmFusedMatMul(\n   aId, aShapeBytes, a.shape.length, bId, bShapeBytes, b.shape.length,\n   transposeA, transposeB, fusedActivation, biasId, preluActivationWeightsId,\n   leakyreluAlpha || 0, outId);\n\n return out;\n}\n\nexport const fusedMatMulConfig: KernelConfig = {\n kernelName: _FusedMatMul,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: fusedBatchMatMul as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may
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==\n
*/\n\nimport {DataType, KernelConfig, TensorInfo, UnaryInputs, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {CppDType} from './types';\n\nexport function createUnaryKernelConfig(\n   kernelName: string, outType?: DataType): KernelConfig {\n let wasmFunc: (xId: number, dtype: number, outId: number) => void;\n\n function setupFunc(backend: BackendWasm): void {\n wasmFunc =
 backend.wasm.cwrap(kernelName, null /* void */, [\n   'number', // x_id\n   'number', // dtype\n   'number', // out_id\n   ]);\n }\n\n function kernelFunc(args: {backend: BackendWasm, inputs: UnaryInputs}):\n   TensorInfo {\n   const {backend, inputs: {x}} = args;\n   const xId = backend.dataIdMap.get(x.dataId).id;\n   const out = backend.makeOutput(x.shape, outType || x.dtype);\n   const outId = backend.dataIdMap.get(out.dataId).id;\n\n   // Short-circuit zero-sized tensors.\n   if (util.sizeFromShape(out.shape) === 0) {\n   return out;\n   }\n\n   wasmFunc(xId, CppDType[x.dtype], outId);\n   return out;\n }\n\n return {kernelName, backendName: 'wasm', setupFunc, kernelFunc};\n}\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n
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==\n
*/\nimport {Abs, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\n\nexport const absConfig: KernelConfig = createUnaryKernelConfig(Abs);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in
 writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific

language governing permissions and\n * limitations under the License.\n *
==========\n
/\n\nimport {backend_util, BinaryInputs, DataType, KernelConfig, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {CppDType} from './types';\n\nexport function createBinaryKernelConfig(\n kernelName: string, supportsFullBroadcast: boolean,\n dtype?: DataType): KernelConfig {\n let wasmFunc:\n   (aId: number, aShape: Uint8Array, aShapeLen: number, bId: number,\n   bShape: Uint8Array, bShapeLen: number, dtype: number, outId: number) =>\n   void;\n\n function setupFunc(backend: BackendWasm): void {\n wasmFunc = backend.wasm.cwrap(kernelName, null / void
 */, [\n   'number', // a_id,\n   'array',   // a_shape\n   'number', // a_shape.length\n   'number', // b_id\n   'array',   // b_shape\n   'number', // b_shape.length\n   'number', // dtype\n   'number'   // out_id\n]);\n }\n\n function kernelFunc(args: {backend: BackendWasm, inputs: BinaryInputs}):\n   TensorInfo {\n const {backend, inputs} = args;\n const {a, b} = inputs;\n const aId = backend.dataIdMap.get(a.dataId).id;\n const bId = backend.dataIdMap.get(b.dataId).id;\n\n const outputType = dtype != null ? dtype : a.dtype;\n const newShape = backend_util.assertAndGetBroadcastShape(a.shape, b.shape);\n const out = backend.makeOutput(newShape, outputType);\n\n // Short-circuit zero-sized tensors.\n if (util.sizeFromShape(newShape) === 0) {\n   return out;\n }\n\n const aShapeBytes = new Uint8Array(new Int32Array(a.shape).buffer);\n const bShapeBytes = new Uint8Array(new Int32Array(b.shape).buffer);\n const
 outId = backend.dataIdMap.get(out.dataId).id;\n const kernelFunc = () => wasmFunc(\n   aId, aShapeBytes, a.shape.length, bId, bShapeBytes, b.shape.length,\n   CppDType[a.dtype], outId);\n\n // Currently only some float operations support full broadcast.\n if (supportsFullBroadcast && a.dtype === 'float32') {\n kernelFunc();\n   return out;\n }\n\n const aBroadcastDims = backend_util.getBroadcastDims(a.shape, newShape);\n const bBroadcastDims = backend_util.getBroadcastDims(b.shape, newShape);\n const loopsOverAllOfA = aBroadcastDims.every((v, i) => v === i);\n const loopsOverAllOfB = bBroadcastDims.every((v, i) => v === i);\n if (loopsOverAllOfA && loopsOverAllOfB) {\n   kernelFunc();\n return out;\n } else {\n   throw new Error(\n   `Broadcasting along outer dims is not yet ` +\n `supported for ${a.dtype} ${kernelName}.`);\n }\n }\n\n return {kernelName, backendName: 'wasm', setupFunc, kernelFunc};\n}\n","/**\n
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==========\n
*/\n\nimport {Add, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from './binary_kernel';\n\nconst supportsFullBroadcast = true;\n\nexport const addConfig: KernelConfig =\n createBinaryKernelConfig(Add, supportsFullBroadcast);\n","/**\n * @license\n
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==========\n
*/\n\nimport {AddN, KernelConfig, KernelFunc, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {CppDType} from './types';\n\nlet wasmFunc:\n   (inputIds: Uint8Array, inputIdsLen: number, dtype: number, outId: number) =>\n   void;\n\nfunction

setupFunc(backend: BackendWasm): void {\n wasmFunc = backend.wasm.cwrap(AddN, null /* void */, [\n 'array', // input_ids\n 'number', // input_ids.length\n 'number', // dtype\n 'number', // out_id\n]);\n}\n\nfunction addn(args: {inputs: TensorInfo[], backend: BackendWasm}) {\n const {inputs, backend} = args;\n const out = backend.makeOutput(inputs[0].shape, inputs[0].dtype);\n\n // Short-circuit zero-sized tensors.\n if (util.sizeFromShape(out.shape) === 0) {\n return out;\n }\n\n const inputIds = inputs.map(x => backend.dataIdMap.get(x.dataId).id);\n const inputIdsBytes = new Uint8Array(new Int32Array(inputIds).buffer);\n const outId = backend.dataIdMap.get(out.dataId).id;\n wasmFunc(inputIdsBytes, inputIds.length, CppDType[out.dtype], outId);\n\n return out;\n}\n\nexport const addNConfig: KernelConfig = {\n kernelName: AddN,\n backendName: 'wasm',\n setupFunc,\n kernelFunc: addn as {} as KernelFunc,\n};\n\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ===\n */\n\nimport {Identity, IdentityInputs, KernelConfig, KernelFunc} from '@tensorflow/tfjs-core';\nimport {TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nexport function identity(args: {inputs: IdentityInputs, backend: BackendWasm}):\n TensorInfo {\n const {inputs: {x}, backend} = args;\n const out = backend.makeOutput(x.shape, x.dtype);\n const inVals = backend.typedArrayFromHeap(x);\n const outVals = backend.typedArrayFromHeap(out);\n outVals.set(inVals);\n return out;\n}\n\nexport const identityConfig: KernelConfig = {\n kernelName: Identity,\n backendName: 'wasm',\n kernelFunc: identity as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ===\n */\n\nimport {KernelConfig, KernelFunc, TensorInfo, Transpose, TransposeAttrs, TransposeInputs} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {identity} from './Identity';\nimport {CppDType} from './types';\n\nlet wasmTranspose: (\n xId: number, xShape: Uint8Array, xShapeLength: number, dtype: CppDType,\n outId: number, perm: Uint8Array, permLength: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmTranspose = backend.wasm.cwrap(Transpose, null /* void */, [\n 'number', // xId\n 'array', // x.shape\n 'number', // x.shape.length\n 'number', // dtype\n 'number', // outId\n 'array', // perm\n 'number', // perm.length\n]);\n}\n\nexport function transpose(\n args:\n {inputs: TransposeInputs, backend: BackendWasm, attrs: TransposeAttrs}):\n TensorInfo {\n const {inputs, backend, attrs} = args;\n\n // Reduce any dimensions with size one. Lower-rank transpose kernel performs\n // better due to simpler memory access pattern.\n const [reducedShape, perm] = removeOneSizeDims(inputs.x.shape, attrs.perm);\n\n let permIsNoOp = true;\n for (let i = 0; i < perm.length; i++) {\n if (perm[i] !== i) {\n permIsNoOp = false;\n }\n }\n const outShape = computeOutShape(inputs.x.shape, attrs.perm);\n const x = {\n dataId: inputs.x.dataId,\n shape: reducedShape,\n dtype: inputs.x.dtype\n };\n\n if (permIsNoOp) {\n const cloned = identity({inputs, backend});\n cloned.shape = outShape;\n return cloned;\n }\n\n const out = backend.makeOutput(outShape, x.dtype);\n const xId = backend.dataIdMap.get(x.dataId).id;\n const outId =

backend.dataIdMap.get(out.dataId).id;\n const permBytes = new Uint8Array(new Int32Array(perm).buffer);\n const xShapeBytes = new Uint8Array(new Int32Array(x.shape).buffer);\n\n wasmTranspose(\n   xId, xShapeBytes, x.shape.length,
 CppDType[x.dtype], outId, permBytes,\n   perm.length);\n return out;\n}\n\nfunction computeOutShape(inShape: number[], perm: number[]): number[] {\n const outShape = new Array(inShape.length);\n for (let i = 0; i < outShape.length; i++) {\n   outShape[i] = inShape[perm[i]];\n }\n return outShape;\n}\n\nfunction removeOneSizeDims(\n   shape: number[], perm: number[]): [number[], number[]] {\n const newShape: number[] = [];\n const newPerm: number[] = [];\n for (let i = 0; i < shape.length; ++i) {\n   if (shape[i] !== 1) {\n   newShape.push(shape[i]);\n   }\n   if (shape[perm[i]] !== 1) {\n newPerm.push(perm[i]);\n   }\n }\n for (let i = 0; i < newPerm.length; ++i) {\n   let minValIdx = -1;\n   for (let j = 0; j < newPerm.length; ++j) {\n   if (newPerm[j] >= i &&\n   (minValIdx === -1 || newPerm[minValIdx] > newPerm[j])) {\n   minValIdx = j;\n   }\n   }\n   newPerm[minValIdx] = i;\n }\n return [newShape, newPerm];\n}\n\nexport const
 transposeConfig: KernelConfig = {\n kernelName: Transpose,\n backendName: 'wasm',\n kernelFunc: transpose as {} as KernelFunc,\n setupFunc: setup,\n};\n","/**\n * @license\n * Copyright 2020 Google Inc. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n
*/\n\nimport {backend_util, TensorInfo, util} from '@tensorflow/tfjs-core';\nimport {BackendWasm} from '../backend_wasm';\nimport
 {transpose} from './Transpose';\n\n/**\n * Compute permutation axes and do a transpose if necessary.\n *\n * Used by reduction ops.\n * @param x input TensorInfo\n * @param axis reduction axes\n * @param backend wasm backend instance\n */\nexport function permuteAxesAndTranspose(\n   x: TensorInfo, axis: number|number[], backend: BackendWasm): {\n transposed: TensorInfo|null,\n axes: number[],\n originalAxes: number[],\n inputWasTransposed: boolean\n} {\n const xShape = x.shape;\n const xRank = x.shape.length;\n\n const originalAxes = util.parseAxisParam(axis, xShape);\n let axes = originalAxes;\n const permutedAxes = backend_util.getAxesPermutation(axes, xRank);\n let xTransposed = null;\n let inputWasTransposed = false;\n if (permutedAxes != null) {\n   const newShape: number[] = new Array(xRank);\n   for (let i = 0; i < newShape.length; i++) {\n   newShape[i] = xShape[permutedAxes[i]];\n   }\n\n   axes = backend_util.getInnerMostAxes(axes.length, xRank);\n
    xTransposed =\n   transpose({inputs: {x}, attrs: {perm: permutedAxes}, backend});\n\n   const xId = backend.dataIdMap.get(x.dataId).id;\n   const transposedId = backend.dataIdMap.get(xTransposed.dataId).id;\n   if (transposedId !== xId) {\n   inputWasTransposed = true;\n   }\n }\n\n return {transposed: xTransposed, originalAxes, axes, inputWasTransposed};\n}\n","/**\n * @license\n * Copyright 2021 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations
 under the License.\n *
==\n
*/\n\nimport {All, AllAttrs, AllInputs, backend_util, KernelConfig, KernelFunc, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport

{permuteAxesAndTranspose} from './kernel_utils';\n\nlet wasmAll: (xId: number, reduceSize: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n wasmAll = backend.wasm.cwrap(All, null /*void*/, ['number, number, number']);\n}\n\nfunction all(args: {backend: BackendWasm, inputs: AllInputs, attrs: AllAttrs}):\n TensorInfo {\n const {backend, inputs, attrs} = args;\n const {axis, keepDims} = attrs;\n const {x} = inputs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n let inputId = xId;\n let input = x;\n\n const {transposed, axes, originalAxes, inputWasTransposed} =\n permuteAxesAndTranspose(x, axis, backend);\n\n if (inputWasTransposed) {\n const transposedId
= backend.dataIdMap.get(transposed.dataId).id;\n input = transposed;\n inputId = transposedId;\n }\n\n const inputRank = input.shape.length;\n backend_util.assertAxesAreInnerMostDims('all', axes, inputRank);\n const [outShape, reduceShape] =\n backend_util.computeOutAndReduceShapes(input.shape, axes);\n const reduceSize = util.sizeFromShape(reduceShape);\n\n const out = backend.makeOutput(outShape, x.dtype);\n if (util.sizeFromShape(input.shape) !== 0) {\n const outId = backend.dataIdMap.get(out.dataId).id;\n wasmAll(inputId, reduceSize, outId);\n }\n\n if (inputWasTransposed) {\n // dispose of the transposed tensor.\n backend.disposeData(transposed.dataId);\n }\n\n if (keepDims) {\n // reshape\n const newShape = backend_util.expandShapeToKeepDim(out.shape, originalAxes);\n out.shape = newShape;\n }\n\n return out;\n}\n\nexport const allConfig: KernelConfig = {\n kernelName: All,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc:
all as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2021 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n */\n\nimport {Any, AnyAttrs, AnyInputs, backend_util, KernelConfig, KernelFunc, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {permuteAxesAndTranspose} from './kernel_utils';\n\nlet wasmAny:
(xId: number, reduceSize: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n wasmAny = backend.wasm.cwrap(Any, null /*void*/, ['number, number, number']);\n}\n\nfunction any(args: {backend: BackendWasm, inputs: AnyInputs, attrs: AnyAttrs}):\n TensorInfo {\n const {backend, inputs, attrs} = args;\n const {axis, keepDims} = attrs;\n const {x} = inputs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n let inputId = xId;\n let input = x;\n\n const {transposed, axes, originalAxes, inputWasTransposed} =\n permuteAxesAndTranspose(x, axis, backend);\n\n if (inputWasTransposed) {\n const transposedId = backend.dataIdMap.get(transposed.dataId).id;\n input = transposed;\n inputId = transposedId;\n }\n\n const inputRank = input.shape.length;\n backend_util.assertAxesAreInnerMostDims('any', axes, inputRank);\n const [outShape, reduceShape] =\n backend_util.computeOutAndReduceShapes(input.shape, axes);\n const reduceSize =
util.sizeFromShape(reduceShape);\n\n const out = backend.makeOutput(outShape, x.dtype);\n if (util.sizeFromShape(input.shape) !== 0) {\n const outId = backend.dataIdMap.get(out.dataId).id;\n wasmAny(inputId, reduceSize, outId);\n }\n\n if (inputWasTransposed) {\n // dispose of the transposed tensor.\n backend.disposeData(transposed.dataId);\n }\n\n if (keepDims) {\n // reshape\n const newShape = backend_util.expandShapeToKeepDim(out.shape, originalAxes);\n out.shape = newShape;\n }\n\n return out;\n}\n\nexport const anyConfig: KernelConfig = {\n kernelName: Any,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: any as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n

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==========\n */\n\nimport {ArgMax, ArgMaxAttrs, ArgMaxInputs, KernelConfig, KernelFunc, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {permuteAxesAndTranspose} from './kernel_utils';\nimport {CppDType} from './types';\n\nlet wasmFunc: (\n xId: number, dtype: number, outerSize: number, innerSize: number,\n outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmFunc = backend.wasm.cwrap(ArgMax, null /* void */, [\n 'number', // x_id\n 'number', // dtype\n 'number', // outer_size\n 'number', // inner_size\n 'number'
// out_id\n]);\n}\n\nfunction argmax(\n args: {inputs: ArgMaxInputs, backend: BackendWasm, attrs: ArgMaxAttrs}) {\n const {backend, inputs, attrs} = args;\n const {axis} = attrs as {} as ArgMaxAttrs;\n const {x} = inputs as {} as ArgMaxInputs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n let inputId = xId;\n let input = x;\n\n const {transposed, axes, inputWasTransposed} =\n permuteAxesAndTranspose(x, axis, backend);\n\n if (inputWasTransposed) {\n const transposedId = backend.dataIdMap.get(transposed.dataId).id;\n if (transposedId !== xId) {\n // transpose was not a no-op. We will need to dispose of this\n // once we are done.\n input = transposed;\n inputId = transposedId;\n }\n }\n\n const outShape = input.shape.slice(0, -1);\n const out = backend.makeOutput(outShape, 'int32');\n const outId = backend.dataIdMap.get(out.dataId).id;\n const outerSize = util.sizeFromShape(out.shape);\n const innerSize = input.shape[axes[0]];\n
wasmFunc(inputId, CppDType[input.dtype], outerSize, innerSize, outId);\n\n if (inputWasTransposed) {\n // dispose of the transposed tensor.\n backend.disposeData(transposed.dataId);\n }\n\n return out;\n}\n\nexport const argMaxConfig: KernelConfig = {\n kernelName: ArgMax,\n backendName: 'wasm',\n kernelFunc: argmax as {} as KernelFunc,\n setupFunc: setup\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations
under the License.\n *
==========\n */\n\nimport {AvgPool, AvgPoolAttrs, AvgPoolInputs, backend_util, KernelConfig, KernelFunc, Tensor4D} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmAvgPool: (\n xId: number, batchSize: number, inputHeight: number, inputWidth: number,\n filterHeight: number, filterWidth: number, padTop: number, padRight: number,\n padBottom: number, padLeft: number, strideHeight: number,\n strideWidth: number, channels: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmAvgPool = backend.wasm.cwrap(AvgPool, null /* void */, [\n 'number', // xId\n 'number', // batchSize\n 'number', // inputHeight\n 'number', // inputWidth\n 'number', // filterHeight\n 'number', // filterWidth\n 'number', // padTop\n 'number', // padRight\n 'number', // padBottom\n 'number', // padLeft\n 'number', // strideHeight\n 'number', // strideWidth\n 'number', // channels\n 'number', // outId\n]);\n}\n\nfunction avgPool(\n args: {inputs: AvgPoolInputs, backend: BackendWasm, attrs: AvgPoolAttrs}) {\n const {inputs, attrs, backend} = args;\n\n const x = inputs.x as Tensor4D;\n const xId = backend.dataIdMap.get(x.dataId).id;\n\n const {filterSize, strides, pad, dimRoundingMode} = attrs;\n const convInfo = backend_util.computePool2DInfo(\n x.shape, filterSize, strides, 1 /* dilations */, pad, dimRoundingMode);\n\n const filterHeight = convInfo.filterHeight;\n const filterWidth = convInfo.filterWidth;\n const padTop = convInfo.padInfo.top;\n const padRight = convInfo.padInfo.right;\n const padBottom = convInfo.padInfo.bottom;\n const padLeft = convInfo.padInfo.left;\n const strideHeight = convInfo.strideHeight;\n

const strideWidth = convInfo.strideWidth;\n const channels = convInfo.inChannels;\n\n if (convInfo.dataFormat !== 'channelsLast') {\n   throw new Error(\n   `wasm backend does not support dataFormat:` +\n   `${convInfo.dataFormat}'. Please use 'channelsLast'.`);\n }\n\n if (convInfo.dilationWidth !== 1 || convInfo.dilationHeight !== 1) {\n   throw new Error(\n   `was backend only supports average pooling with dilation = [1, 1], ` +\n   `got [${convInfo.dilationHeight}, ${convInfo.dilationWidth}].`);\n }\n\n const out = backend.makeOutput(convInfo.outShape, 'float32');\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n wasmAvgPool(\n   xId, x.shape[0], x.shape[1], x.shape[2], filterHeight, filterWidth,\n   padTop, padRight, padBottom, padLeft, strideHeight, strideWidth, channels,\n   outId);\n return out;\n}\n\nexport const avgPoolConfig: KernelConfig = {\n kernelName: AvgPool,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: avgPool as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License,
 Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {KernelConfig, KernelFunc, Reshape, ReshapeAttrs, ReshapeInputs, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nexport function reshape(\n   args: {inputs: ReshapeInputs, attrs: ReshapeAttrs, backend: BackendWasm}) {\n const {inputs, attrs} = args;\n const {x} = inputs;\n const {shape} = attrs;\n\n const xSize = util.sizeFromShape(x.shape);\n
  const $shape = util.inferFromImplicitShape(shape, xSize);\n\n util.assert(\n   xSize === util.sizeFromShape($shape),\n   () => `new shape: ${$shape}, old shape: ${x.shape}. New shape and old ` +\n
  `shape must have the same number of elements.`);\n\n // Backend needs to track refCount for the dataId for reshape op\n args.backend.incRef(x.dataId);\n return {dataId: x.dataId, shape: $shape, dtype: x.dtype};\n}\n\nexport const reshapeConfig: KernelConfig = {\n kernelName: Reshape,\n backendName: 'wasm',\n kernelFunc: reshape as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under
 the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {BatchMatMul, BatchMatMulAttrs, BatchMatMulInputs, KernelConfig, KernelFunc, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {reshape} from './Reshape';\n\nlet wasmBatchMatMul: (\n   aId: number, aShape: Uint8Array, aShapeSize: number, bId: number,\n
 bShape: Uint8Array, bShapeSize: number, transposeA: boolean,\n   transposeB: boolean, outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmBatchMatMul = backend.wasm.cwrap(BatchMatMul, null /* void */, [\n   'number', // a_id\n   'array',   // a_shape\n   'number', // a_shape.length\n   'number', // b_id\n   'array',   // b_shape\n   'number',
  // b_shape.length\n   'number', // transpose_a\n   'number', // transpose_b\n   'number'   // out_id\n]);\n}\n\nfunction batchMatMul(args: {\n inputs: BatchMatMulInputs,\n backend: BackendWasm,\n attrs: BatchMatMulAttrs\n}) {\n const {inputs, backend, attrs} = args;\n const {a, b} = inputs;\n const {transposeA, transposeB} = attrs;\n\n if (a.dtype !== 'float32' || b.dtype !== 'float32') {\n   throw new Error(\n`BatchMatMul for non non-float32 tensors not yet supported.`);\n }\n\n const aRank = a.shape.length;\n const bRank = b.shape.length;\n\n const innerShapeA = transposeA ? a.shape[aRank - 2] : a.shape[aRank - 1];\n const

innerShapeB = transposeB ? b.shape[bRank - 1] : b.shape[bRank - 2];\n\n const outerShapeA = transposeA ? a.shape[aRank - 1] : a.shape[aRank - 2];\n const outerShapeB = transposeB ? b.shape[bRank - 2] : b.shape[bRank - 1];\n\n const outerDimsA = a.shape.slice(0, -2);\n const outerDimsB = b.shape.slice(0, -2);\n\n const batchDimA = util.sizeFromShape(outerDimsA);\n const batchDimB = util.sizeFromShape(outerDimsB);\n\n const batchDimsCompatible =\n   batchDimA === batchDimB || batchDimA === 1 || batchDimB === 1;\n\n util.assert(\n   aRank >= 2 && bRank >= 2 && batchDimsCompatible,\n   () => `Error in matMul: the input batch dimensions must either be the ` +\n   `same or at least one input batch dimension must be 1. Got input ` +\n   `batch dimensions of (${outerDimsA}) and (${outerDimsB}).`);\n\n const outShapeOuterDims =\n   batchDimA > batchDimB ? a.shape.slice(0, -2) : b.shape.slice(0, -2);\n const outShape = outShapeOuterDims.concat([outerShapeA, outerShapeB]);\n\n util.assert(\n   innerShapeA === innerShapeB,\n   () => `Error in matMul: inner shapes (${innerShapeA}) and (` +\n   `${innerShapeB}) of Tensors with shapes ${a.shape} and ` +\n   `${b.shape} and transposeA=${transposeA}` +\n   ` and transposeB=${transposeB} must match.`);\n\n const
  a3dShape = transposeA ? [batchDimA, innerShapeA, outerShapeA] :\n   [batchDimA, outerShapeA, innerShapeA];\n const b3dShape = transposeB ? [batchDimB, outerShapeB, innerShapeB] :\n   [batchDimB, innerShapeB, outerShapeB];\n\n // The rest of the implementation is designed to operate on rank-3 tensors\n const a3d = reshape({inputs: {x: a}, backend, attrs: {shape: a3dShape}});\n const b3d = reshape({inputs: {x: b}, backend, attrs: {shape: b3dShape}});\n\n const a3dId = backend.dataIdMap.get(a3d.dataId).id;\n const b3dId = backend.dataIdMap.get(b3d.dataId).id;\n\n const leftDim = transposeA ? a3d.shape[2] : a3d.shape[1];\n const rightDim = transposeB ? b3d.shape[1] : b3d.shape[2];\n const batchDim = Math.max(batchDimA, batchDimB);\n\n const out = backend.makeOutput([batchDim, leftDim, rightDim], a3d.dtype);\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n const aShapeBytes = new Uint8Array(new Int32Array(a3d.shape).buffer);\n
  const bShapeBytes = new Uint8Array(new Int32Array(b3d.shape).buffer);\n\n wasmBatchMatMul(\n   a3dId, aShapeBytes, a3d.shape.length, b3dId, bShapeBytes,\n   b3d.shape.length, transposeA, transposeB, outId);\n\n backend.disposeData(a3d.dataId);\n backend.disposeData(b3d.dataId);\n\n out.shape = outShape;\n return out;\n}\n\nexport const batchMatMulConfig: KernelConfig = {\n kernelName: BatchMatMul,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: batchMatMul as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES
 OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n
*/\nimport { backend_util, util } from '@tensorflow/tfjs-core';\nexport function concatImpl(inputs, outShape, dtype, simplyConcat) {\n const outVals = util.getArrayFromDType(dtype, util.sizeFromShape(outShape));\n if (simplyConcat && dtype !== 'string') {\n   // Use built-in TypedArray.set() method for speed.\n   let offset = 0;\n   inputs.forEach(input => {\n   const size = util.sizeFromShape(input.shape);\n   outVals.set(input.vals, offset);\n   offset += size;\n   });\n }\n else {\n   let colOffset = 0;\n   inputs.forEach(input => {\n   const decodedData = dtype === 'string' ?\n   backend_util.fromUint8ToStringArray(input.vals) :\n   input.vals;\n   let tIdx = 0;\n   for (let row = 0; row < input.shape[0]; ++row) {\n   const resIdx = row * outShape[1] + colOffset;\n   for (let col = 0; col < input.shape[1]; ++col) {\n   outVals[resIdx + col] = decodedData[tIdx++];\n   }\n   }\n   colOffset += input.shape[1];\n   });\n }\n return outVals;\n}\n//#
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XJuZWxzL0NvbmNhdF9pbXBsLnRzIl0sIm5hbWVzIjpbXSwibWFwcGluZ3MiOiJBQUFBOzs7Ozs7Ozs7Ozs7Oz
s7R0FlRztBQUVILE9BQU8sRUFBQyxXVDLElBQUksRUFBQyxNQUFNLHVCQUFDLFlBQUMsTUFBTSxHVCQUF1QixxDQU
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UksRUFBRSxRSxDQUFDLENBQUM7aUJBQzdDO2FBQU07YWFFRCxxTQUFTLElBQUksS0FBSyxyDQUFDLEtBQ
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VSb290IjoiIiwic291cmNlcyI6WyIuLi8uLi8uLi8uLi8uLi8uLi90ZmpzLWJhY2tlbmQtY3B1L3NyYy9rZXJuZWxzL1NsaWNlLnRzIl0sIm5hbWVzIjpbXSwibWFwcGluZ3MiOiJBQUFBOzs7Ozs7Ozs7Ozs7R0FlRztBQUU9sRUFBQyxyZQUFZLEVBQQWlCLE1BQU0sRUFBc0MsMsS0FBSyxFUFBBc0MsS0FBSyxFUFBbUQsSUFBSSxSxFQUFFLE1BQU0sdUJBQXVCLENBQUM7QUFBQSxXVCLENBQUFBO0FBRTdEakIsTUFBTSxTLENBQUFBLFdBQVcsRUFBRSxNQUFNLEVBQUUsTUFBTSxFQUFFLE1BQU0sRUFBRSxNQUFNLEVBQUUsTUFBTSxFIsTUFBTSxFQUFFLE1BQU0s

EtJTkQsIGVpdGhlciBleHByZXNzIG9yIGltcGxpZWQuXG4gKiBTZWUgdGhlIExpY2Vuc2UgZm9yIHRoZSBzcGVjaWZpYyBsYW5ndWFnZSBnb3Zlcm5pbmcgcGVybWlzc2lvbnMgYW5kXG4gKiBsaW1pdGF0aW9ucyB1bmRlciB0aGUgTGljZW5zZS5cbiAqID09PT09PT09PT09PT09PT09PT09PT09PT09PT09PT09PT09PT09PT09PT09PT09PT09PT09PT09PT09PT09PT09PT09PT09PT09PT09PT09PT09XG4gKi9cblxuaW1wb3J0IHtiYWNrZW5kX3V0aWwsIEJhY2tlbmRWYWx1ZXMsIGJ1ZmZlciwgRGF0YVR5cGUsIEtlcm5lbENvbmZpZywgS2VybmVsRnVuYywgU2xpY2UsIHNsaWNlX3V0aWwsIFNsaWNlQXR0cnMsIFNsaWNlSW5wdXRzLCBTdHJpbmcsIFR5cGVkQXJyYXksIHV0aWx9IGZyb20gJy4uL2NwdV91dGlsJztcblxuaW1wb3J0IGZ1bmN0aW9uIHNsaWNlSW1wbChhcbiAgICBjb250ZXh0OiBiYWNrZW5kX2NwdSxcbiAgICBiOiBTbGljZUlucHV0cyxcbiAgICBhOiBTbGljZUF0dHJzKTogVHlwZWRBcnJheSB7XG4gICAgY29uc3QgYmVnaW4gPSBiLmJlZ2luWzBdO1xuICAgIGNvbnN0IHNpemUgPSBiLnNpemVbMF07XG4gICAgY29uc3QgcmVzdWx0ID0gY29udGV4dC5tYWtlVHlwZWRBcnJheShhLmR0eXBlLCBzaXplKTtcbiAgICBjb250ZXh0LmNhbGxLZXJuZWwoXG4gICAgICAgIHRoaXMuc2xpY2VJbXBsLCBbYSwgYmVnaW4sIHNpemUsIHJlc3VsdF0sIFtdKTtcbiAgICByZXR1cm4gcmVzdWx0O1xufVxuXG5leHBvcnQgY29uc3Qgc2xpY2VDb25maWc6IEtlcm5lbENvbmZpZyA9IHtcbiAgICBrZXJuZWxOYW1lOiBTbGljZSxcbiAgICBpbXBsOiBzbGljZUltcGwsXG59O1xuIl,"/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==\n */\n\nimport {backend_util, KernelConfig, KernelFunc, Slice, slice_util, SliceAttrs, SliceInputs, TypedArray, util}

```
from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\nimport {sliceImplCPU} from '../kernel_utils/shared';\n\nexport function slice(\n    args: {inputs: SliceInputs, attrs: SliceAttrs, backend: BackendWasm}) {\n  const {inputs: {x}, attrs: {begin, size}, backend} = args;\n\n
  const [begin_, size_] = slice_util.parseSliceParams(x, begin, size);\n\n  const isContinous = slice_util.isSliceContinous(x.shape, begin_, size_);\n  const xVals = backend.readSync(x.dataId);\n  const out = backend.makeOutput(size_, x.dtype);\n  const xStrides = util.computeStrides(x.shape);\n  const outData = backend.dataIdMap.get(out.dataId);\n\n  if (isContinous) {\n    const flatOffset = slice_util.computeFlatOffset(begin_, xStrides);\n\n    if (x.dtype === 'string') {\n      outData.stringBytes =\n (xVals as Uint8Array[])\n              .slice(flatOffset, flatOffset + util.sizeFromShape(size_));\n    } else {\n      const outVals = backend.typedArrayFromHeap(out);\n      outVals.set(\n          (xVals as TypedArray)\n .subarray(flatOffset, flatOffset + util.sizeFromShape(size_)));\n    }\n\n    return out;\n  }\n\n  const outVals = backend.typedArrayFromHeap(out);\n  const rank = x.shape.length;\n  if (rank === 2) {\n    slice2d(\n        xVals as TypedArray, xStrides[0], outVals, begin_ as [number, number],\n size_ as [number, number]);\n  } else if (rank === 3) {\n    slice3d(\n        xVals as TypedArray, xStrides[0], xStrides[1], outVals,\n        begin_ as [number, number, number], size_ as [number, number, number]);\n  } else if (rank === 4) {\n    slice4d(\n        xVals as TypedArray, xStrides[0], xStrides[1], xStrides[2], outVals,\n        begin_ as [number, number, number, number],\n        size_ as [number, number, number, number]);\n  } else {\n    const res =\n        sliceImplCPU(xVals, begin_, size_, x.shape, x.dtype) as TypedArray;\n    outVals.set(res);\n  }\n\n  return out;\n}\n\nfunction slice2d(\n    xVals: backend_util.TypedArray, xStride: number,\n    outVals: backend_util.TypedArray, begin: [number, number],\n    size: [number, number]):
 void {\n  let outOffset = 0;\n  const beginI = begin[0];\n  const beginJ = begin[1];\n  const endI = beginI + size[0];\n for (let i = beginI; i < endI; i++) {\n    const xOffset = i * xStride + beginJ;\n    outVals.set(xVals.subarray(xOffset, xOffset + size[1]), outOffset);\n    outOffset += size[1];\n  }\n}\n\nfunction slice3d(\n    xVals: backend_util.TypedArray, xStride1: number, xStride2: number,\n    outVals: backend_util.TypedArray, begin: [number, number, number],\n    size: [number, number, number]): void {\n  let outOffset = 0;\n  const beginI = begin[0];\n  const beginJ = begin[1];\n  const beginK = begin[2];\n  const endI = beginI + size[0];\n  const endJ = beginJ + size[1];\n  for (let i = beginI; i < endI; i++) {\n    for (let j = beginJ; j < endJ; j++) {\n      const xOffset = i * xStride1 + j * xStride2 + beginK;\n      outVals.set(xVals.subarray(xOffset, xOffset + size[2]), outOffset);\n outOffset += size[2];\n    }\n  }\n}\n\nfunction slice4d(\n    xVals: backend_util.TypedArray,
 xStride1: number, xStride2: number,\n    xStride3: number, outVals: backend_util.TypedArray,\n    begin: [number, number, number, number],\n    size: [number, number, number, number]): void {\n  let outOffset = 0;\n  const beginI = begin[0];\n  const beginJ = begin[1];\n  const beginK = begin[2];\n  const endI = beginI + size[0];\n  const endJ = beginJ + size[1];\n  const endK = beginK + size[2];\n  const beginL = begin[3];\n\n  for (let i = beginI; i < endI; i++) {\n    for (let j = beginJ; j < endJ; j++) {\n      for (let k = beginK; k < endK; k++) {\n        const xOffset = i * xStride1 + j * xStride2 + k * xStride3 + beginL;\n        outVals.set(xVals.subarray(xOffset, xOffset + size[3]), outOffset);\n        outOffset += size[3];\n      }\n    }\n  }\n}\n\nexport const sliceConfig: KernelConfig = {\n kernelName: Slice,\n  backendName: 'wasm',\n  kernelFunc: slice as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2021 Google LLC. All Rights Reserved.\n
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==========================================================================\n
*/\n\nimport {backend_util, BatchToSpaceND, BatchToSpaceNDAttrs, BatchToSpaceNDInputs, KernelConfig,
```

KernelFunc} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {reshape} from './Reshape';\nimport {slice} from './Slice';\nimport {transpose} from './Transpose';\n\nfunction batchToSpaceND(args: {\n inputs: BatchToSpaceNDInputs,\n backend: BackendWasm,\n attrs: BatchToSpaceNDAttrs\n}) {\n const {inputs, backend, attrs} = args;\n const {x} = inputs;\n const {blockShape, crops} = attrs;\n\n const prod = blockShape.reduce((a, b) => a * b);\n\n const reshaped = backend_util.getReshaped(x.shape, blockShape, prod);\n const permuted = backend_util.getPermuted(reshaped.length, blockShape.length);\n const reshapedPermuted =\n backend_util.getReshapedPermuted(x.shape, blockShape, prod);\n const sliceBeginCoords =\n backend_util.getSliceBeginCoords(crops, blockShape.length);\n const sliceSize =\n backend_util.getSliceSize(reshapedPermuted, crops, blockShape.length);\n\n const xReshaped = reshape({inputs: {x}, backend, attrs: {shape: reshaped}});\n const xTransposed =\n   transpose({inputs: {x: xReshaped}, backend, attrs: {perm: permuted}});\n const xTransposedReshaped = reshape(\n   {inputs: {x: xTransposed}, backend, attrs: {shape: reshapedPermuted}});\n const result\n = slice({\n   inputs: {x: xTransposedReshaped},\n   backend,\n   attrs: {begin: sliceBeginCoords, size: sliceSize}\n });\n\n backend.disposeData(xReshaped.dataId);\n backend.disposeData(xTransposed.dataId);\n backend.disposeData(xReshaped.dataId);\n\n return result;\n}\n\nexport const batchToSpaceNDConfig: KernelConfig = {\n kernelName: BatchToSpaceND,\n backendName: 'wasm',\n kernelFunc: batchToSpaceND as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for
 the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {Cast, CastAttrs, CastInputs, KernelConfig, KernelFunc} from '@tensorflow/tfjs-core';\nimport {TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nexport function cast(\n   args: {inputs: CastInputs, attrs: CastAttrs, backend: BackendWasm}):\n   TensorInfo {\n const {inputs: {x}, attrs: {dtype}, backend} = args;\n const out = backend.makeOutput(x.shape, dtype);\n const inVals = backend.typedArrayFromHeap(x);\n const outVals = backend.typedArrayFromHeap(out);\n outVals.set(inVals);\n return out;\n}\n\nexport const castConfig: KernelConfig = {\n kernelName: Cast,\n backendName: 'wasm',\n kernelFunc: cast as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2021 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n
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/\n\nimport {ClipByValue, ClipByValueAttrs, ClipByValueInputs, KernelConfig, KernelFunc} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmClip: (xId: number, min: number, max: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmClip = backend.wasm.cwrap(ClipByValue, null / void */, [\n 'number', // x_id\n 'number', // min\n 'number', // max\n 'number' // out_id\n]);\n}\n\nfunction clip(args: {\n inputs: ClipByValueInputs,\n backend: BackendWasm,\n attrs: ClipByValueAttrs\n}) {\n const {inputs, backend, attrs} = args;\n const {x} = inputs;\n const {clipValueMin, clipValueMax} = attrs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n const out = backend.makeOutput(x.shape, x.dtype);\n const outId = backend.dataIdMap.get(out.dataId).id;\n wasmClip(xId, clipValueMin, clipValueMax, outId);\n return out;\n}\n\nexport const clipByValueConfig: KernelConfig = {\n kernelName: ClipByValue,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: clip as {} as KernelFunc\n};\n\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under
the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
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*/\n\nimport {backend_util, Concat, ConcatAttrs, ConcatInputs, KernelConfig, KernelFunc, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\nimport {concatImplCPU} from '../kernel_utils/shared';\nimport {identity} from './Identity';\nimport {reshape} from './Reshape';\n\nexport function concat(\n args: {inputs: ConcatInputs, backend: BackendWasm, attrs: ConcatAttrs}) {\n const {inputs, backend} = args;\n\n const axis = util.parseAxisParam(args.attrs.axis, inputs[0].shape)[0];\n\n let outShape = backend_util.computeOutShape(inputs.map(t => t.shape), axis);\n\n // Keep only non-empty tensors (ignore tensors with 0 in their shape).\n const
$inputs = inputs.filter(t => util.sizeFromShape(t.shape) > 0);\n if ($inputs.length === 1) {\n return identity({inputs: {x: $inputs[0]}, backend});\n }\n\n const out = backend.makeOutput(outShape, inputs[0].dtype);\n\n if (util.sizeFromShape(outShape) === 0) {\n return out;\n }\n\n const shapes = $inputs.map(t => t.shape);\n backend_util.assertParamsConsistent(shapes, axis);\n\n if ($inputs[0].dtype === 'string') {\n // Any concat of n-dimensional tensors across any axis can be reduced to\n // a concatenation of two-dimensional tensors across the axis 1 by first\n // partitioning the axes of the original tensors into those less than the\n // axis to be concatenated and the rest. Then reshape the tensors\n // into a two-dimensional tensor by collapsing these two sets of axes and\n // concatenate the resulting matrices across the axis 1, finally reshaping\n // the result to have the proper shape.\n const inputs2D = $inputs.map(t => {\n const
innerSize = util.sizeFromShape(t.shape.slice(axis));\n const shape = [-1, innerSize];\n return reshape({inputs: {x: t}, backend, attrs: {shape}});\n });\n\n const inputsValShapes = inputs2D.map(t => {\n return {vals: backend.readSync(t.dataId), shape: t.shape};\n });\n\n // Concats 2d tensors along axis=1.\n outShape =\n backend_util.computeOutShape(inputs2D.map(t => t.shape), 1 /* axis */);\n const simplyConcat = inputs2D[0].shape[0] === 1;\n const outVals = concatImplCPU(\n inputsValShapes, outShape, inputs[0].dtype,\n simplyConcat) as string[];\n\n const finalOutShape =\n backend_util.computeOutShape($inputs.map(t => t.shape), axis);\n\n out.shape = finalOutShape;\n const outData = backend.dataIdMap.get(out.dataId);\n outData.stringBytes = backend_util.fromStringArrayToUint8(outVals);\n\n inputs2D.forEach(t => backend.disposeData(t.dataId));\n\n return out;\n }\n\n const
batchDim = util.sizeFromShape($inputs[0].shape.slice(0, axis));\n let sumInnerDims = 0;\n const innerDims = $inputs.map(input => {\n const innerDim = util.sizeFromShape(input.shape.slice(axis));\n sumInnerDims += innerDim;\n return innerDim;\n });\n const inVals = $inputs.map(input =>

backend.typedArrayFromHeap(input));\n const outVals = backend.typedArrayFromHeap(out);\n for (let b = 0; b < batchDim; b++) {\n   let outOffset = b * sumInnerDims;\n   for (let i = 0; i < inVals.length; i++) {\n   const innerDim = innerDims[i];\n   const inOffset = b * innerDim;\n   const vals = inVals[i].subarray(inOffset, inOffset + innerDim);\n   outVals.set(vals, outOffset);\n   outOffset += innerDim;\n   }\n }\n return out;\n}\n\nexport const concatConfig: KernelConfig = {\n kernelName: Concat,\n backendName: 'wasm',\n kernelFunc: concat as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache
License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==\n */\n\nimport {backend_util, Conv2D, Conv2DAttrs, Conv2DInputs, KernelConfig, KernelFunc, Tensor4D} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmConv2d: (\n   xId: number, batchSize: number, inputHeight: number, inputWidth: number,\n   filterId: number, filterHeight: number, filterWidth: number, padTop: number,\n   padRight: number,
padBottom: number, padLeft: number, isSamePad: number,\n   dilationHeight: number, dilationWidth: number, strideHeight: number,\n   strideWidth: number, inputChannels: number, outputChannels: number,\n   outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmConv2d = backend.wasm.cwrap(Conv2D, null /* void */, [\n   'number', // xId\n   'number', // batchSize\n   'number', // inputHeight\n   'number', // inputWidth\n   'number', // filterId\n   'number', // filterHeight\n   'number', // filterWidth\n   'number', // padTop\n   'number', // padRight\n   'number', // padBottom\n   'number', // padLeft\n   'number', // isSamePad\n   'number', // dilationHeight\n   'number', // dilationWidth\n   'number', // strideHeight\n   'number', // strideWidth\n   'number', // inputChannels\n   'number', // outputChannels\n   'number', // outId\n]);\n}\n\nfunction conv2d(\n   args: {inputs: Conv2DInputs, backend: BackendWasm, attrs: Conv2DAttrs}) {\n const {inputs, attrs, backend} = args;\n\n const {x, filter} = inputs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n const filterId = backend.dataIdMap.get(filter.dataId).id;\n\n const {strides, dilations, pad, dimRoundingMode, dataFormat} = attrs;\n const $dataFormat = backend_util.convertConv2DDataFormat(dataFormat);\n const convInfo = backend_util.computeConv2DInfo(\n   (x as Tensor4D).shape, (filter as Tensor4D).shape, strides, dilations,\n   pad, dimRoundingMode, false, $dataFormat);\n\n const filterHeight = convInfo.filterHeight;\n const filterWidth = convInfo.filterWidth;\n const padTop = convInfo.padInfo.top;\n const padRight = convInfo.padInfo.right;\n const padBottom = convInfo.padInfo.bottom;\n const padLeft = convInfo.padInfo.left;\n const dilationHeight = convInfo.dilationHeight;\n const dilationWidth = convInfo.dilationWidth;\n const strideHeight = convInfo.strideHeight;\n const strideWidth = convInfo.strideWidth;\n const inputChannels = convInfo.inChannels;\n const outputChannels = convInfo.outChannels;\n const isSamePad = convInfo.padInfo.type === 'SAME' ? 1 : 0;\n\n if (convInfo.dataFormat !== 'channelsLast') {\n   throw new Error(\n   `wasm backend Conv2D does not support dataFormat:` +\n   `${convInfo.dataFormat}'. Please use 'channelsLast'.`);\n }\n\n const out = backend.makeOutput(convInfo.outShape, 'float32');\n const outId = backend.dataIdMap.get(out.dataId).id;\n wasmConv2d(\n   xId, x.shape[0], x.shape[1], x.shape[2], filterId, filterHeight,\n   filterWidth, padTop, padRight, padBottom, padLeft, isSamePad,\n   dilationHeight, dilationWidth, strideHeight, strideWidth, inputChannels,\n   outputChannels, outId);\n return out;\n}\n\nexport const conv2DConfig: KernelConfig = {\n kernelName: Conv2D,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: conv2d as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed
under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n

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==========\n */\n\nimport {backend_util, Conv2DBackpropInput, Conv2DBackpropInputAttrs, Conv2DBackpropInputInputs, KernelConfig, KernelFunc, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmConv2DBackpropInput: (\n dyId: number, filterId: number, batchSize: number, filterHeight: number,\n filterWidth: number,
inHeight: number, inWidth: number, inChannels: number,\n outHeight: number, outWidth: number, outChannels: number,\n strideHeight: number, strideWidth: number, topPad: number, leftPad: number,\n fltS0: number, fltS1: number, fltS2: number, xBatchStride: number,\n xRowStride: number, xColStride: number, xChannelStride: number,\n yBatchStride: number, yRowStride: number, yColStride: number,\n yChannelStride: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n wasmConv2DBackpropInput = backend.wasm.cwrap(Conv2DBackpropInput, null, [\n 'number', // dyId\n 'number', // filterId\n 'number', // batchSize\n 'number', // filterHeight\n 'number', // filterWidth\n 'number', // inHeight\n 'number', // inWidth\n 'number', // inChannels\n 'number', // outHeight\n 'number', // outWidth\n 'number', // outChannels\n 'number', // strideHeight\n 'number', // strideWidth\n 'number', // topPad\n 'number', // leftPad\n 'number', // fltS0\n 'number', // fltS1\n 'number', // fltS2\n 'number', // xBatchStride\n 'number', // xRowStride\n 'number', // xColStride\n 'number', // xChannelStride\n 'number', // yBatchStride\n 'number', // yRowStride\n 'number', // yColStride\n 'number', // yChannelStride\n 'number', // outId\n]);\n}\n\nfunction conv2DBackpropInput(args: {\n backend: BackendWasm,\n inputs: Conv2DBackpropInputInputs,\n attrs: Conv2DBackpropInputAttrs\n}): TensorInfo {\n const {backend, inputs, attrs} = args;\n const {dy, filter} = inputs;\n const {strides, pad, dataFormat, dimRoundingMode, inputShape} = attrs;\n\n const dilations = 1;\n\n const $dataFormat = backend_util.convertConv2DDataFormat(dataFormat);\n const convInfo = backend_util.computeConv2DInfo(\n inputShape, filter.shape as [number, number, number, number], strides,\n dilations, pad, dimRoundingMode, false /* depthwise */, $dataFormat);\n const {\n batchSize,\n filterHeight,\n filterWidth,\n inChannels,\n inHeight,\n inWidth,\n outChannels,\n outHeight,\n outWidth,\n strideHeight,\n strideWidth\n } = convInfo;\n\n const topPad = filterHeight - 1 - convInfo.padInfo.top;\n const leftPad = filterWidth - 1 - convInfo.padInfo.left;\n\n const isChannelsLast = convInfo.dataFormat === 'channelsLast';\n const dxStrides = util.computeStrides(convInfo.inShape);\n const dyStrides = util.computeStrides(dy.shape);\n const [fltS0, fltS1, fltS2] = util.computeStrides(filter.shape);\n const xBatchStride = dxStrides[0];\n const xRowStride = isChannelsLast ? dxStrides[1] : dxStrides[2];\n const xColStride = isChannelsLast ? dxStrides[2] : 1;\n const xChannelStride = isChannelsLast ? 1 : dxStrides[1];\n const yBatchStride = dyStrides[0];\n const yRowStride = isChannelsLast ? dyStrides[1] : dyStrides[2];\n const yColStride = isChannelsLast ? dyStrides[2] : 1;\n const yChannelStride = isChannelsLast
? 1 : dyStrides[1];\n\n const out = backend.makeOutput(convInfo.inShape, 'float32');\n const outId = backend.dataIdMap.get(out.dataId).id;\n const dyId = backend.dataIdMap.get(dy.dataId).id;\n const filterId = backend.dataIdMap.get(filter.dataId).id;\n\n wasmConv2DBackpropInput(\n dyId, filterId, batchSize, filterHeight, filterWidth, inHeight, inWidth,\n inChannels, outHeight, outWidth, outChannels, strideHeight, strideWidth,\n topPad, leftPad, fltS0, fltS1, fltS2, xBatchStride, xRowStride,\n xColStride, xChannelStride, yBatchStride, yRowStride, yColStride,\n yChannelStride, outId);\n return out;\n}\n\nexport const conv2DBackpropInputConfig: KernelConfig = {\n kernelName: Conv2DBackpropInput,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: conv2DBackpropInput as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not

use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n===\n*/\n\nimport {Cos, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\n\nexport const cosConfig: KernelConfig = createUnaryKernelConfig(Cos);\n","/**\n * @license\n * Copyright 2021 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n===\n*/\nimport {Cosh, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\n\nexport const coshConfig: KernelConfig = createUnaryKernelConfig(Cosh);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n===\n*/\n\nimport {CropAndResize, CropAndResizeAttrs, CropAndResizeInputs, KernelConfig, KernelFunc, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {cast} from './Cast';\n\n// Must match enum in CropAndResize.cc\nenum InterpolationMethod {\n bilinear = 0,\n nearest = 1\n}\n\nlet wasmCropAndResize: (\n   imagesId: number, boxesId: number, boxIndId: number, numBoxes: number,\n   imagesShape: Uint8Array, cropHeight: number, cropWidth: number,\n   method: number, extrapolationValue: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n wasmCropAndResize = backend.wasm.cwrap(CropAndResize, null /*void*/, [\n   'number', // imagesId\n   'number', // boxesId\n   'number', // boxIndId\n   'number', // numBoxes\n   'array',   // images shape\n   'number', // cropHeight\n   'number', // cropWidth\n   'number', // method\n   'number', // extrapolation value\n   'number'   // out id\n]);\n}\n\nfunction cropAndResize(args: {\n backend: BackendWasm,\n inputs: CropAndResizeInputs,\n attrs: CropAndResizeAttrs\n}): TensorInfo {\n const {backend, inputs, attrs} = args;\n const {method, extrapolationValue, cropSize} = attrs;\n const {image, boxes, boxInd} = inputs;\n\n const numBoxes = boxes.shape[0];\n\n const [cropHeight, cropWidth] = cropSize as [number, number];\n const outShape = [numBoxes, cropHeight, cropWidth, image.shape[3]];\n\n let imagesData = backend.dataIdMap.get(image.dataId);\n let castedData;\n if (image.dtype !== 'float32') {\n   castedData = cast({backend, inputs: {x: image}, attrs: {dtype: 'float32'}});\n   imagesData = backend.dataIdMap.get(castedData.dataId);\n }\n\n const imagesId = imagesData.id;\n const boxesId = backend.dataIdMap.get(boxes.dataId).id;\n const boxIndId = backend.dataIdMap.get(boxInd.dataId).id;\n\n const out = backend.makeOutput(outShape, 'float32');\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n const imagesShapeBytes = new Uint8Array(new Int32Array(image.shape).buffer);\n\n wasmCropAndResize(\n   imagesId, boxesId, boxIndId, numBoxes, imagesShapeBytes, cropHeight,\n   cropWidth,\n   InterpolationMethod[method as {} as keyof typeof InterpolationMethod],\n   extrapolationValue, outId);\n\n if (castedData != null) {\n   backend.disposeData(castedData.dataId);\n }\n\n return out;\n}\n\nexport const cropAndResizeConfig:

KernelConfig = {\n kernelName: CropAndResize,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: cropAndResize as {} as KernelFunc\n};\n","/**\n * @license\n
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==========\n
*/\n\nimport {backend_util, KernelConfig, KernelFunc, Cumsum, CumsumAttrs, CumsumInputs, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {CppDType} from './types';\n\nimport {transpose} from './Transpose';\n\nlet wasmCumsum: (xId: number, exclusive:
 number, reverse: number,\n   finalDim: number, outId: number, dtype: CppDType) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmCumsum = backend.wasm.cwrap(Cumsum, null /* void */, [\n   'number', // x_id\n   'number', // exclusive\n   'number', // reverse\n   'number', // final_dim\n   'number', // out_id\n   'number' // dtype\n]);\n}\n\nexport function cumsum(\n args: {inputs: CumsumInputs, backend: BackendWasm, attrs: CumsumAttrs}):\nTensorInfo {\n const {inputs, backend, attrs} = args;\n const {x} = inputs;\n const {axis, exclusive, reverse} = attrs;\n const xRank = x.shape.length;\n\n util.assert(x.dtype === 'float32' || x.dtype === 'int32',\n   () => `cumsum does not support ${x.dtype} tensors in the WASM backend`);\n // permute required axis to inner most axis\n const permutation = backend_util.getAxesPermutation([axis], xRank);\n let permutedX = x;\n if (permutation !== null) {\n   permutedX = transpose({inputs: {x}, attrs: {perm:
 permutation}, backend});\n }\n const permutedAxis = backend_util.getInnerMostAxes(1, xRank)[0];\n backend_util.assertAxesAreInnerMostDims('cumsum', [permutedAxis], xRank);\n\n const permutedOut = backend.makeOutput(permutedX.shape, permutedX.dtype);\n const finalDim = permutedX.shape[permutedAxis];\n const permutedXId = backend.dataIdMap.get(permutedX.dataId).id;\n const permutedOutId = backend.dataIdMap.get(permutedOut.dataId).id;\n wasmCumsum(permutedXId, exclusive ? 1 : 0, reverse ? 1 : 0, finalDim,\n   permutedOutId, CppDType[x.dtype]);\n\n // transpose data back if permuted\n let out = permutedOut;\n if (permutation !== null) {\n   const undoPermutation = backend_util.getUndoAxesPermutation(permutation);\n   out = transpose(\n   {inputs: {x: permutedOut}, attrs: {perm: undoPermutation}, backend});\n   backend.disposeData(permutedX.dataId);\n   backend.disposeData(permutedOut.dataId);\n }\n return out;\n}\n\nexport const cumsumConfig: KernelConfig
 = {\n kernelName: Cumsum,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: cumsum as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n
*/\n\nimport {DepthToSpace, DepthToSpaceAttrs, DepthToSpaceInputs, KernelConfig, KernelFunc, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm}
 from '../backend_wasm';\n\nlet wasmDepthToSpace: (\n   xId: number, blockSize: number, channelsLast: number, xStrides: Uint8Array,\n   xStridesLength: number, outputShape: Uint8Array, outputStrides: Uint8Array,\n   outSize: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n wasmDepthToSpace = backend.wasm.cwrap(DepthToSpace, null /*void*/, [\n   'number', // xId\n   'number', // blockSize\n   'number', // channelsLast\n   'array',   // xStrides\n   'number', // xStridesLength\n   'array',   // outputShape\n   'array',   // outputStrides\n   'number', // outSize\n   'number', // outId\n]);\n}\n\nexport function

depthToSpace(args: {\n backend: BackendWasm,\n inputs: DepthToSpaceInputs,\n attrs: DepthToSpaceAttrs\n}): TensorInfo {\n const {backend, inputs, attrs} = args;\n const {x} = inputs;\n const {blockSize, dataFormat} = attrs;\n\n const batchSize = x.shape[0];\n const inputHeight = (dataFormat === 'NHWC') ? x.shape[1] : x.shape[2];\n const inputWidth = (dataFormat === 'NHWC') ? x.shape[2] : x.shape[3];\n const inputDepth = (dataFormat === 'NHWC') ? x.shape[3] : x.shape[1];\n\n const outputHeight = inputHeight * blockSize;\n const outputWidth = inputWidth * blockSize;\n const outputDepth = inputDepth / (blockSize * blockSize);\n\n const outputShape = (dataFormat === 'NHWC') ?\n   [batchSize, outputHeight, outputWidth, outputDepth] :\n   [batchSize, outputDepth, outputHeight, outputWidth];\n\n const out = backend.makeOutput(outputShape, 'float32');\n\n const xData = backend.dataIdMap.get(x.dataId);\n const xId = xData.id;\n const xStridesBytes =\n   new Uint8Array(new Int32Array(util.computeStrides(x.shape)).buffer);\n\n const outputShapeBytes = new Uint8Array(new Int32Array(outputShape).buffer);\n const outStridesBytes =\n   new Uint8Array(new Int32Array(util.computeStrides(outputShape)).buffer);\n\n const outId = backend.dataIdMap.get(out.dataId).id;\n const channelsLast = dataFormat === 'NHWC' ? 1 : 0;\n wasmDepthToSpace(\n   xId, blockSize, channelsLast, xStridesBytes, x.shape.length - 1,\n   outputShapeBytes, outStridesBytes, outputShape.length, outId);\n\n return out;\n}\n\nexport const depthToSpaceConfig: KernelConfig = {\n kernelName: DepthToSpace,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: depthToSpace as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n * ==\n */\n\nimport {backend_util, DepthwiseConv2dNative, DepthwiseConv2dNativeAttrs, DepthwiseConv2dNativeInputs, KernelConfig, KernelFunc, Tensor4D} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmDepthwiseConv2d: (\n   xId: number, batchSize: number, inputHeight: number, inputWidth: number,\n   filterId: number, filterHeight: number, filterWidth: number, padTop: number,\n   padRight: number, padBottom: number, padLeft: number, isSamePad: number,\n   dilationHeight: number, dilationWidth: number, strideHeight: number,\n   strideWidth: number, inputChannels: number, outputChannels: number,\n   outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmDepthwiseConv2d =\n   backend.wasm.cwrap(DepthwiseConv2dNative, null /* void */, [\n   'number', // xId\n   'number', // batchSize\n   'number', // inputHeight\n   'number', // inputWidth\n   'number', // filterId\n   'number', // filterHeight\n   'number', // filterWidth\n   'number', // padTop\n   'number', // padRight\n   'number', // padBottom\n   'number', // padLeft\n   'number', // isSamePad\n   'number', // dilationHeight\n   'number', // dilationWidth\n   'number', // strideHeight\n   'number', // strideWidth\n   'number', // inputChannels\n   'number', // outputChannels\n   'number', // outId\n   ]);\n}\n\nfunction depthwiseConv2d(args: {\n inputs: DepthwiseConv2dNativeInputs,\n backend: BackendWasm,\n attrs: DepthwiseConv2dNativeAttrs\n}) {\n const {inputs, attrs, backend} = args;\n\n const {x, filter} = inputs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n const filterId = backend.dataIdMap.get(filter.dataId).id;\n\n const {strides, dilations, pad, dimRoundingMode} = attrs;\n\n const $dilations = dilations == null ? [1, 1] : dilations;\n\n const convInfo = backend_util.computeConv2DInfo(\n   (x as Tensor4D).shape, (filter as Tensor4D).shape, strides,\n   ($dilations as number | [number, number]), pad, dimRoundingMode,\n   true /* depthwise */);\n\n const filterHeight = convInfo.filterHeight;\n const filterWidth = convInfo.filterWidth;\n const padTop = convInfo.padInfo.top;\n const padRight = convInfo.padInfo.right;\n const padBottom = convInfo.padInfo.bottom;\n const padLeft = convInfo.padInfo.left;\n const dilationHeight =

convInfo.dilationHeight;\n const dilationWidth = convInfo.dilationWidth;\n const strideHeight = convInfo.strideHeight;\n const strideWidth = convInfo.strideWidth;\n const inputChannels = convInfo.inChannels;\n const outputChannels = convInfo.outChannels;\n const isSamePad = convInfo.padInfo.type === 'SAME' ? 1 : 0;\n\n if (convInfo.dataFormat !== 'channelsLast') {\n   throw new Error(\n   `wasm backend DepthwiseConv2dNative does not support dataFormat:'` +\n   `${convInfo.dataFormat}'. Please use 'channelsLast'.`);\n }\n\n const out = backend.makeOutput(convInfo.outShape, 'float32');\n const outId = backend.dataIdMap.get(out.dataId).id;\n wasmDepthwiseConv2d(\n   xId, x.shape[0], x.shape[1], x.shape[2], filterId, filterHeight,\n   filterWidth, padTop, padRight, padBottom, padLeft, isSamePad,\n   dilationHeight, dilationWidth, strideHeight, strideWidth, inputChannels,\n   outputChannels, outId);\n return out;\n}\n\nexport const depthwiseConv2dNativeConfig: KernelConfig = {\n kernelName: DepthwiseConv2dNative,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: depthwiseConv2d as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2021 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==*/\nimport {Elu, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\n\nexport const eluConfig: KernelConfig = createUnaryKernelConfig(Elu);\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==*/\nimport {Equal, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from './binary_kernel';\n\nconst supportsFullBroadcast = false;\nexport const equalConfig: KernelConfig =\n createBinaryKernelConfig(Equal, supportsFullBroadcast, 'bool');\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==*/\nimport {Exp, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\n\nexport const expConfig: KernelConfig = createUnaryKernelConfig(Exp, 'float32');\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n

* WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n===\n*/\n\nimport {ExpandDims, ExpandDimsAttrs, ExpandDimsInputs, KernelConfig, KernelFunc, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\nimport {reshape} from './Reshape';\n\nexport function expandDims(args: {\n inputs: ExpandDimsInputs,\n attrs: ExpandDimsAttrs,\n backend: BackendWasm\n}) {\n const {inputs, attrs, backend} = args;\n const {input} = inputs;\n const {dim} = attrs;\n\n const inputRank = input.shape.length;\n const newShape = input.shape.slice();\n let $dim = dim;\n if (dim < 0) {\n   // Negative value is counted from the tail of rank.\n   util.assert(\n   -(inputRank + 1) <= dim,\n   () => `Axis must be in the interval [${- (inputRank + 1)}, ${\n        inputRank}]`);\n $dim = inputRank + dim + 1;\n }\n newShape.splice($dim, 0, 1);\n\n return reshape({inputs: {x: input}, backend, attrs: {shape: newShape}});\n}\n\nexport const expandDimsConfig: KernelConfig = {\n kernelName: ExpandDims,\n backendName: 'wasm',\n kernelFunc: expandDims as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n===\n */\n\nimport {KernelConfig, KernelFunc} from '@tensorflow/tfjs-core';\nimport {Fill, FillAttrs} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nexport function fill(args: {attrs: FillAttrs, backend: BackendWasm}) {\n const {attrs: {shape, value, dtype}, backend} = args;\n const out = backend.makeOutput(shape, dtype);\n const outVals = backend.typedArrayFromHeap(out);\n outVals.fill(value as number);\n return out;\n}\n\nexport const fillConfig: KernelConfig = {\n kernelName: Fill,\n backendName: 'wasm',\n kernelFunc: fill as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n===\n*/\n\nimport {FlipLeftRight, FlipLeftRightInputs, KernelConfig, KernelFunc, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmFlipLeftRight: (\n   xId: number, batch: number, imageHeight: number, imageWidth: number,\n   numChannels: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmFlipLeftRight = backend.wasm.cwrap(FlipLeftRight, null /* void */, [\n   'number', // xId\n   'number', // batch\n   'number', // imageHeight\n   'number', // imageWidth\n   'number', // numChannels\n   'number', // outId\n]);\n}\n\nexport function flipLeftRight(\n   args: {inputs: FlipLeftRightInputs, backend: BackendWasm}): TensorInfo {\n const {inputs, backend} = args;\n const {image} = inputs;\n\n const out = backend.makeOutput(image.shape, image.dtype);\n const imageId = backend.dataIdMap.get(image.dataId).id;\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n const [batch, imageHeight, imageWidth, numChannels] = image.shape;\n\n wasmFlipLeftRight(\n   imageId, batch, imageHeight, imageWidth, numChannels, outId);\n return out;\n}\n\nexport const flipLeftRightConfig: KernelConfig = {\n kernelName: FlipLeftRight,\n backendName: 'wasm',\n kernelFunc: flipLeftRight as {} as KernelFunc,\n setupFunc: setup\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in

compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==========\n */\nimport {Floor, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\nexport const floorConfig: KernelConfig = createUnaryKernelConfig(Floor);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==========\n */\n\nimport {FloorDiv, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from './binary_kernel';\n\nconst supportsFullBroadcast = false;\nexport const floorDivConfig: KernelConfig =\n createBinaryKernelConfig(FloorDiv, supportsFullBroadcast);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n *
distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==========\n */\n\nimport {FusedBatchNorm, FusedBatchNormAttrs, FusedBatchNormInputs, KernelConfig, KernelFunc, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmBatchNorm: (\n xId: number, meanId: number, varianceId: number, offsetId: number,\n scaleId: number, varianceEpsilon: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n wasmBatchNorm = backend.wasm.cwrap(\n FusedBatchNorm, null /* void */,\n ['number', 'number', 'number', 'number', 'number', 'number', 'number']);\n}\n\nfunction fusedBatchNorm(args: {\n backend: BackendWasm,\n inputs: FusedBatchNormInputs,\n attrs: FusedBatchNormAttrs\n}): TensorInfo {\n const {backend, inputs, attrs} = args;\n const {varianceEpsilon} = attrs;\n const {x, mean, variance, offset, scale} = inputs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n const meanId = backend.dataIdMap.get(mean.dataId).id;\n const varianceId = backend.dataIdMap.get(variance.dataId).id;\n const offsetId = offset != null ? backend.dataIdMap.get(offset.dataId).id : 0;\n const scaleId = scale != null ? backend.dataIdMap.get(scale.dataId).id : 0;\n\n const out = backend.makeOutput(x.shape, x.dtype);\n // Short-circuit zero-sized tensors.\n if (util.sizeFromShape(x.shape) === 0) {\n return out;\n }\n\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n wasmBatchNorm(\n xId, meanId, varianceId, offsetId, scaleId, varianceEpsilon, outId);\n return out;\n}\n\nexport const fusedBatchNormConfig: KernelConfig = {\n kernelName: FusedBatchNorm,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: fusedBatchNorm as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n *

Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n==========\n */\n\nimport {backend_util, FusedConv2D, FusedConv2DAttrs, FusedConv2DInputs, KernelConfig, KernelFunc, Tensor4D} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {FusableActivation} from './types';\n\nlet wasmFusedConv2d:\n (xId: number, batchSize: number, inputHeight: number, inputWidth: number,\n filterId: number, filterHeight: number, filterWidth: number,\n biasId: number, padTop: number, padRight: number, padBottom: number,\n padLeft: number, isSamePad: number, dilationHeight: number,\n dilationWidth: number, strideHeight: number, strideWidth: number,\n inputChannels: number, outputChannels: number, activation: number,\n preluActivationWeightsId: number, leakyreluAlpha: number, outId: number) =>\n void;\n\nfunction setup(backend: BackendWasm) {\n wasmFusedConv2d = backend.wasm.cwrap(FusedConv2D, null /* void */, [\n 'number', // xId\n 'number', // batchSize\n 'number', // inputHeight\n 'number', // inputWidth\n 'number', // filterId\n 'number', // filterHeight\n 'number', // filterWidth\n 'number', // biasId\n 'number', // padTop\n 'number', // padRight\n 'number', // padBottom\n 'number', // padLeft\n 'number', // isSamePad\n 'number', // dilationHeight\n 'number', // dilationWidth\n 'number', // strideHeight\n 'number', // strideWidth\n 'number', // inputChannels\n 'number', // outputChannels\n 'number', // activation\n 'number', // preluActivationWeightsId\n 'number', // leakyreluAlpha\n 'number', // outId\n]);\n}\n\nfunction fusedConv2d(args: {\n inputs: FusedConv2DInputs,\n backend: BackendWasm,\n attrs: FusedConv2DAttrs\n}) {\n const {inputs, attrs, backend} = args;\n const {x, filter, bias, preluActivationWeights} = inputs;\n const {\n strides,\n pad,\n dilations,\n dataFormat,\n dimRoundingMode,\n activation,\n leakyreluAlpha\n } = attrs;\n\n const convInfo = backend_util.computeConv2DInfo(\n (x as Tensor4D).shape, (filter as Tensor4D).shape, strides, dilations,\n pad, dimRoundingMode);\n\n const fusedActivation =\n FusableActivation[activation as {} as keyof typeof FusableActivation];\n\n if (fusedActivation == null) {\n throw new Error(\n `${activation} activation not yet supported for FusedConv2D ` +\n `in the wasm backend.`);\n }\n\n const xId = backend.dataIdMap.get(x.dataId).id;\n const filterId = backend.dataIdMap.get(filter.dataId).id;\n\n const outputChannels = convInfo.outChannels;\n\n let biasId = 0;\n if (bias != null) {\n const biasData = backend.dataIdMap.get(bias.dataId);\n if (biasData.shape.length !== 1) {\n throw new Error(\n `FusedConv2D only supports rank-1 bias but got ` +\n `rank ${biasData.shape.length}.`);\n }\n if (biasData.shape[0] !== outputChannels) {\n throw new Error(\n `FusedConv2D bias shape (${biasData.shape}) does not ` +\n `match the number of output channels (${outputChannels})`);\n }\n biasId = biasData.id;\n }\n\n const filterHeight = convInfo.filterHeight;\n const filterWidth = convInfo.filterWidth;\n const padTop = convInfo.padInfo.top;\n\n const padRight = convInfo.padInfo.right;\n const padBottom = convInfo.padInfo.bottom;\n const padLeft = convInfo.padInfo.left;\n const dilationHeight = convInfo.dilationHeight;\n const dilationWidth = convInfo.dilationWidth;\n const strideHeight = convInfo.strideHeight;\n const strideWidth = convInfo.strideWidth;\n const inputChannels = convInfo.inChannels;\n const isSamePad = convInfo.padInfo.type === 'SAME' ? 1 : 0;\n const batchSize = convInfo.batchSize;\n const inHeight = convInfo.inHeight;\n const inWidth = convInfo.inWidth;\n\n if (dataFormat !== 'NHWC') {\n throw new Error(\n `wasm backend FusedConv2D does not support dataFormat:'` +\n `${dataFormat}'. Please use 'NHWC'.`);\n }\n\n const out = backend.makeOutput(convInfo.outShape, 'float32');\n const outId = backend.dataIdMap.get(out.dataId).id;\n const preluActivationWeightsId = preluActivationWeights == null ?\n 0 :\n backend.dataIdMap.get(preluActivationWeights.dataId).id;\n\n wasmFusedConv2d(\n xId, batchSize, inHeight, inWidth, filterId, filterHeight, filterWidth,\n biasId, padTop, padRight, padBottom, padLeft, isSamePad, dilationHeight,\n dilationWidth, strideHeight, strideWidth, inputChannels,\n outputChannels, fusedActivation, preluActivationWeightsId, leakyreluAlpha || 0, outId);\n\n return

```
out;\n}\n\nexport const fusedConv2DConfig: KernelConfig = {\n  kernelName: FusedConv2D,\n  backendName:
'wasm',\n  setupFunc: setup,\n  kernelFunc: fusedConv2d as {} as KernelFunc\n};\n","/**\n * @license\n *
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agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n *
WITHOUT WARRANTIES
 OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language
governing permissions and\n * limitations under the License.\n *
==========================================================================\n
*/\n\nimport {backend_util, FusedDepthwiseConv2D, FusedDepthwiseConv2DAttrs,
FusedDepthwiseConv2DInputs, KernelConfig, KernelFunc, Tensor4D} from '@tensorflow/tfjs-core';\n\nimport
{BackendWasm} from '../backend_wasm';\n\nimport {FusableActivation} from './types';\n\nlet
wasmFusedDepthwiseConv2d:\n    (xId: number, batchSize: number, inputHeight: number, inputWidth: number,\n
filterId: number, filterHeight: number, filterWidth: number,\n     biasId: number, padTop: number, padRight:
number, padBottom: number,\n     padLeft: number, isSamePad: number, dilationHeight: number,\n
dilationWidth: number, strideHeight: number, strideWidth: number,\n     inputChannels: number, outputChannels:
number, activation: number,\n     preluActivationWeightsId:
 number, leakyreluAlpha: number, outId: number) =>\n        void;\n\nfunction setup(backend: BackendWasm) {\n
wasmFusedDepthwiseConv2d =\n      backend.wasm.cwrap(FusedDepthwiseConv2D, null /* void */, [\n
'number',  // xId\n        'number',  // batchSize\n        'number',  // inputHeight\n        'number',  // inputWidth\n
'number',  // filterId\n        'number',  // filterHeight\n        'number',  // filterWidth\n        'number',  // biasId\n
'number',  // padTop\n        'number',  // padRight\n        'number',  // padBottom\n        'number',  // padLeft\n
'number',  // isSamePad\n        'number',  // dilationHeight\n        'number',  // dilationWidth\n        'number',  //
strideHeight\n        'number',  // strideWidth\n        'number',  // inputChannels\n        'number',  // outputChannels\n
 'number',  // activation\n        'number',  // preluActivationWeightsId\n        'number',  // leakyreluAlpha\n
'number',
 // outId\n      ]);\n}\n\nfunction fusedDepthwiseConv2d(args: {\n  inputs: FusedDepthwiseConv2DInputs,\n
backend: BackendWasm,\n  attrs: FusedDepthwiseConv2DAttrs\n}) {\n  const {inputs, attrs, backend} = args;\n
const {x, filter, bias, preluActivationWeights} = inputs;\n  const {\n    strides,\n    pad,\n    dilations,\n
dataFormat,\n    dimRoundingMode,\n    activation,\n    leakyreluAlpha\n  } = attrs;\n\n  const convInfo =
backend_util.computeConv2DInfo(\n      (x as Tensor4D).shape, (filter as Tensor4D).shape, strides, dilations,\n
pad, dimRoundingMode, true /* depthwise */);\n\n  const fusedActivation =\n      FusableActivation[activation as {}
as keyof typeof FusableActivation];\n  if (fusedActivation == null) {\n    throw new Error(\n        `${activation}
activation not yet supported for FusedDepthwiseConv2D ` +\n        `in the wasm backend.`);\n  }\n\n  const xId =
backend.dataIdMap.get(x.dataId).id;\n  const filterId = backend.dataIdMap.get(filter.dataId).id;\n\n
  const outputChannels = convInfo.outChannels;\n\n  let biasId = 0;\n  if (bias != null) {\n    const biasData =
backend.dataIdMap.get(bias.dataId);\n    if (biasData.shape.length !== 1) {\n      throw new Error(\n
`FusedDepthwiseConv2D only supports rank-1 bias but got ` +\n          `rank ${biasData.shape.length}.`);\n    }\n
if (biasData.shape[0] !== outputChannels) {\n      throw new Error(\n          `FusedDepthwiseConv2D bias shape
(${biasData.shape}) does not ` +\n          `match the number of output channels (${outputChannels})`);\n    }\n
biasId = biasData.id;\n  }\n\n  const filterHeight = convInfo.filterHeight;\n  const filterWidth =
convInfo.filterWidth;\n  const padTop = convInfo.padInfo.top;\n  const padRight = convInfo.padInfo.right;\n  const
padBottom = convInfo.padInfo.bottom;\n  const padLeft = convInfo.padInfo.left;\n  const dilationHeight =
convInfo.dilationHeight;\n  const dilationWidth = convInfo.dilationWidth;\n  const strideHeight =
convInfo.strideHeight;\n
  const strideWidth = convInfo.strideWidth;\n  const inputChannels = convInfo.inChannels;\n  const isSamePad =
convInfo.padInfo.type === 'SAME' ? 1 : 0;\n  const batchSize = convInfo.batchSize;\n  const inHeight =
```

convInfo.inHeight;\n const inWidth = convInfo.inWidth;\n\n if (dataFormat !== 'NHWC') {\n   throw new Error(\n   `wasm backend FusedDepthwiseConv2D does not support dataFormat:'` +\n   `${dataFormat}'. Please use 'NHWC'.`);\n }\n\n const out = backend.makeOutput(convInfo.outShape, 'float32');\n const outId = backend.dataIdMap.get(out.dataId).id;\n const preluActivationWeightsId = preluActivationWeights == null ?\n   0 :\n   backend.dataIdMap.get(preluActivationWeights.dataId).id;\n\n wasmFusedDepthwiseConv2d(\n   xId, batchSize, inHeight, inWidth, filterId, filterHeight, filterWidth,\n   biasId, padTop, padRight, padBottom, padLeft, isSamePad, dilationHeight,\n   dilationWidth, strideHeight, strideWidth, inputChannels, outputChannels,\n   fusedActivation, preluActivationWeightsId, leakyreluAlpha || 0, outId);\n\n return out;\n}\n\nexport const fusedDepthwiseConv2DConfig: KernelConfig = {\n kernelName: FusedDepthwiseConv2D,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: fusedDepthwiseConv2d as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ===\n */\n\nimport {gather_util, GatherNd, GatherNdInputs, KernelConfig, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {CppDType} from './types';\n\nlet wasmGatherNd: (\n   xId: number, dtype: CppDType, indicesId: number, numSlices: number,\n   sliceRank: number, sliceSize: number, strides: Uint8Array, outId: number) =>\n   void;\n\nfunction setup(backend: BackendWasm): void {\n wasmGatherNd = backend.wasm.cwrap(GatherNd, null /*void*/, [\n   'number', // xId\n   'number', // dtype\n   'number', // indicesId\n   'number', // numSlices\n   'number', // sliceRank\n   'number', // sliceSize\n   'array',   // strides\n   'number'   // outId\n]);\n}\n\nfunction gatherNd(args: {backend: BackendWasm, inputs: GatherNdInputs}):\n   TensorInfo {\n const {backend, inputs} = args;\n const {params, indices} = inputs;\n\n const [resultShape, numSlices, sliceSize, strides] =\n   gather_util.prepareAndValidate(params, indices);\n\n const out = backend.makeOutput(resultShape, params.dtype);\n if (numSlices === 0) {\n   return out;\n }\n\n const indicesShape = indices.shape;\n const sliceRank = indicesShape[indicesShape.length - 1];\n\n const xData = backend.dataIdMap.get(params.dataId);\n const xId = xData.id;\n const indicesData = backend.dataIdMap.get(indices.dataId);\n const indicesId = indicesData.id;\n\n const stridesBytes = new Uint8Array(new Int32Array(strides).buffer);\n\n const outId = backend.dataIdMap.get(out.dataId).id;\n wasmGatherNd(\n   xId, CppDType[params.dtype], indicesId, numSlices, sliceRank, sliceSize,\n   stridesBytes, outId);\n\n return out;\n}\n\nexport const gatherNdConfig: KernelConfig = {\n kernelName: GatherNd,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: gatherNd\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may\n not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ===\n */\n\nimport {backend_util, GatherV2, GatherV2Attrs, GatherV2Inputs, KernelConfig, KernelFunc, Tensor, TensorInfo, TypedArray, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {reshape} from './Reshape';\nimport {CppDType} from './types';\n\nlet wasmGather: (\n   xId: number, dtype: CppDType, xStrides: Uint8Array, stridesSize: number,\n   indicesId: number, batchSize: number, outStrides:

Uint8Array,\n outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n wasmGather = backend.wasm.cwrap('Gather', null /*void*/, [\n 'number', // xId\n 'number', // dtype\n 'array', // xStrides\n 'number', // stridesSize\n 'number', // indicesId\n 'number', // batchSize\n 'array', // outStrides\n 'number' // outId\n]);\n}\n\nfunction gatherV2(\n args: {backend: BackendWasm, inputs: GatherV2Inputs, attrs: GatherV2Attrs}):\n TensorInfo {\n const {backend, inputs, attrs} = args;\n const {x, indices} = inputs;\n const {axis, batchDims} = attrs;\n\n // Throw error when any index is out of bound.\n const parsedAxis = util.parseAxisParam(axis, x.shape)[0];\n const indicesVals = backend.readSync(indices.dataId) as TypedArray;\n const axisDim = x.shape[parsedAxis];\n for (let i = 0; i < indicesVals.length; ++i) {\n const index = indicesVals[i];\n util.assert(\n index <= axisDim - 1 && index >= 0,\n () =>\n `GatherV2: the index value ${index} is not in [0, ${axisDim - 1}]`);\n }\n\n const shapeInfo = backend_util.segment_util.collectGatherOpShapeInfo(\n x as Tensor, indices as Tensor, parsedAxis, batchDims);\n\n const flattenX = reshape({\n inputs: {x},\n attrs: {\n shape: [\n shapeInfo.batchSize, shapeInfo.outerSize, shapeInfo.dimSize,\n shapeInfo.sliceSize\n]\n },\n backend\n });\n const indicesSize = util.sizeFromShape(indices.shape);\n const flattenIndex = reshape({\n inputs: {x: indices},\n attrs: {shape: [shapeInfo.batchSize, indicesSize / shapeInfo.batchSize]},\n backend\n });\n const flattenOutputShape = [\n shapeInfo.batchSize, shapeInfo.outerSize, indicesSize / shapeInfo.batchSize,\n shapeInfo.sliceSize\n];\n\n const out = backend.makeOutput(flattenOutputShape, x.dtype);\n if (util.sizeFromShape(x.shape) === 0) {\n return out;\n }\n const stridesSize = flattenX.shape.length - 1;\n\n const xData = backend.dataIdMap.get(flattenX.dataId);\n const xId = xData.id;\n\n const indicesData = backend.dataIdMap.get(flattenIndex.dataId);\n const indicesId = indicesData.id;\n\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n const xStridesBytes = new Uint8Array(\n new Int32Array(util.computeStrides(flattenX.shape)).buffer);\n const outStridesBytes = new Uint8Array(\n new Int32Array(util.computeStrides(flattenOutputShape)).buffer);\n\n wasmGather(\n xId, CppDType[x.dtype], xStridesBytes, stridesSize, indicesId,\n shapeInfo.batchSize, outStridesBytes, outId);\n\n backend.disposeData(flattenX.dataId);\n backend.disposeData(flattenIndex.dataId);\n\n // reshape\n out.shape = shapeInfo.outputShape;\n return out;\n}\n\nexport const gatherV2Config: KernelConfig = {\n kernelName: GatherV2,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: gatherV2 as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\nimport {Greater, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from './binary_kernel';\n\nconst supportsFullBroadcast = false;\nexport const greaterConfig: KernelConfig =\n createBinaryKernelConfig(Greater, supportsFullBroadcast, 'bool');\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\nimport {GreaterEqual, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from './binary_kernel';\n\nconst supportsFullBroadcast = false;\nexport const greaterEqualConfig: KernelConfig =\n

createBinaryKernelConfig(GreaterEqual, supportsFullBroadcast, 'bool');\n","/**\n * @license\n * Copyright 2019 Google
LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n
*/\n\nimport {KernelConfig, KernelFunc, LeakyRelu, LeakyReluAttrs, LeakyReluInputs, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {CppDType} from './types';\n\nlet wasmFunc: (\n xId: number, dtype: number, leakyreluAlpha: number, outId: number) => void;\n\nfunction
setupFunc(backend: BackendWasm): void {\n wasmFunc = backend.wasm.cwrap(LeakyRelu, null /* void */, [\n 'number', // x_id\n 'number', // dtype\n 'number', // leakyrelu_alpha\n 'number', // out_id\n]);\n}\n\nexport function leakyRelu(\n args:\n {inputs: LeakyReluInputs, attrs: LeakyReluAttrs, backend: BackendWasm}):\n TensorInfo {\n const {inputs: {x}, attrs: {alpha}, backend} = args;\n\n const xId = backend.dataIdMap.get(x.dataId).id;\n // According to TF API, LeakyRelu returns float32 when input is either float32\n // or int32.\n const out = backend.makeOutput(x.shape, 'float32');\n\n if (util.sizeFromShape(x.shape) !== 0) {\n const outId = backend.dataIdMap.get(out.dataId).id;\n wasmFunc(xId, CppDType[x.dtype], alpha, outId);\n }\n\n return out;\n}\n\nexport const leakyReluConfig: KernelConfig = {\n kernelName: LeakyRelu,\n backendName: 'wasm',\n setupFunc,\n kernelFunc: leakyRelu as {} as KernelFunc,\n};\n","/**\n * @license\n
* Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n
*/\nimport {KernelConfig, Less} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from './binary_kernel';\nconst supportsFullBroadcast = false;\nexport const lessConfig: KernelConfig =\n createBinaryKernelConfig(Less, supportsFullBroadcast, 'bool');\n","/**\n * @license\n * Copyright
2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n
*/\n\nimport {KernelConfig, LessEqual} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from './binary_kernel';\nconst supportsFullBroadcast = false;\nexport const lessEqualConfig: KernelConfig =\n createBinaryKernelConfig(LessEqual, supportsFullBroadcast, 'bool');\n","/**\n * @license\n
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==========\n */\nimport {KernelConfig, Log} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\nexport const logConfig: KernelConfig = createUnaryKernelConfig(Log);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n==========\n */\nimport {KernelConfig, LogicalAnd} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from './binary_kernel';\nconst supportsFullBroadcast = false;\nexport const logicalAndConfig: KernelConfig =\n createBinaryKernelConfig(LogicalAnd, supportsFullBroadcast, 'bool');\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n==========\n */\n\nimport {backend_util, KernelConfig, KernelFunc, Max, MaxAttrs, MaxInputs, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {permuteAxesAndTranspose} from './kernel_utils';\nimport {CppDType} from './types';\n\nlet wasmMax: (xId: number, dtype: number, reduceSize: number, outId: number) =>\n void;\n\nfunction setup(backend: BackendWasm): void {\n wasmMax = backend.wasm.cwrap(Max, null /*void*/, [\n 'number', // x_id\n 'number', // dtype\n 'number', // reduce_size\n 'number', // out_id\n]);\n}\n\nfunction max(args: {backend: BackendWasm, inputs: MaxInputs, attrs: MaxAttrs}):\n TensorInfo {\n const {backend, inputs, attrs} = args;\n const {reductionIndices: axis, keepDims} = attrs;\n const {x} = inputs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n let inputId = xId;\n let input = x;\n\n const {transposed, axes, originalAxes, inputWasTransposed} =\n permuteAxesAndTranspose(x, axis, backend);\n\n if (inputWasTransposed) {\n const transposedId = backend.dataIdMap.get(transposed.dataId).id;\n input = transposed;\n inputId = transposedId;\n }\n\n const inputRank = input.shape.length;\n backend_util.assertAxesAreInnerMostDims('max', axes, inputRank);\n const [outShape, reduceShape] =\n backend_util.computeOutAndReduceShapes(input.shape, axes);\n const reduceSize = util.sizeFromShape(reduceShape);\n\n const out = backend.makeOutput(outShape, x.dtype);\n if (util.sizeFromShape(input.shape) !== 0) {\n const outId = backend.dataIdMap.get(out.dataId).id;\n wasmMax(inputId, CppDType[x.dtype], reduceSize, outId);\n }\n\n if (inputWasTransposed) {\n // dispose of the transposed tensor.\n backend.disposeData(transposed.dataId);\n }\n\n if (keepDims) {\n // reshape\n const newShape = backend_util.expandShapeToKeepDim(out.shape, originalAxes);\n out.shape = newShape;\n }\n\n return out;\n}\n\nexport const maxConfig: KernelConfig = {\n kernelName: Max,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: max as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *

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=============================================================================\n
*/\nimport {KernelConfig, Maximum} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from
'./binary_kernel';\nconst supportsFullBroadcast = false;\nexport const maximumConfig: KernelConfig =\n
createBinaryKernelConfig(Maximum, supportsFullBroadcast);\n","/**\n * @license\n * Copyright 2019 Google
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distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either
express or implied.\n * See the License for the specific language governing permissions and\n * limitations under
the License.\n *
=============================================================================\n
*/\n\nimport {backend_util, KernelConfig, KernelFunc, MaxPool, MaxPoolAttrs, MaxPoolInputs, Tensor4D, util}
from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmMaxPool: (\n    xId:
number, batchSize: number, inputHeight: number, inputWidth: number,\n    filterHeight: number, filterWidth:
number, padTop: number, padRight: number,\n    padBottom: number, padLeft: number, dilationHeight: number,\n
dilationWidth: number, strideHeight: number, strideWidth: number,\n    inputChannels: number, outputChannels:
 number, outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n  wasmMaxPool =
backend.wasm.cwrap(MaxPool, null /* void */, [\n    'number',  // xId\n    'number',  // batchSize\n    'number',  //
inputHeight\n    'number',  // inputWidth\n    'number',  // filterHeight\n    'number',  // filterWidth\n    'number',  //
padTop\n    'number',  // padRight\n    'number',  // padBottom\n    'number',  // padLeft\n    'number',  //
dilationHeight\n    'number',  // dilationWidth\n    'number',  // strideHeight\n    'number',  // strideWidth\n    'number',
// inputChannels\n    'number',  // outputChannels\n    'number',  // outId\n  ]);\n}\n\nfunction maxPool(\n    args:
{inputs: MaxPoolInputs, backend: BackendWasm, attrs: MaxPoolAttrs}) {\n  const {inputs, attrs, backend} =
args;\n\n  const x = inputs.x as Tensor4D;\n  const xId = backend.dataIdMap.get(x.dataId).id;\n\n  // TF API
supports int32 input. CPU and WebGL backend also support int32\n  // input. WASM backend doesn't
 support it because it uses xnnpack which only\n  // supports float32.\n  //\n  // Add the following assert only for the
WASM backend instead of at core op\n  // level.\n  //\n  // TODO: add support for int32 input.\n  util.assert(\n
x.dtype === 'float32',\n      () =>\n          `Error in MaxPool: only float32 input is supported. Got ${x.dtype}.`);\n\n
const {filterSize, strides, pad, dimRoundingMode} = attrs;\n  const convInfo = backend_util.computePool2DInfo(\n
   x.shape, filterSize, strides, 1 /* dilations */, pad, dimRoundingMode);\n\n  const filterHeight =
convInfo.filterHeight;\n  const filterWidth = convInfo.filterWidth;\n  const padTop = convInfo.padInfo.top;\n  const
padRight = convInfo.padInfo.right;\n  const padBottom = convInfo.padInfo.bottom;\n  const padLeft =
convInfo.padInfo.left;\n  const dilationHeight = convInfo.dilationHeight;\n  const dilationWidth =
convInfo.dilationWidth;\n  const strideHeight = convInfo.strideHeight;\n  const strideWidth =
convInfo.strideWidth;\n
  const inputChannels = convInfo.inChannels;\n  const outputChannels = convInfo.outChannels;\n\n  if
(convInfo.dataFormat !== 'channelsLast') {\n    throw new Error(\n        `wasm backend does not support
dataFormat:'` +\n        `${convInfo.dataFormat}'. Please use 'channelsLast'.`);\n  }\n\n  const out =
backend.makeOutput(convInfo.outShape, 'float32');\n  const outId = backend.dataIdMap.get(out.dataId).id;\n\n
wasmMaxPool(\n      xId, x.shape[0], x.shape[1], x.shape[2], filterHeight, filterWidth,\n      padTop, padRight,
padBottom, padLeft, dilationHeight, dilationWidth,\n      strideHeight, strideWidth, inputChannels, outputChannels,
outId);\n  return out;\n}\n\nexport const maxPoolConfig: KernelConfig = {\n  kernelName: MaxPool,\n
backendName: 'wasm',\n  setupFunc: setup,\n  kernelFunc: maxPool as {} as KernelFunc\n};\n","/**\n * @license\n
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http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing,
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software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {backend_util, KernelConfig, KernelFunc, Mean, MeanAttrs, MeanInputs, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\nimport {cast} from './Cast';\n\nimport {permuteAxesAndTranspose} from './kernel_utils';\n\nlet wasmMean: (xId: number, reduceSize: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n wasmMean =\n backend.wasm.cwrap(Mean,
null /*void*/, ['number, number, number']);\n}\n\nexport function mean(\n args: {backend: BackendWasm, inputs: MeanInputs, attrs: MeanAttrs}):\n TensorInfo {\n const {backend, inputs, attrs} = args;\n const {axis, keepDims} = attrs;\n const {x} = inputs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n let inputId = xId;\n let input = x;\n\n const {transposed, axes, originalAxes, inputWasTransposed} =\n permuteAxesAndTranspose(x, axis, backend);\n\n let reductionAxes = axes;\n if (inputWasTransposed) {\n const transposedId = backend.dataIdMap.get(transposed.dataId).id;\n if (transposedId !== xId) {\n // transpose was not a no-op. We will need to dispose of this\n // once we are done.\n input = transposed;\n inputId = transposedId;\n reductionAxes = backend_util.getInnerMostAxes(\n reductionAxes.length, input.shape.length);\n }\n }\n\n backend_util.assertAxesAreInnerMostDims(\n 'mean', reductionAxes, input.shape.length);\n
const [outShape, reduceShape] =\n backend_util.computeOutAndReduceShapes(input.shape, reductionAxes);\n const reduceSize = util.sizeFromShape(reduceShape);\n let castedInput = input;\n if (input.dtype !== 'float32') {\n castedInput =\n cast({backend, inputs: {x: input}, attrs: {dtype: 'float32'}});\n inputId = backend.dataIdMap.get(castedInput.dataId).id;\n }\n\n const out = backend.makeOutput(outShape, 'float32');\n if (util.sizeFromShape(input.shape) !== 0) {\n const outId = backend.dataIdMap.get(out.dataId).id;\n wasmMean(inputId, reduceSize, outId);\n }\n\n if (inputWasTransposed) {\n // dispose of the transposed tensor.\n backend.disposeData(transposed.dataId);\n }\n\n if (keepDims) {\n // reshape\n const newShape = backend_util.expandShapeToKeepDim(out.shape, originalAxes);\n out.shape = newShape;\n }\n\n if (input.dtype !== 'float32') {\n backend.disposeData(castedInput.dataId);\n }\n\n return out;\n}\n\nexport
const meanConfig: KernelConfig = {\n kernelName: Mean,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: mean as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {backend_util, KernelConfig, KernelFunc, Min, MinAttrs, MinInputs, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport
{BackendWasm} from '../backend_wasm';\n\nimport {permuteAxesAndTranspose} from './kernel_utils';\nimport {CppDType} from './types';\n\nlet wasmMin: (xId: number, dtype: number, reduceSize: number, outId: number) =>\n void;\n\nfunction setup(backend: BackendWasm): void {\n wasmMin = backend.wasm.cwrap(Min, null /*void*/, [\n 'number', // x_id\n 'number', // dtype\n 'number', // reduce_size\n 'number', // out_id\n]);\n}\n\nfunction min(args: {backend: BackendWasm, inputs: MinInputs, attrs: MinAttrs}):\n TensorInfo {\n const {backend, inputs, attrs} = args;\n const {axis, keepDims} = attrs;\n const {x} = inputs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n let inputId = xId;\n let input = x;\n\n const {transposed, axes, originalAxes, inputWasTransposed} =\n permuteAxesAndTranspose(x, axis, backend);\n\n if (inputWasTransposed) {\n const transposedId = backend.dataIdMap.get(transposed.dataId).id;\n if (transposedId !== xId)

{\n // transpose was not a no-op. We will need to dispose of this\n // once we are done.\n input = transposed;\n inputId = transposedId;\n }\n }\n\n const inputRank = input.shape.length;\n\n backend_util.assertAxesAreInnerMostDims('min', axes, inputRank);\n const [outShape, reduceShape] =\n backend_util.computeOutAndReduceShapes(input.shape, axes);\n const reduceSize = util.sizeFromShape(reduceShape);\n\n const out = backend.makeOutput(outShape, input.dtype);\n if (util.sizeFromShape(input.shape) !== 0) {\n const outId = backend.dataIdMap.get(out.dataId).id;\n wasmMin(inputId, CppDType[x.dtype], reduceSize, outId);\n }\n\n if (inputWasTransposed) {\n // dispose of the transposed tensor.\n backend.disposeData(transposed.dataId);\n }\n\n if (keepDims) {\n // reshape\n const newShape = backend_util.expandShapeToKeepDim(out.shape, originalAxes);\n out.shape = newShape;\n }\n\n return out;\n}\n\nexport const minConfig: KernelConfig = {\n kernelName: Min,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: min as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\nimport {KernelConfig, Minimum} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from './binary_kernel';\nconst supportsFullBroadcast = false;\nexport const minimumConfig: KernelConfig = createBinaryKernelConfig(Minimum, supportsFullBroadcast);\n","/**\n * @license\n * Copyright 2021 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {KernelConfig, KernelFunc, MirrorPad, MirrorPadAttrs, MirrorPadInputs} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {CppDType} from './types';\n\n// Must match enum in MirrorPad.cc\nenum MirrorPaddingMode {\n reflect = 0,\n symmetric = 1\n}\n\nlet wasmMirrorPad: (\n xId: number, xShapeBytes: Uint8Array, xShapeLength: number, xDtype: number,\n prePaddingsBytes: Uint8Array, postPaddingsBytes: Uint8Array, mode: number,\n outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmMirrorPad = backend.wasm.cwrap(MirrorPad, null /* void */, [\n 'number', // xId\n 'array', // x.shape\n 'number', // x.shape.length\n 'number', // x.dtype\n 'array', // pre-paddings\n 'array', // post-paddings\n 'number', // mode\n 'number', // outId\n]);\n}\n\nfunction mirrorPad(args: {\n inputs: MirrorPadInputs,\n backend: BackendWasm,\n attrs: MirrorPadAttrs\n}) {\n const {inputs: {x}, backend, attrs: {paddings, mode}} = args;\n\n const outShape = paddings.map(\n (p, i) => p[0] /* beforePad */ + x.shape[i] + p[1] /* afterPad */);\n const xId = backend.dataIdMap.get(x.dataId).id;\n const out = backend.makeOutput(outShape, x.dtype);\n const outId = backend.dataIdMap.get(out.dataId).id;\n const xShapeBytes = new Uint8Array(new Int32Array(x.shape).buffer);\n\n const prePaddingsFlat = paddings.map(padTuple => padTuple[0]);\n const postPaddingsFlat = paddings.map(padTuple => padTuple[1]);\n const prePaddingsBytes =\n new Uint8Array(new Int32Array(prePaddingsFlat).buffer);\n const postPaddingsBytes =\n new Uint8Array(new Int32Array(postPaddingsFlat).buffer);\n\n wasmMirrorPad(\n xId, xShapeBytes, x.shape.length, CppDType[x.dtype], prePaddingsBytes,\n postPaddingsBytes,

MirrorPaddingMode[mode], outId);\n return out;\n}\n\nexport const mirrorPadConfig: KernelConfig = {\n kernelName: MirrorPad,\n backendName: 'wasm',\n kernelFunc: mirrorPad as {} as KernelFunc,\n setupFunc: setup\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the
 \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {KernelConfig, Multiply} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from './binary_kernel';\n\nconst supportsFullBroadcast = true;\nexport const multiplyConfig: KernelConfig =\n createBinaryKernelConfig(Multiply, supportsFullBroadcast);\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the
 \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\nimport {KernelConfig, Neg} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\nexport const negConfig: KernelConfig = createUnaryKernelConfig(Neg);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n
 * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {BackendWasm} from '../backend_wasm';\n\n// Analogous to `struct Result` in `non_max_suppression_impl.h`.\ninterface Result {\n pSelectedIndices: number;\n selectedSize: number;\n pSelectedScores: number;\n pValidOutputs: number;\n}\n\n/**\n * Parse the result of the c++ method, which has the shape equivalent to\n * `Result`.\n */\nexport function parseResultStruct(\n   backend: BackendWasm, resOffset: number): Result {\n const result = new Int32Array(backend.wasm.HEAPU8.buffer,
 resOffset, 4);\n const pSelectedIndices = result[0];\n const selectedSize = result[1];\n const pSelectedScores = result[2];\n const pValidOutputs = result[3];\n // Since the result was allocated on the heap, we have to delete it.\n backend.wasm._free(resOffset);\n return {pSelectedIndices, selectedSize, pSelectedScores, pValidOutputs};\n}\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n
 * ==========\n */\n\nimport {KernelConfig, KernelFunc, NonMaxSuppressionV3, NonMaxSuppressionV3Attrs, NonMaxSuppressionV3Inputs, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {parseResultStruct} from './NonMaxSuppression_util';\n\nlet wasmFunc: (\n

boxesId: number, scoresId: number, maxOutputSize: number,\n iouThreshold: number, scoreThreshold: number) => number;\n\nfunction setup(backend: BackendWasm): void {\n wasmFunc = backend.wasm.cwrap(\n NonMaxSuppressionV3,\n 'number', // Result*\n [\n 'number', // boxesId\n 'number', // scoresId\n 'number', // maxOutputSize\n 'number', // iouThreshold\n 'number', // scoreThreshold\n]);\n}\n\nfunction kernelFunc(args: {\n backend: BackendWasm,\n inputs: NonMaxSuppressionV3Inputs,\n attrs: NonMaxSuppressionV3Attrs\n}): TensorInfo {\n const {backend, inputs, attrs} = args;\n const {iouThreshold, maxOutputSize, scoreThreshold} = attrs;\n const {boxes, scores} = inputs;\n\n const boxesId = backend.dataIdMap.get(boxes.dataId).id;\n const scoresId = backend.dataIdMap.get(scores.dataId).id;\n\n const resOffset =\n wasmFunc(boxesId, scoresId, maxOutputSize, iouThreshold, scoreThreshold);\n\n const {pSelectedIndices, selectedSize, pSelectedScores, pValidOutputs} =\n parseResultStruct(backend, resOffset);\n\n // Since we are not using scores for V3, we have to delete it from the heap.\n backend.wasm._free(pSelectedScores);\n backend.wasm._free(pValidOutputs);\n\n const selectedIndicesTensor =\n backend.makeOutput([selectedSize], 'int32', pSelectedIndices);\n\n return selectedIndicesTensor;\n}\n\nexport const nonMaxSuppressionV3Config: KernelConfig = {\n kernelName: NonMaxSuppressionV3,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: kernelFunc as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {KernelConfig, KernelFunc, NonMaxSuppressionV4, NonMaxSuppressionV4Attrs, NonMaxSuppressionV4Inputs, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {parseResultStruct} from './NonMaxSuppression_util';\n\nlet wasmFunc: (\n boxesId: number, scoresId: number, maxOutputSize: number,\n iouThreshold: number, scoreThreshold: number,\n padToMaxOutputSize: boolean) => number;\n\nfunction setup(backend: BackendWasm): void {\n wasmFunc = backend.wasm.cwrap(\n NonMaxSuppressionV4,\n 'number', // Result*\n [\n 'number', // boxesId\n 'number', // scoresId\n 'number', // maxOutputSize\n 'number', // iouThreshold\n 'number', // scoreThreshold\n 'bool', // padToMaxOutputSize\n]);\n}\n\nfunction nonMaxSuppressionV4(args: {\n backend: BackendWasm,\n inputs: NonMaxSuppressionV4Inputs,\n attrs: NonMaxSuppressionV4Attrs\n}): TensorInfo[] {\n const {backend, inputs, attrs} = args;\n const {iouThreshold, maxOutputSize, scoreThreshold, padToMaxOutputSize} =\n attrs;\n const {boxes, scores} = inputs;\n\n const boxesId = backend.dataIdMap.get(boxes.dataId).id;\n const scoresId = backend.dataIdMap.get(scores.dataId).id;\n\n const resOffset = wasmFunc(\n boxesId, scoresId, maxOutputSize, iouThreshold, scoreThreshold,\n padToMaxOutputSize);\n\n const {pSelectedIndices, selectedSize, pSelectedScores, pValidOutputs} =\n parseResultStruct(backend, resOffset);\n\n // Since we are not using scores for V4, we have to delete it from the heap.\n backend.wasm._free(pSelectedScores);\n\n const selectedIndicesTensor =\n backend.makeOutput([selectedSize], 'int32', pSelectedIndices);\n\n const validOutputsTensor = backend.makeOutput([], 'int32', pValidOutputs);\n\n return [selectedIndicesTensor, validOutputsTensor];\n}\n\nexport const nonMaxSuppressionV4Config: KernelConfig = {\n kernelName: NonMaxSuppressionV4,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: nonMaxSuppressionV4 as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\"

BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {KernelConfig, KernelFunc, NonMaxSuppressionV5, NonMaxSuppressionV5Attrs, NonMaxSuppressionV5Inputs, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {parseResultStruct} from './NonMaxSuppression_util';\n\nlet wasmFunc:\n (boxesId: number, scoresId: number, maxOutputSize: number,\n iouThreshold: number, scoreThreshold: number, softNmsSigma: number) =>\n number;\n\nfunction setup(backend: BackendWasm): void {\n wasmFunc = backend.wasm.cwrap(\n NonMaxSuppressionV5,\n 'number', // Result*\n [\n 'number', // boxesId\n 'number', // scoresId\n 'number', // maxOutputSize\n 'number', // iouThreshold\n 'number', // scoreThreshold\n 'number', // softNmsSigma\n]);\n}\n\nfunction kernelFunc(args: {\n backend: BackendWasm,\n inputs: NonMaxSuppressionV5Inputs,\n attrs: NonMaxSuppressionV5Attrs\n}): TensorInfo[] {\n const {backend, inputs, attrs} = args;\n const {iouThreshold, maxOutputSize, scoreThreshold, softNmsSigma} = attrs;\n const {boxes, scores} = inputs;\n\n const boxesId = backend.dataIdMap.get(boxes.dataId).id;\n const scoresId = backend.dataIdMap.get(scores.dataId).id;\n\n const resOffset = wasmFunc(\n boxesId, scoresId, maxOutputSize, iouThreshold, scoreThreshold,\n softNmsSigma);\n\n const {pSelectedIndices, selectedSize, pSelectedScores, pValidOutputs} =\n parseResultStruct(backend, resOffset);\n\n //
Since we are not using validOutputs for V5, we have to delete it from the\n // heap.\n backend.wasm._free(pValidOutputs);\n\n const selectedIndicesTensor =\n backend.makeOutput([selectedSize], 'int32', pSelectedIndices);\n const selectedScoresTensor =\n backend.makeOutput([selectedSize], 'float32', pSelectedScores);\n\n return [selectedIndicesTensor, selectedScoresTensor];\n}\n\nexport const nonMaxSuppressionV5Config: KernelConfig = {\n kernelName: NonMaxSuppressionV5,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: kernelFunc as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License
is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\nimport {KernelConfig, NotEqual} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from './binary_kernel';\nconst supportsFullBroadcast = false;\nexport const notEqualConfig: KernelConfig =\n createBinaryKernelConfig(NotEqual, supportsFullBroadcast, 'bool');\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the
License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {KernelConfig, KernelFunc, OneHot, OneHotAttrs, OneHotInputs} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmOneHot: (\n indicesId: number, depth: number, onValue: number, offValue: number,\n outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmOneHot = backend.wasm.cwrap(OneHot, null /* void */, [\n 'number', // indices_id\n 'number', // depth,\n 'number', // onValue\n 'number', // offValue\n 'number' // out_id\n]);\n}\n\nfunction

oneHot(\n   args: {inputs: OneHotInputs, attrs: OneHotAttrs, backend: BackendWasm}) {\n const {inputs, backend, attrs} = args;\n const {indices}
 = inputs;\n const {depth, onValue, offValue} = attrs;\n\n const out = backend.makeOutput([...indices.shape, depth], 'int32');\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n const indicesData = backend.dataIdMap.get(indices.dataId);\n const indicesId = indicesData.id;\n\n wasmOneHot(indicesId, depth, onValue, offValue, outId);\n\n return out;\n}\n\nexport const oneHotConfig: KernelConfig = {\n kernelName: OneHot,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: oneHot as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES
 OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n
*/\n\nimport {KernelConfig, KernelFunc, OnesLike, OnesLikeInputs} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nfunction onesLike(args: {inputs: OnesLikeInputs, backend: BackendWasm}) {\n const {inputs: {x}, backend} = args;\n const out = backend.makeOutput(x.shape, x.dtype);\n const outVals = backend.typedArrayFromHeap(out);\n outVals.fill(1);\n return out;\n}\n\nexport const onesLikeConfig: KernelConfig = {\n kernelName: OnesLike,\n backendName: 'wasm',\n kernelFunc: onesLike as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with
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==\n
*/\n\nimport {KernelConfig, KernelFunc, Pack, PackAttrs, PackInputs, TensorInfo, util} from '@tensorflow/tfjs-core';\nimport {BackendWasm} from '../backend_wasm';\n\nimport {concat} from './Concat';\nimport {expandDims} from './ExpandDims';\n\nexport function pack(\n   args: {inputs: PackInputs, backend: BackendWasm, attrs: PackAttrs}):\n   TensorInfo {\n const {inputs, backend, attrs} = args;\n const {axis} = attrs;\n\n if (inputs.length === 1) {\n   return expandDims(\n
        {inputs: {input: inputs[0]}, backend, attrs: {dim: axis}});\n }\n\n const shape = inputs[0].shape;\n const dtype = inputs[0].dtype;\n\n inputs.forEach(t => {\n   util.assertShapesMatch(\n   shape, t.shape,\n   'All tensors passed to stack must have matching shapes');\n   util.assert(\n   dtype === t.dtype,\n   () => 'All tensors passed to stack must have matching dtypes');\n });\n\n const intermediateTensorInfos: TensorInfo[] = [];\n const expandedTensors = inputs.map(t => {\n   const expandedT =\n   expandDims({inputs: {input: t}, backend, attrs: {dim: axis}});\n   intermediateTensorInfos.push(expandedT);\n   return expandedT;\n });\n\n const result = concat({inputs: expandedTensors, backend, attrs: {axis}});\n\n intermediateTensorInfos.forEach(t => backend.disposeData(t.dataId));\n\n return result;\n}\n\nexport const packConfig: KernelConfig = {\n kernelName: Pack,\n backendName: 'wasm',\n kernelFunc: pack as {} as KernelFunc\n};\n","/**\n
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*/\n\nimport {KernelConfig, KernelFunc, PadV2, PadV2Attrs, PadV2Inputs, util} from '@tensorflow/tfjs-
core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {fill} from './Fill';\n\nimport {CppDType}
from './types';\n\nlet wasmPadV2: (\n    xId: number, xShapeBytes:
 Uint8Array, xShapeLength: number, xDtype: number,\n    prePaddingsBytes: Uint8Array, postPaddingsBytes:
Uint8Array,\n    constantValue: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n
wasmPadV2 = backend.wasm.cwrap(PadV2, null /* void */, [\n    'number',  // xId\n    'array',   // x.shape\n
'number',  // x.shape.length\n    'number',  // x.dtype\n    'array',   // pre-paddings\n    'array',   // post-paddings\n
'number',  // constantValue\n    'number',  // outId\n  ]);\n}\n\nfunction pad(\n    args: {inputs: PadV2Inputs, backend:
BackendWasm, attrs: PadV2Attrs}) {\n  const {inputs: {x}, backend, attrs: {paddings, constantValue}} = args;\n\n
const outShape = paddings.map(\n      (p, i) => p[0] /* beforePad */ + x.shape[i] + p[1] /* afterPad */);\n\n  if
(util.sizeFromShape(x.shape) === 0) {\n    // Short-circuit the computation, since x doesn't have value, only\n    //
the shape is used to compute output shape to pad.\n    return fill({\n
   backend,\n      attrs: {shape: outShape, value: constantValue, dtype: x.dtype}\n    });\n  }\n\n  const xId =
backend.dataIdMap.get(x.dataId).id;\n  const out = backend.makeOutput(outShape, x.dtype);\n  const
outTensorData = backend.dataIdMap.get(out.dataId);\n  const outId = outTensorData.id;\n\n  const xShapeBytes =
new Uint8Array(new Int32Array(x.shape).buffer);\n\n  const prePaddingsFlat = paddings.map(padTuple =>
padTuple[0]);\n  const postPaddingsFlat = paddings.map(padTuple => padTuple[1]);\n  const prePaddingsBytes =\n
   new Uint8Array(new Int32Array(prePaddingsFlat).buffer);\n  const postPaddingsBytes =\n      new
Uint8Array(new Int32Array(postPaddingsFlat).buffer);\n\n  wasmPadV2(\n      xId, xShapeBytes, x.shape.length,
CppDType[x.dtype], prePaddingsBytes,\n      postPaddingsBytes, constantValue, outId);\n  return out;\n}\n\nexport
const padV2Config: KernelConfig = {\n  kernelName: PadV2,\n  backendName: 'wasm',\n  kernelFunc: pad as {} as
KernelFunc,\n  setupFunc: setup\n};\n","/**\n
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WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for
the specific language governing permissions and\n * limitations under the License.\n *
=============================================================================\n
*/\nimport {KernelConfig, Pow} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from
'./binary_kernel';\nconst supportsFullBroadcast = false;\nexport const powConfig: KernelConfig =\n
createBinaryKernelConfig(Pow, supportsFullBroadcast);\n","/**\n *
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2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a
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WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for
the specific language governing permissions and\n * limitations under the License.\n *
=============================================================================\n
*/\n\nimport {KernelConfig, KernelFunc, Prelu, PreluInputs} from '@tensorflow/tfjs-core';\n\nimport
{BackendWasm} from '../backend_wasm';\n\nimport {cast} from './Cast';\n\nlet wasmPrelu: (xId: number,
weightsId: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n
  wasmPrelu = backend.wasm.cwrap(Prelu, null /* void */, [\n    'number',  // x_id\n    'number',  // weights_id\n
'number'   // out_id\n  ]);\n}\n\nfunction prelu(args: {inputs: PreluInputs, backend: BackendWasm}) {\n  const
{inputs, backend} = args;\n  const {x, alpha} = inputs;\n  const xId = backend.dataIdMap.get(x.dataId).id;\n  const
weightsId = backend.dataIdMap.get(alpha.dataId).id;\n\n  let inputId = xId;\n  const input = x;\n  let castedInput =
input;\n  if (input.dtype !== 'float32') {\n    castedInput = cast({backend, inputs: {x}, attrs: {dtype: 'float32'}});\n
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inputId = backend.dataIdMap.get(castedInput.dataId).id;\n }\n\n const out = backend.makeOutput(x.shape, 'float32');\n const outId = backend.dataIdMap.get(out.dataId).id;\n wasmPrelu(inputId, weightsId, outId);\n\n if (input.dtype !== 'float32') {\n   backend.disposeData(castedInput.dataId);\n }\n return out;\n}\n\nexport const preluConfig: KernelConfig = {\n kernelName: Prelu,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: prelu as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {backend_util, KernelConfig, KernelFunc, Prod, ProdAttrs, ProdInputs, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {permuteAxesAndTranspose}
 from './kernel_utils';\n\nimport {CppDType} from './types';\n\nlet wasmProd: (\n   xId: number, reduceSize: number,\n   dtype: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n wasmProd = backend.wasm.cwrap(Prod, null /*void*/, [\n   'number',\n   'number',\n   'number',\n   'number'\n]);\n}\n\nfunction prod(args: {\n backend: BackendWasm,\n inputs: ProdInputs,\n attrs: ProdAttrs\n}): TensorInfo {\n const {backend, inputs, attrs} = args;\n const {axis, keepDims} = attrs;\n const {x} = inputs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n let inputId = xId;\n let input = x;\n\n const {transposed, axes, originalAxes, inputWasTransposed} =\n   permuteAxesAndTranspose(x, axis, backend);\n\n let reductionAxes = axes;\n if (inputWasTransposed) {\n   const transposedId = backend.dataIdMap.get(transposed.dataId).id;\n   if (transposedId !== xId) {\n   // transpose was not a no-op. We will need to dispose of this\n   // once
 we are done.\n   input = transposed;\n   inputId = transposedId;\n   reductionAxes =
backend_util.getInnerMostAxes(\n   reductionAxes.length, input.shape.length);\n   }\n }\n\n
backend_util.assertAxesAreInnerMostDims(\n   'prod', reductionAxes, input.shape.length);\n const [outShape, reduceShape] =\n   backend_util.computeOutAndReduceShapes(input.shape, reductionAxes);\n const reduceSize = util.sizeFromShape(reduceShape);\n\n const out = backend.makeOutput(outShape, input.dtype);\n if (util.sizeFromShape(input.shape) !== 0) {\n   const outId = backend.dataIdMap.get(out.dataId).id;\n   wasmProd(inputId, reduceSize, CppDType[out.dtype], outId);\n }\n\n if (inputWasTransposed) {\n   // dispose of the transposed tensor.\n   backend.disposeData(transposed.dataId);\n }\n\n if (keepDims) {\n   // reshape\n   const newShape = backend_util.expandShapeToKeepDim(out.shape, originalAxes);\n   out.shape = newShape;\n }\n\n return out;\n}\n\nexport const prodConfig:
 KernelConfig = {\n kernelName: Prod,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: prod as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {KernelConfig, KernelFunc, Range, RangeAttrs, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport
 {rangeImplCPU} from '../kernel_utils/shared';\n\nexport const range =\n   (args: {backend: BackendWasm, attrs: RangeAttrs}): TensorInfo => {\n   const {backend, attrs} = args;\n   const {start, stop, step, dtype} = attrs;\n   const values = rangeImplCPU(start, stop, step, dtype);\n\n   const out = backend.makeOutput([values.length],

dtype);\n const outVals = backend.typedArrayFromHeap(out);\n outVals.set(values);\n return out;\n};\n\nexport const rangeConfig: KernelConfig = {\n kernelName: Range,\n backendName: 'wasm',\n kernelFunc: range as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n
 * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
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*/\n\nimport {KernelConfig, RealDiv} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from './binary_kernel';\n\nconst supportsFullBroadcast = true;\nexport const realDivConfig: KernelConfig =\n createBinaryKernelConfig(RealDiv, supportsFullBroadcast);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n
 * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
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*/\nimport {KernelConfig, Relu} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\nexport const reluConfig: KernelConfig = createUnaryKernelConfig(Relu);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT
 WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
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*/\nimport {KernelConfig, Relu6} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\nexport const relu6Config: KernelConfig = createUnaryKernelConfig(Relu6);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License
 for the specific language governing permissions and\n * limitations under the License.\n *
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*/\n\nimport {KernelConfig, KernelFunc, ResizeBilinear, ResizeBilinearAttrs, ResizeBilinearInputs, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {cast} from './Cast';\n\nlet wasmResizeBilinear: (\n xId: number, batch: number, oldHeight: number, oldWidth: number,\n numChannels: number, newHeight: number, newWidth: number,\n alignCorners: number, halfPixelCenters: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n wasmResizeBilinear = backend.wasm.cwrap(ResizeBilinear, null /*void*/, [\n 'number', // xId\n 'number', // batch\n 'number', // oldHeight\n 'number', // oldWidth\n 'number', // numChannels\n 'number', // newHeight\n 'number', //

newWidth\n 'number', // alignCorners\n 'number',
  // halfPixelCenters\n 'number' // outId\n]);\n}\n\nfunction resizeBilinear(args: {\n backend: BackendWasm,\n inputs: ResizeBilinearInputs,\n attrs: ResizeBilinearAttrs\n}): TensorInfo {\n const {backend, inputs, attrs} = args;\n\n const {images} = inputs;\n const {alignCorners, halfPixelCenters, size} = attrs;\n const [newHeight, newWidth] = size;\n\n const [batch, oldHeight, oldWidth, numChannels] = images.shape;\n const outShape = [batch, newHeight, newWidth, numChannels];\n\n let xData = backend.dataIdMap.get(images.dataId);\n let castedData;\n if (xData.dtype !== 'float32') {\n   castedData =\n   cast({backend, inputs: {x: images}, attrs: {dtype: 'float32'}});\n   xData = backend.dataIdMap.get(castedData.dataId);\n }\n const xId = xData.id;\n\n const out = backend.makeOutput(outShape, 'float32');\n if (util.sizeFromShape(images.shape) === 0) {\n   return out;\n }\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n wasmResizeBilinear(\n   xId, batch, oldHeight, oldWidth, numChannels, newHeight, newWidth,\n   alignCorners ? 1 : 0, halfPixelCenters ? 1 : 0, outId);\n\n if (castedData != null) {\n   backend.disposeData(castedData.dataId);\n }\n\n return out;\n}\n\nexport const resizeBilinearConfig: KernelConfig = {\n kernelName: ResizeBilinear,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: resizeBilinear as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language
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==\n
*/\n\nimport {KernelConfig, KernelFunc, Reverse, ReverseAttrs, ReverseInputs, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {identity} from './Identity';\nimport {reshape} from './Reshape';\n\nlet wasmReverse: (\n   xId: number, axes: Uint8Array, axesLength: number, outShape: Uint8Array,\n   outShapeLength: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmReverse = backend.wasm.cwrap(Reverse, null, [\n   'number', // x_id\n   'array',   // axes\n   'number', // axes_length\n   'array',   // out_shape\n   'number', // out_shape_length\n   'number'
  // out_id\n]);\n}\n\nexport function reverse(\n   args: {inputs: ReverseInputs, backend: BackendWasm, attrs: ReverseAttrs}):\n   TensorInfo {\n const {inputs, backend, attrs} = args;\n const
 {x} = inputs;\n const {dims} = attrs;\n\n const axes = util.parseAxisParam(dims, x.shape);\n\n if (x.shape.length === 0) {\n   return identity({inputs: {x}, backend});\n }\n\n const out = backend.makeOutput(x.shape, x.dtype);\n const xId = backend.dataIdMap.get(x.dataId).id;\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n const axesBytes = new Uint8Array(new Int32Array(axes).buffer);\n const outShapeBytes = new Uint8Array(new Int32Array(x.shape).buffer);\n\n wasmReverse(\n   xId, axesBytes, axes.length, outShapeBytes, x.shape.length, outId);\n\n const reshaped =\n   reshape({inputs: {x: out}, attrs: {shape: x.shape}, backend});\n\n backend.disposeData(out.dataId);\n return reshaped;\n}\n\nexport const reverseConfig: KernelConfig = {\n kernelName: Reverse,\n backendName: 'wasm',\n kernelFunc: reverse as {} as KernelFunc,\n setupFunc: setup\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License,
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*/\n\nimport {KernelConfig, KernelFunc, RotateWithOffset, RotateWithOffsetAttrs, RotateWithOffsetInputs, TensorInfo} from '@tensorflow/tfjs-core';\nimport {backend_util} from '@tensorflow/tfjs-core';\n\nimport

{BackendWasm} from '../backend_wasm';\n\nlet wasmRotate: (\n xId: number, batch: number, imageHeight: number, imageWidth: number,\n numChannels: number, radians: number, centerX: number, centerY: number,\n fillBytes: Uint8Array, fillLength: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmRotate = backend.wasm.cwrap(RotateWithOffset, null /* void */, [\n 'number', // xId\n 'number', // batch\n 'number', // imageHeight\n 'number', // imageWidth\n 'number', // numChannels\n 'number', // radians\n 'number', // centerX\n 'number', // centerY\n 'array', // fillBytes\n 'number', // fillLength\n 'number', // outId\n]);\n}\n\nexport function rotateWithOffset(args: {\n inputs: RotateWithOffsetInputs,\n backend: BackendWasm,\n attrs: RotateWithOffsetAttrs\n}): TensorInfo {\n const {inputs, backend, attrs} = args;\n const {image} = inputs;\n const {radians, fillValue, center} = attrs;\n\n const out = backend.makeOutput(image.shape, image.dtype);\n const imageId = backend.dataIdMap.get(image.dataId).id;\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n const [batch, imageHeight, imageWidth, numChannels] = image.shape;\n\n const [centerX, centerY] =\n backend_util.getImageCenter(center, imageHeight, imageWidth);\n\n const fillIsBlack = fillValue === 0;\n const fullOpacityValue = 255;\n\n const fillValues = typeof fillValue === 'number' ?\n [fillValue, fillValue, fillValue, fillIsBlack ? 0 : fullOpacityValue] :\n [...fillValue, fullOpacityValue];\n const fillBytes = new Uint8Array(new Int32Array(fillValues).buffer);\n\n wasmRotate(\n imageId, batch, imageHeight, imageWidth, numChannels, radians, centerX,\n centerY, fillBytes, fillValues.length, outId);\n return out;\n}\n\nexport const rotateWithOffsetConfig: KernelConfig = {\n kernelName: RotateWithOffset,\n backendName: 'wasm',\n kernelFunc: rotateWithOffset as {} as KernelFunc,\n setupFunc: setup\n};\n","/**\n * @license\n * Copyright 2021 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\nimport {KernelConfig, Round} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\n\nexport const roundConfig: KernelConfig = createUnaryKernelConfig(Round);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\nimport {KernelConfig, Rsqrt} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\nexport const rsqrtConfig: KernelConfig = createUnaryKernelConfig(Rsqrt);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {KernelConfig, KernelFunc, scatter_util, ScatterNd, ScatterNdAttrs, ScatterNdInputs, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {CppDType} from

'./types';\n\nlet wasmScatterNd: (\n indicesId: number, updatesId: number, dtype: CppDType, sliceRank: number,\n numUpdates: number, sliceSize: number, strides: Uint8Array,\n outputSize: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n wasmScatterNd = backend.wasm.cwrap(ScatterNd, null /*void*/, [\n 'number', // indicesId\n 'number',
  // updatesId\n 'number', // dtype\n 'number', // sliceRank\n 'number', // numUpdates\n 'number', // sliceSize\n 'array', // strides\n 'number', // outputSize\n 'number' // outId\n]);\n}\n\nfunction scatterNd(\n args:\n {backend: BackendWasm, inputs: ScatterNdInputs, attrs: ScatterNdAttrs}):\n TensorInfo {\n const {backend, inputs, attrs} = args;\n const {indices, updates} = inputs;\n const {shape} = attrs;\n\n const out = backend.makeOutput(shape, updates.dtype);\n if (util.sizeFromShape(shape) === 0) {\n return out;\n }\n\n const {sliceRank, numUpdates, sliceSize, strides, outputSize} =\n scatter_util.calculateShapes(updates, indices, shape);\n\n const indicesData = backend.dataIdMap.get(indices.dataId);\n const indicesId = indicesData.id;\n\n const updatesData = backend.dataIdMap.get(updates.dataId);\n const updatesId = updatesData.id;\n\n const stridesBytes = new Uint8Array(new Int32Array(strides).buffer);\n\n const
  outId = backend.dataIdMap.get(out.dataId).id;\n wasmScatterNd(\n indicesId, updatesId, CppDType[updates.dtype], sliceRank, numUpdates,\n sliceSize, stridesBytes, outputSize, outId);\n\n return out;\n}\n\nexport const scatterNdConfig: KernelConfig = {\n kernelName: ScatterNd,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: scatterNd as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations
  under the License.\n *
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*/\n\nimport {KernelConfig, KernelFunc, Select, SelectInputs, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmSelect: (\n conditionId: number, tId: number, eId: number, offset: number,\n outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmSelect = backend.wasm.cwrap('SelectV2', null, [\n 'number', // conditionId\n 'number', // tId\n 'number', // eId\n 'number', // offset\n 'number', // outId\n]);\n}\n\nfunction select(args: {inputs: SelectInputs, backend: BackendWasm}) {\n const {inputs, backend} = args;\n const {condition, t, e} = inputs;\n\n const conditionId = backend.dataIdMap.get(condition.dataId).id;\n const tId = backend.dataIdMap.get(t.dataId).id;\n const eId = backend.dataIdMap.get(e.dataId).id;\n const out = backend.makeOutput(t.shape, t.dtype);\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n
  const cRank = condition.shape.length;\n const tRank = t.shape.length;\n\n const offset = cRank === 0 || cRank > 1 || tRank === 1 ?\n 1 :\n util.sizeFromShape(t.shape.slice(1));\n\n wasmSelect(conditionId, tId, eId, offset, outId);\n return out;\n}\n\nexport const selectConfig: KernelConfig = {\n kernelName: Select,\n backendName: 'wasm',\n kernelFunc: select as {} as KernelFunc,\n setupFunc: setup\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See
  the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n
/\n\nimport {KernelConfig, KernelFunc, Sigmoid, SigmoidInputs, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmFunc: (xId: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n wasmFunc = backend.wasm.cwrap(Sigmoid, null /

void */, ['number', 'number']);\n}\n\nfunction sigmoid(args: {backend: BackendWasm, inputs: SigmoidInputs}):\n TensorInfo {\n const {backend, inputs: {x}} = args;\n const xId = backend.dataIdMap.get(x.dataId).id;\n const out = backend.makeOutput(x.shape, x.dtype);\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n // Short-circuit zero-sized tensors.\n if (util.sizeFromShape(out.shape) === 0) {\n   return out;\n }\n\n wasmFunc(xId, outId);\n return out;\n}\n\nexport const sigmoidConfig:
 KernelConfig = {\n kernelName: 'Sigmoid',\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: sigmoid as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\nimport {KernelConfig, Sin} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\nexport const
 sinConfig: KernelConfig = createUnaryKernelConfig(Sin);\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {KernelConfig, KernelFunc, Softmax, SoftmaxAttrs, SoftmaxInputs, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmFunc: (xId: number, outId: number,
 channels: number, batch: number) =>\n   void;\n\nfunction setup(backend: BackendWasm): void {\n wasmFunc = backend.wasm.cwrap(Softmax, null /* void */, [\n   'number', // xId\n   'number', // outId\n   'number', // channels\n   'number'   // batch\n]);\n}\n\nfunction softmax(\n   args: {backend: BackendWasm, inputs: SoftmaxInputs, attrs: SoftmaxAttrs}):\n   TensorInfo {\n const {backend, inputs: {logits}, attrs: {dim}} = args;\n const xId = backend.dataIdMap.get(logits.dataId).id;\n const out = backend.makeOutput(logits.shape, logits.dtype);\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n const channels = logits.shape[dim];\n const batch = util.sizeFromShape(logits.shape) / channels;\n\n // Short-circuit zero-sized tensors.\n if (util.sizeFromShape(out.shape) === 0) {\n   return out;\n }\n\n wasmFunc(xId, outId, channels, batch);\n return out;\n}\n\nexport const softmaxConfig: KernelConfig = {\n kernelName: Softmax,\n backendName: 'wasm',\n setupFunc:
 setup,\n kernelFunc: softmax as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2021 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {backend_util, KernelConfig, KernelFunc, ReshapeAttrs, ReshapeInputs, SpaceToBatchND, SpaceToBatchNDAttrs, SpaceToBatchNDInputs, TensorInfo, TransposeAttrs, TransposeInputs, util} from '@tensorflow/tfjs-core';\n\nimport

{BackendWasm} from '../backend_wasm';\n\nimport {padV2Config} from './PadV2';\nimport {reshape} from './Reshape';\nimport {transpose} from './Transpose';\n\nfunction spaceToBatchND(args: {\n inputs: SpaceToBatchNDInputs,\n backend: BackendWasm,\n attrs: SpaceToBatchNDAttrs\n}) {\n const {inputs, backend, attrs} = args;\n const {x} = inputs;\n const {blockShape, paddings} = attrs;\n\n const prod = util.sizeFromShape(blockShape);\n\n const completePaddings: Array<[number, number]> = [[0, 0]];\n completePaddings.push(...(paddings as Array<[number, number]>));\n\n for (let i = 1 + blockShape.length; i < x.shape.length; ++i) {\n   completePaddings.push([0, 0]);\n }\n\n const paddedX = padV2Config.kernelFunc({\n inputs: {x},\n   backend,\n   attrs: {paddings: completePaddings, constantValue: 0}\n }) as TensorInfo;\n\n const reshapedPaddedShape =\n   backend_util.getReshaped(paddedX.shape, blockShape, prod, false);\n\n const permutedReshapedPaddedPermutation
 = backend_util.getPermuted(\n   reshapedPaddedShape.length, blockShape.length, false);\n\n const flattenShape =\n   backend_util.getReshapedPermuted(paddedX.shape, blockShape, prod, false);\n\n const reshapeInputs: ReshapeInputs = {x: paddedX};\n const reshapeAttrs: ReshapeAttrs = {shape: reshapedPaddedShape};\n const paddedXReshaped =\n   reshape({inputs: reshapeInputs, backend, attrs: reshapeAttrs});\n\n const transposeInputs: TransposeInputs = {x: paddedXReshaped};\n const transposeAttrs:\n   TransposeAttrs = {perm: permutedReshapedPaddedPermutation};\n const paddedXT =\n   transpose({inputs: transposeInputs, backend, attrs: transposeAttrs});\n\n const resultReshapeInputs: ReshapeInputs = {x: paddedXT};\n const resultReshapeAttrs: ReshapeAttrs = {shape: flattenShape};\n const result = reshape(\n   {inputs: resultReshapeInputs, backend, attrs: resultReshapeAttrs});\n\n backend.disposeData(paddedX.dataId);\n backend.disposeData(paddedXReshaped.dataId);\n
  backend.disposeData(paddedXT.dataId);\n\n return result;\n}\n\nexport const spaceToBatchNDConfig: KernelConfig = {\n kernelName: SpaceToBatchND,\n backendName: 'wasm',\n kernelFunc: spaceToBatchND as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
 ==\n */\n\nimport {KernelConfig, KernelFunc, SplitV,
 SplitVAttrs, SplitVInputs, util} from '@tensorflow/tfjs-core';\nimport {backend_util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {slice} from './Slice';\n\nexport function splitV(\n   args: {inputs: SplitVInputs, attrs: SplitVAttrs, backend: BackendWasm}) {\n const {inputs, attrs, backend} = args;\n const {x} = inputs;\n const {numOrSizeSplits, axis} = attrs;\n\n const $axis = util.parseAxisParam(axis, x.shape)[0];\n\n const splitSizes = backend_util.prepareSplitSize(x, numOrSizeSplits, $axis);\n const begin = new Array(x.shape.length).fill(0);\n const size = x.shape.slice();\n return splitSizes.map(s => {\n   const xSliceSize = [...size];\n   xSliceSize[$axis] = s;\n   const xSlice =\n   slice({inputs: {x}, attrs: {begin, size: xSliceSize}, backend});\n   begin[$axis] += s;\n   return xSlice;\n });\n}\n\nexport const splitVConfig: KernelConfig = {\n kernelName: SplitV,\n backendName: 'wasm',\n kernelFunc: splitV as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
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*/\n\nimport {KernelConfig, Sqrt} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\nexport const sqrtConfig: KernelConfig = createUnaryKernelConfig(Sqrt);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights
Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n*/\nimport {KernelConfig, Square} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\nexport const squareConfig: KernelConfig = createUnaryKernelConfig(Square);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n
* you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n*/\nimport {KernelConfig, SquaredDifference} from '@tensorflow/tfjs-core';\nimport {createBinaryKernelConfig} from './binary_kernel';\nconst supportsFullBroadcast = true;\nexport const squaredDifferenceConfig: KernelConfig =\n createBinaryKernelConfig(SquaredDifference, supportsFullBroadcast);\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version
2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n*/\n\nimport {KernelConfig, KernelFunc, Step, StepAttrs, StepInputs, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {CppDType} from './types';\n\nlet wasmStep: (xId: number, alpha: number, dtype: number, outId: number) =>\n void;\n\nfunction setup(backend: BackendWasm): void {\n wasmStep = backend.wasm.cwrap(Step, null /*void*/, [\n 'number', // x_id\n 'number', // alpha\n 'number', // dtype\n 'number', // out_id\n]);\n}\n\nfunction step(\n args: {backend: BackendWasm, inputs: StepInputs, attrs: StepAttrs}):\n TensorInfo {\n const {backend, inputs, attrs} = args;\n const {alpha} = attrs;\n const {x} = inputs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n\n const out = backend.makeOutput(x.shape, x.dtype);\n const outId = backend.dataIdMap.get(out.dataId).id;\n wasmStep(xId, alpha, CppDType[x.dtype], outId);\n return out;\n}\n\nexport const stepConfig: KernelConfig = {\n kernelName: Step,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: step as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2021 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
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*/\n\nimport {KernelConfig, KernelFunc, slice_util, StridedSlice, StridedSliceAttrs, StridedSliceInputs, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\nimport {reshape} from './Reshape';\nimport {slice} from './Slice';\n\nlet wasmStridedSlice: (\n xId: number, xStridesBytes: Uint8Array, xRank: number,\n beginBytes: Uint8Array, endBytes: Uint8Array, stridesBytes: Uint8Array,\n outShapeBytes: Uint8Array, outStridesBytes: Uint8Array,\n outShapeLength: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm):
void {\n wasmStridedSlice = backend.wasm.cwrap(StridedSlice, null /*void*/, [\n 'number', // xId\n 'array', // xStrides\n 'number', // xRank\n 'array', // beginBytes\n 'array', // endBytes\n 'array', // stridesBytes\n 'array', // outShapeBytes\n 'array', // outStridesBytes\n 'number', // outShapeLength\n 'number', // outId\n]);\n}\n\nexport function stridedSlice(args: {\n backend: BackendWasm,\n inputs: StridedSliceInputs,\n attrs: StridedSliceAttrs\n}): TensorInfo {\n const {backend, inputs, attrs} = args;\n const {x} = inputs;\n\n const {\n begin,\n end,\n strides,\n beginMask,\n endMask,\n ellipsisMask,\n newAxisMask,\n shrinkAxisMask\n } = attrs;\n\n const {\n finalShapeSparse,\n finalShape,\n isIdentity,\n sliceDim0,\n isSimpleSlice,\n begin: $begin,\n end: $end,\n strides: $strides\n } =\n slice_util.sliceInfo(\n x.shape, begin, end, strides, beginMask, endMask,
ellipsisMask,\n newAxisMask, shrinkAxisMask);\n\n let result;\n\n if (isIdentity) {\n // Optimization #1, slice is a no-op plus reshape\n result = reshape({inputs: {x}, backend, attrs: {shape: finalShape}});\n } else if (sliceDim0 || isSimpleSlice) {\n // Optimization #2, slice is memory contiguous (only occurs in dim 0)\n util.assert(\n x.shape.length >= 1,\n () => `Input must have rank at least 1, got: ${x.shape.length}`);\n\n const size = slice_util.computeOutShape($begin, $end, $strides);\n // To tolerate begin[0] > end[0] (a 0-output slice), we min(begin, end).\n const sliced = slice({inputs: {x}, backend, attrs: {begin: $begin, size}});\n result =\n reshape({inputs: {x: sliced}, backend, attrs: {shape: finalShape}});\n backend.disposeData(sliced.dataId);\n } else {\n const out = backend.makeOutput(finalShapeSparse, 'float32');\n\n const xId = backend.dataIdMap.get(x.dataId).id;\n const xStridesBytes =\n new Uint8Array(new Int32Array(util.computeStrides(x.shape)).buffer);\n const beginBytes = new Uint8Array(new Int32Array($begin).buffer);\n const endBytes = new Uint8Array(new Int32Array($end).buffer);\n const stridesBytes = new Uint8Array(new Int32Array($strides).buffer);\n\n const outputShapeBytes =\n new Uint8Array(new Int32Array(finalShapeSparse).buffer);\n const outStridesBytes = new Uint8Array(\n new Int32Array(util.computeStrides(finalShapeSparse)).buffer);\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n wasmStridedSlice(\n xId, xStridesBytes, x.shape.length, beginBytes, endBytes, stridesBytes,\n outputShapeBytes, outStridesBytes, finalShapeSparse.length, outId);\n\n result = reshape({inputs: {x: out}, backend, attrs: {shape: finalShape}});\n\n backend.disposeData(out.dataId);\n }\n\n return result;\n}\n\nexport const stridedSliceConfig: KernelConfig = {\n kernelName: StridedSlice,\n backendName: 'wasm',\n setupFunc:
setup,\n kernelFunc: stridedSlice as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n */\nimport {KernelConfig, Sub} from '@tensorflow/tfjs-core';\nimport {createBinaryKernelConfig} from './binary_kernel';\nconst supportsFullBroadcast = true;\nexport const subConfig: KernelConfig =\n createBinaryKernelConfig(Sub,
supportsFullBroadcast);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n *

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==========\n
*/\n\nimport {backend_util, KernelConfig, KernelFunc, Sum, SumAttrs, SumInputs, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {permuteAxesAndTranspose} from './kernel_utils';\nimport {CppDType} from './types';\n\nlet wasmSum: (xId: number, reduceSize: number, dtype: number, outId: number) =>\n void;\n\nfunction setup(backend: BackendWasm): void {\n wasmSum = backend.wasm.cwrap(Sum, null /*void*/, [\n 'number', // input_id\n 'number', // reduce_size\n 'number', // dtype\n 'number', // out_id\n]);\n}\n\nfunction sum(args: {backend: BackendWasm, inputs: SumInputs, attrs: SumAttrs}):\n TensorInfo {\n const {backend, inputs, attrs} = args;\n const {axis, keepDims} = attrs;\n const {x} = inputs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n let inputId = xId;\n let input = x;\n\n const {transposed, axes, originalAxes, inputWasTransposed} =\n permuteAxesAndTranspose(x, axis, backend);\n\n let reductionAxes = axes;\n if (inputWasTransposed) {\n const transposedId = backend.dataIdMap.get(transposed.dataId).id;\n if (transposedId !== xId) {\n // transpose was not a no-op. We will need to dispose of this\n // once we are done.\n input = transposed;\n inputId = transposedId;\n reductionAxes = backend_util.getInnerMostAxes(\n reductionAxes.length, input.shape.length);\n }\n }\n\n backend_util.assertAxesAreInnerMostDims(\n 'sum', reductionAxes, input.shape.length);\n const [outShape, reduceShape] =\n backend_util.computeOutAndReduceShapes(input.shape, reductionAxes);\n const reduceSize = util.sizeFromShape(reduceShape);\n\n const out = backend.makeOutput(outShape, input.dtype);\n if (util.sizeFromShape(input.shape) !== 0) {\n const outId = backend.dataIdMap.get(out.dataId).id;\n wasmSum(inputId, reduceSize, CppDType[out.dtype], outId);\n }\n\n if (inputWasTransposed) {\n // dispose of the transposed tensor.\n backend.disposeData(transposed.dataId);\n }\n\n if (keepDims) {\n // reshape\n const newShape = backend_util.expandShapeToKeepDim(out.shape, originalAxes);\n out.shape = newShape;\n }\n\n return out;\n}\n\nexport const sumConfig: KernelConfig = {\n kernelName: Sum,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: sum as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2021 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n
*/\nimport {KernelConfig, Tan} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\nexport const tanConfig: KernelConfig = createUnaryKernelConfig(Tan);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n
*/\nimport {KernelConfig, Tanh} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\nexport const tanhConfig: KernelConfig = createUnaryKernelConfig(Tanh);\n","/**\n * @license\n

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OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language
governing permissions and\n * limitations under the License.\n *
==========================================================================\n
*/\n\nimport {KernelConfig, KernelFunc, Tile, TileAttrs, TileInputs} from '@tensorflow/tfjs-core';\n\nimport
{BackendWasm} from '../backend_wasm';\n\nimport {CppDType} from './types';\n\nlet wasmTile: (\n    xId:
number, xShape: Uint8Array, xShapeSize: number, newShape: Uint8Array,\n    newShapeSize: number,
 dtype: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n  wasmTile =
backend.wasm.cwrap(Tile, null /* void */, [\n    'number',  // x_id\n    'array',   // x_shape\n    'number',  //
x_shape.length\n    'array',   // new_shape\n    'number',  // new_shape.length\n    'number'   // out_id\n
]);\n}\n\nfunction tile(\n    args: {inputs: TileInputs, backend: BackendWasm, attrs: TileAttrs}) {\n  const {inputs,
backend, attrs} = args;\n  const {x} = inputs;\n  const xId = backend.dataIdMap.get(x.dataId).id;\n  const {reps} =
attrs;\n\n  const newShape: number[] = new Array(x.shape.length);\n  for (let i = 0; i < newShape.length; i++) {\n
newShape[i] = x.shape[i] * reps[i];\n  }\n  const xShapeBytes = new Uint8Array(new Int32Array(x.shape).buffer);\n
const newShapeBytes = new Uint8Array(new Int32Array(newShape).buffer);\n\n  const out =
backend.makeOutput(newShape, x.dtype);\n  const outId = backend.dataIdMap.get(out.dataId).id;\n  wasmTile(\n
xId, xShapeBytes,
 x.shape.length, newShapeBytes, newShape.length,\n      CppDType[out.dtype], outId);\n  return out;\n}\n\nexport
const tileConfig: KernelConfig = {\n  kernelName: Tile,\n  backendName: 'wasm',\n  setupFunc: setup,\n
kernelFunc: tile as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights
Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file
except in compliance with the License.\n * You may obtain a copy of the License at\n *\n *
http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing,
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OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language
governing permissions and\n * limitations under the License.\n *
==========================================================================\n
*/\n\nimport
 {KernelConfig, KernelFunc, TensorInfo, TopK, TopKAttrs, TopKInputs} from '@tensorflow/tfjs-core';\n\nimport
{BackendWasm} from '../backend_wasm';\nimport {CppDType} from './types';\n\nlet wasmTopK: (\n    xId:
number, xShapeBytes: Uint8Array, xShapeLength: number,\n    xDtype: CppDType, k: number, sorted: boolean,
outValuesId: number,\n    outIndicesId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n
wasmTopK = backend.wasm.cwrap(TopK, null /* void */, [\n    'number',  // xId\n    'array',   // x.shape\n    'number',
// x.shape.length\n    'number',  // x.dtype\n    'number',  // k\n    'bool',    // sorted\n    'number',  // outValuesId\n
'number',  // outIndicesId\n  ]);\n}\n\nexport const topk:\n    (args: {inputs: TopKInputs, backend: BackendWasm,
attrs: TopKAttrs}) =>\n        TensorInfo[] | TensorInfo = ({inputs, backend, attrs}) => {\n          const {x} = inputs;\n
        const {k, sorted} = attrs;\n\n          const xId = backend.dataIdMap.get(x.dataId).id;\n
          const xShapeBytes = new Uint8Array(new Int32Array(x.shape).buffer);\n          const outputShape =
x.shape.slice();\n          outputShape[outputShape.length - 1] = k;\n          const outValues =
backend.makeOutput(outputShape, x.dtype);\n          const outValuesId =
backend.dataIdMap.get(outValues.dataId).id;\n          const outIndices = backend.makeOutput(outputShape,
'int32');\n          const outIndicesId = backend.dataIdMap.get(outIndices.dataId).id;\n\n          wasmTopK(\n
xId, xShapeBytes, x.shape.length, CppDType[x.dtype], k, sorted,\n              outValuesId, outIndicesId);\n\n
return [outValues, outIndices];\n        };\n\nexport const topKConfig: KernelConfig = {\n  kernelName: TopK,\n
```

backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: topk as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2021 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use
this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {KernelConfig, KernelFunc, TensorInfo, Transform, TransformAttrs, TransformInputs, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmTransform: (\n imageId: number, transformsId: number, isBatchTransform: boolean,\n batch: number, outHeight: number, outWidth: number, numChannels: number,\n imageWidth: number, imageHeight: number, strides: Uint8Array,\n stridesLength:
number, interpolationModeId: number, fillModeId: number,\n fillValue: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n wasmTransform = backend.wasm.cwrap(Transform, null /*void*/, [\n 'number', // imageId\n 'number', // transformsId\n 'bool', // isBatchTransform\n 'number', // batch\n 'number', // outHeight\n 'number', // outWidth\n 'number', // numChannels\n 'number', // imageWidth\n 'number', // imageHeight\n 'array', // strides\n 'number', // stridesLength\n 'number', // interpolationModeId\n 'number', // fillModeId\n 'number', // fillValue\n 'number' // outId\n]);\n}\n\nfunction transform(\n args:\n {backend: BackendWasm, inputs: TransformInputs, attrs: TransformAttrs}):\n TensorInfo {\n const {backend, inputs, attrs} = args;\n const {image, transforms} = inputs;\n const {interpolation, fillMode, fillValue, outputShape} = attrs;\n\n const [batch, imageHeight, imageWidth,
numChannels] = image.shape;\n const [outHeight, outWidth] =\n outputShape != null ? outputShape :
[imageHeight, imageWidth];\n const outShape =\n [batch, outHeight, outWidth,\n numChannels] as [number, number, number, number];\n const strides =\n new Uint8Array(new Int32Array(util.computeStrides(image.shape)).buffer);\n\n const out = backend.makeOutput(outShape, image.dtype);\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n const imageData = backend.dataIdMap.get(image.dataId);\n const imageId = imageData.id;\n\n const transformsData = backend.dataIdMap.get(transforms.dataId);\n const transformsId = transformsData.id;\n\n const interpolationModeId = interpolation === 'nearest' ? 1 : 2;\n let fillModeId;\n switch (fillMode) {\n case 'constant':\n fillModeId = 1;\n break;\n case 'reflect':\n fillModeId = 2;\n break;\n case 'wrap':\n fillModeId = 3;\n break;\n case 'nearest':\n fillModeId = 4;\n
  break;\n default:\n fillModeId = 1;\n break;\n }\n\n wasmTransform(\n imageId, transformsId, (transforms.shape[0] > 1), batch, outHeight,\n outWidth, numChannels, imageWidth, imageHeight, strides,\n image.shape.length - 1, interpolationModeId, fillModeId, fillValue,\n outId);\n\n return out;\n}\n\nexport const transformConfig: KernelConfig = {\n kernelName: Transform,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: transform as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS
OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {KernelConfig, KernelFunc, TensorInfo, Unpack, UnpackAttrs, UnpackInputs} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {slice} from

'./Slice';\n\nfunction unpack(\n args: {inputs: UnpackInputs, backend: BackendWasm, attrs: UnpackAttrs}):\n TensorInfo[] {\n const {inputs, backend, attrs} = args;\n const {value} = inputs;\n let {axis} = attrs;\n\n if (axis < 0) {\n axis += value.shape.length;\n }\n\n const numOutputs = value.shape[axis];\n const rank = value.shape.length;\n const outShape: number[] = new Array(rank - 1);\n let outIndex = 0;\n for (let i = 0; i < rank; i++) {\n if (i !== axis) {\n outShape[outIndex++] = value.shape[i];\n }\n }\n const outs: TensorInfo[] = new Array(numOutputs);\n const begin = new Array(rank).fill(0);\n const size = value.shape.slice();\n size[axis] = 1;\n for (let i = 0; i < outs.length; i++) {\n begin[axis] = i;\n outs[i] = slice({inputs: {x: value}, attrs: {begin, size}, backend});\n }\n return outs.map(({dataId, dtype}) => ({dataId, dtype, shape: outShape}));\n}\n\nexport const unpackConfig: KernelConfig = {\n kernelName: Unpack,\n backendName: 'wasm',\n kernelFunc: unpack as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {KernelConfig, KernelFunc, ZerosLike, ZerosLikeInputs} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nfunction zerosLike(args: {inputs: ZerosLikeInputs, backend: BackendWasm}) {\n const {inputs: {x}, backend} = args;\n const out = backend.makeOutput(x.shape, x.dtype);\n const outVals = backend.typedArrayFromHeap(out);\n outVals.fill(0);\n return out;\n}\n\nexport const zerosLikeConfig: KernelConfig = {\n kernelName: ZerosLike,\n backendName: 'wasm',\n kernelFunc: zerosLike as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n//\n// We explicitly import the modular kernels so they get registered in the\n// global registry when we compile the library. A modular build would replace\n// the contents of this file and import only the kernels that are needed.\nimport {KernelConfig, registerKernel} from '@tensorflow/tfjs-core';\n\nimport {fusedMatMulConfig} from './kernels/_FusedMatMul';\nimport {absConfig} from './kernels/Abs';\nimport {addConfig} from './kernels/Add';\nimport {addNConfig} from './kernels/AddN';\nimport {allConfig} from './kernels/All';\nimport {anyConfig} from './kernels/Any';\nimport {argMaxConfig} from './kernels/ArgMax';\nimport {avgPoolConfig} from './kernels/AvgPool';\nimport {batchMatMulConfig} from './kernels/BatchMatMul';\nimport {batchToSpaceNDConfig} from './kernels/BatchToSpaceND';\nimport {castConfig} from './kernels/Cast';\nimport {ceilConfig} from './kernels/Ceil';\nimport {clipByValueConfig} from './kernels/ClipByValue';\nimport {concatConfig} from './kernels/Concat';\nimport {conv2DConfig} from './kernels/Conv2D';\nimport {conv2DBackpropInputConfig} from './kernels/Conv2DBackpropInput';\nimport {cosConfig} from './kernels/Cos';\nimport {coshConfig} from './kernels/Cosh';\nimport {cropAndResizeConfig} from './kernels/CropAndResize';\nimport {cumsumConfig} from './kernels/Cumsum';\nimport {depthToSpaceConfig} from './kernels/DepthToSpace';\nimport {depthwiseConv2dNativeConfig} from './kernels/DepthwiseConv2dNative';\nimport {eluConfig} from './kernels/Elu';\nimport {equalConfig} from './kernels/Equal';\nimport {expConfig} from './kernels/Exp';\nimport {expandDimsConfig} from './kernels/ExpandDims';\nimport {fillConfig} from './kernels/Fill';\nimport {flipLeftRightConfig} from './kernels/FlipLeftRight';\nimport {floorConfig} from './kernels/Floor';\nimport {floorDivConfig} from

'./kernels/FloorDiv';\nimport {fusedBatchNormConfig} from './kernels/FusedBatchNorm';\nimport {fusedConv2DConfig} from './kernels/FusedConv2D';\nimport {fusedDepthwiseConv2DConfig} from './kernels/FusedDepthwiseConv2D';\nimport {gatherNdConfig} from './kernels/GatherNd';\nimport {gatherV2Config} from './kernels/GatherV2';\nimport {greaterConfig} from './kernels/Greater';\nimport {greaterEqualConfig} from './kernels/GreaterEqual';\nimport {identityConfig} from './kernels/Identity';\nimport {leakyReluConfig} from './kernels/LeakyRelu';\nimport {lessConfig} from './kernels/Less';\nimport {lessEqualConfig} from './kernels/LessEqual';\nimport {logConfig} from './kernels/Log';\nimport {logicalAndConfig}
from './kernels/LogicalAnd';\nimport {maxConfig} from './kernels/Max';\nimport {maximumConfig} from './kernels/Maximum';\nimport {maxPoolConfig} from './kernels/MaxPool';\nimport {meanConfig} from './kernels/Mean';\nimport {minConfig} from './kernels/Min';\nimport {minimumConfig} from './kernels/Minimum';\nimport {mirrorPadConfig} from './kernels/MirrorPad';\nimport {multiplyConfig} from './kernels/Multiply';\nimport {negConfig} from './kernels/Neg';\nimport {nonMaxSuppressionV3Config} from './kernels/NonMaxSuppressionV3';\nimport {nonMaxSuppressionV4Config} from './kernels/NonMaxSuppressionV4';\nimport {nonMaxSuppressionV5Config} from './kernels/NonMaxSuppressionV5';\nimport {notEqualConfig} from './kernels/NotEqual';\nimport {oneHotConfig} from './kernels/OneHot';\nimport {onesLikeConfig} from './kernels/OnesLike';\nimport {packConfig} from './kernels/Pack';\nimport {padV2Config} from './kernels/PadV2';\nimport {powConfig} from './kernels/Pow';\nimport {preluConfig} from './kernels/Prelu';\nimport
{prodConfig} from './kernels/Prod';\nimport {rangeConfig} from './kernels/Range';\nimport {realDivConfig} from './kernels/RealDiv';\nimport {reluConfig} from './kernels/Relu';\nimport {relu6Config} from './kernels/Relu6';\nimport {reshapeConfig} from './kernels/Reshape';\nimport {resizeBilinearConfig} from './kernels/ResizeBilinear';\nimport {reverseConfig} from './kernels/Reverse';\nimport {rotateWithOffsetConfig} from './kernels/RotateWithOffset';\nimport {roundConfig} from './kernels/Round';\nimport {rsqrtConfig} from './kernels/Rsqrt';\nimport {scatterNdConfig} from './kernels/ScatterNd';\nimport {selectConfig} from './kernels/Select';\nimport {sigmoidConfig} from './kernels/Sigmoid';\nimport {sinConfig} from './kernels/Sin';\nimport {sliceConfig} from './kernels/Slice';\nimport {softmaxConfig} from './kernels/Softmax';\nimport {spaceToBatchNDConfig} from './kernels/SpaceToBatchND';\nimport {splitVConfig} from './kernels/SplitV';\nimport {sqrtConfig} from './kernels/Sqrt';\nimport
{squareConfig} from './kernels/Square';\nimport {squaredDifferenceConfig} from './kernels/SquaredDifference';\nimport {stepConfig} from './kernels/Step';\nimport {stridedSliceConfig} from './kernels/StridedSlice';\nimport {subConfig} from './kernels/Sub';\nimport {sumConfig} from './kernels/Sum';\nimport {tanConfig} from './kernels/Tan';\nimport {tanhConfig} from './kernels/Tanh';\nimport {tileConfig} from './kernels/Tile';\nimport {topKConfig} from './kernels/TopK';\nimport {transformConfig} from './kernels/Transform';\nimport {transposeConfig} from './kernels/Transpose';\nimport {unpackConfig} from './kernels/Unpack';\nimport {zerosLikeConfig} from './kernels/ZerosLike';\n\n// List all kernel configs here\nconst kernelConfigs: KernelConfig[] = [\n absConfig,\n addConfig,\n addNConfig,\n allConfig,\n anyConfig,\n argMaxConfig,\n avgPoolConfig,\n batchMatMulConfig,\n batchToSpaceNDConfig,\n castConfig,\n ceilConfig,\n clipByValueConfig,\n concatConfig,\n
conv2DConfig,\n conv2DBackpropInputConfig,\n cosConfig,\n coshConfig,\n cropAndResizeConfig,\n cumsumConfig,\n depthToSpaceConfig,\n depthwiseConv2dNativeConfig,\n eluConfig,\n equalConfig,\n expConfig,\n expandDimsConfig,\n fillConfig,\n flipLeftRightConfig,\n floorConfig,\n floorDivConfig,\n fusedMatMulConfig,\n fusedBatchNormConfig,\n fusedConv2DConfig,\n fusedDepthwiseConv2DConfig,\n gatherNdConfig,\n gatherV2Config,\n greaterConfig,\n greaterEqualConfig,\n identityConfig,\n leakyReluConfig,\n lessConfig,\n lessEqualConfig,\n logConfig,\n logicalAndConfig,\n maxConfig,\n maximumConfig,\n maxPoolConfig,\n meanConfig,\n minConfig,\n minimumConfig,\n mirrorPadConfig,\n multiplyConfig,\n negConfig,\n nonMaxSuppressionV3Config,\n nonMaxSuppressionV4Config,\n nonMaxSuppressionV5Config,\n notEqualConfig,\n oneHotConfig,\n onesLikeConfig,\n packConfig,\n

padV2Config,\n powConfig,\n preluConfig,\n prodConfig,\n rangeConfig,\n realDivConfig,\n reluConfig,\n relu6Config,\n reshapeConfig,\n resizeBilinearConfig,\n reverseConfig,\n rotateWithOffsetConfig,\n rsqrtConfig,\n roundConfig,\n scatterNdConfig,\n selectConfig,\n sigmoidConfig,\n sinConfig,\n sliceConfig,\n softmaxConfig,\n spaceToBatchNDConfig,\n splitVConfig,\n sqrtConfig,\n squareConfig,\n squaredDifferenceConfig,\n stepConfig,\n stridedSliceConfig,\n subConfig,\n sumConfig,\n tanConfig,\n tanhConfig,\n tileConfig,\n topKConfig,\n transformConfig,\n transposeConfig,\n unpackConfig,\n zerosLikeConfig\n];\n\nfor (const kernelConfig of kernelConfigs) {\n registerKernel(kernelConfig);\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law
or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==\n */\n\nimport {env} from '@tensorflow/tfjs-core';\n\nconst ENV = env();\n\n/**\n * True if SIMD is supported.\n */\n// From: https://github.com/GoogleChromeLabs/wasm-feature-detect\nENV.registerFlag(\n // This typed array passed in to WebAssembly.validate is WebAssembly binary\n // code. In this case it is a small program that contains SIMD\n // instructions.\n 'WASM_HAS_SIMD_SUPPORT', async () => WebAssembly.validate(new Uint8Array([\n 0, 97, 115, 109, 1, 0, 0, 0, 1, 4, 1, 96, 0, 0, 3,\n 2, 1, 0, 10, 9, 1, 7, 0, 65, 0, 253, 15, 26, 11\n])));\n\n/**\n * True if threads are supported.\n */\n// From: https://github.com/GoogleChromeLabs/wasm-feature-detect\nENV.registerFlag('WASM_HAS_MULTITHREAD_SUPPORT', async () => {\n // TODO(annxingyuan): Enable node support once this is resolved:\n // https://github.com/tensorflow/tfjs/issues/3830\n if (ENV.get('IS_NODE')) {\n return false;\n }\n\n try {\n // Test for transferability of SABs (needed for Firefox)\n // https://groups.google.com/forum/#!msg/mozilla.dev.platform/IHkBZlHETpA/dwsMNchWEQAJ\n new MessageChannel().port1.postMessage(new SharedArrayBuffer(1));\n // This typed array is a WebAssembly program containing threaded\n // instructions.\n return WebAssembly.validate(new Uint8Array([\n 0, 97, 115, 109, 1, 0, 0, 0, 1, 4, 1, 96, 0, 0, 3, 2, 1, 0, 5,\n 4, 1, 3, 1, 1, 10, 11, 1, 9, 0, 65, 0, 254, 16, 2, 0, 26, 11\n]));\n } catch (e) {\n return false;\n }\n});\n","\nvar WasmBackendModuleThreadedSimd = (function() {\n var _scriptDir = typeof document !== 'undefined'
&& document.currentScript ? document.currentScript.src : undefined;\n if (typeof __filename !== 'undefined') _scriptDir = _scriptDir || __filename;\n return (\nfunction(WasmBackendModuleThreadedSimd) {\n WasmBackendModuleThreadedSimd = WasmBackendModuleThreadedSimd || {};\n\n\nfunction GROWABLE_HEAP_I8(){if(wasmMemory.buffer!=buffer){updateGlobalBufferAndViews(wasmMemory.buffer)}return HEAP8}function GROWABLE_HEAP_U8(){if(wasmMemory.buffer!=buffer){updateGlobalBufferAndViews(wasmMemory.buffer)}return HEAPU8}function GROWABLE_HEAP_I32(){if(wasmMemory.buffer!=buffer){updateGlobalBufferAndViews(wasmMemory.buffer)}return HEAP32}function GROWABLE_HEAP_U32(){if(wasmMemory.buffer!=buffer){updateGlobalBufferAndViews(wasmMemory.buffer)}return HEAPU32}function GROWABLE_HEAP_F64(){if(wasmMemory.buffer!=buffer){updateGlobalBufferAndViews(wasmMemory.buffer)}return HEAPF64}var Module=typeof WasmBackendModuleThreadedSimd!==\"undefined\"?WasmBackendModuleThreadedSimd:{};var readyPromiseResolve,readyPromiseReject;Module[\"ready\"]=new Promise(function(resolve,reject){readyPromiseResolve=resolve;readyPromiseReject=reject});var moduleOverrides={};var key;for(key in

Module){if(Module.hasOwnProperty(key)){moduleOverrides[key]=Module[key]}}var arguments_=[];var thisProgram=\"./this.program\";var quit_=function(status,toThrow){throw toThrow};var ENVIRONMENT_IS_WEB=false;var ENVIRONMENT_IS_WORKER=false;var ENVIRONMENT_IS_NODE=false;var ENVIRONMENT_IS_SHELL=false;ENVIRONMENT_IS_WEB=typeof window===\"object\";ENVIRONMENT_IS_WORKER=typeof importScripts===\"function\";ENVIRONMENT_IS_NODE=typeof process===\"object\"&&typeof process.versions===\"object\"&&typeof process.versions.node===\"string\";ENVIRONMENT_IS_SHELL=!ENVIRONMENT_IS_WEB&&!ENVIRONMENT_IS_NODE&&!ENVIRONMENT_IS_WORKER;var ENVIRONMENT_IS_PTHREAD=Module[\"ENVIRONMENT_IS_PTHREAD\"]||false;if(ENVIRONMENT_IS_PTHREAD){buffer=Module[\"buffer\"]}var scriptDirectory=\"\";function locateFile(path){if(Module[\"locateFile\"]){return Module[\"locateFile\"](path,scriptDirectory)}return scriptDirectory+path}var read_,readAsync,readBinary,setWindowTitle;var nodeFS;var nodePath;if(ENVIRONMENT_IS_NODE){if(ENVIRONMENT_IS_WORKER){scriptDirectory=require(\"path\").dirname(scriptDirectory)+\"/\"}else{scriptDirectory=__dirname+\"/\"}read_=function shell_read(filename,binary){if(!nodeFS)nodeFS=require(\"fs\");if(!nodePath)nodePath=require(\"path\");filename=nodePath[\"normalize\"](filename);return nodeFS[\"readFileSync\"](filename,binary?null:\"utf8\")};readBinary=function readBinary(filename){var ret=read_(filename,true);if(!ret.buffer){ret=new Uint8Array(ret)}assert(ret.buffer);return ret};if(process[\"argv\"].length>1){thisProgram=process[\"argv\"][1].replace(/\\\\/g,\"/\")}arguments_=process[\"argv\"].slice(2);process[\"on\"](\"uncaughtException\",function(ex){if(!(ex instanceof ExitStatus)){throw ex}});process[\"on\"](\"unhandledRejection\",abort);quit_=function(status){process[\"exit\"](status)};Module[\"inspect\"]=function(){return\"[Emscripten Module object]\"};var nodeWorkerThreads;try{nodeWorkerThreads=require(\"worker_threads\")}catch(e){console.error('The \"worker_threads\" module is not supported in this node.js build - perhaps a newer version is needed?');throw e}global.Worker=nodeWorkerThreads.Worker}else if(ENVIRONMENT_IS_SHELL){if(typeof read!=\"undefined\"){read_=function shell_read(f){return read(f)}}readBinary=function readBinary(f){var data;if(typeof readbuffer===\"function\"){return new Uint8Array(readbuffer(f))}data=read(f,\"binary\");assert(typeof data===\"object\");return data};if(typeof scriptArgs!=\"undefined\"){arguments_=scriptArgs}else if(typeof arguments!=\"undefined\"){arguments_=arguments}if(typeof quit===\"function\"){quit_=function(status){quit(status)}}if(typeof print!==\"undefined\"){if(typeof console===\"undefined\")console={};console.log=print;console.warn=console.error=typeof printErr!==\"undefined\"?printErr:print}}else if(ENVIRONMENT_IS_WEB||ENVIRONMENT_IS_WORKER){if(ENVIRONMENT_IS_WORKER){scriptDirectory=self.location.href}else if(typeof document!==\"undefined\"&&document.currentScript){scriptDirectory=document.currentScript.src}if(typeof _scriptDir !== \"undefined\" && _scriptDir){scriptDirectory=_scriptDir}if(scriptDirectory.indexOf(\"blob:\")!==0){scriptDirectory=scriptDirectory.substr(0,scriptDirectory.lastIndexOf(\"/\")+1)}else{scriptDirectory=\"\"}if(ENVIRONMENT_IS_NODE){read_=function shell_read(filename,binary){if(!nodeFS)nodeFS=require(\"fs\");if(!nodePath)nodePath=require(\"path\");filename=nodePath[\"normalize\"](filename);return nodeFS[\"readFileSync\"](filename,binary?null:\"utf8\")};readBinary=function readBinary(filename){var ret=read_(filename,true);if(!ret.buffer){ret=new Uint8Array(ret)}assert(ret.buffer);return ret}}else{read_=function(url){var xhr=new XMLHttpRequest;xhr.open(\"GET\",url,false);xhr.send(null);return

xhr.responseText};if(ENVIRONMENT_IS_WORKER){readBinary=function(url){var xhr=new XMLHttpRequest;xhr.open(\"GET\",url,false);xhr.responseType=\"arraybuffer\";xhr.send(null);return new Uint8Array(xhr.response)}}readAsync=function(url,onload,onerror){var xhr=new XMLHttpRequest;xhr.open(\"GET\",url,true);xhr.responseType=\"arraybuffer\";xhr.onload=function(){if(xhr.status==200||xhr.status==0&&xhr.response){onload(xhr.response);return}onerror()};xhr.onerror=onerror;xhr.send(null)}}setWindowTitle=function(title){document.title=title}}else{}if(ENVIRONMENT_IS_NODE){if(typeof performance===\"undefined\"){global.performance=require(\"perf_hooks\").performance}}var out=Module[\"print\"]||console.log.bind(console);var err=Module[\"printErr\"]||console.warn.bind(console);for(key in moduleOverrides){if(moduleOverrides.hasOwnProperty(key)){Module[key]=moduleOverrides[key]}}moduleOverrides=null;if(Module[\"arguments\"])arguments_=Module[\"arguments\"];if(Module[\"thisProgram\"])thisProgram=Module[\"thisProgram\"];if(Module[\"quit\"])quit_=Module[\"quit\"];function warnOnce(text){if(!warnOnce.shown)warnOnce.shown={};if(!warnOnce.shown[text]){warnOnce.shown[text]=1;err(text)}}var Atomics_load=Atomics.load;var Atomics_store=Atomics.store;var Atomics_compareExchange=Atomics.compareExchange;var wasmBinary;if(Module[\"wasmBinary\"])wasmBinary=Module[\"wasmBinary\"];var noExitRuntime=Module[\"noExitRuntime\"]||true;if(typeof WebAssembly!==\"object\"){abort(\"no native wasm support detected\")}var wasmMemory;var wasmModule;var ABORT=false;var EXITSTATUS;function assert(condition,text){if(!condition){abort(\"Assertion failed: \"+text)}}function getCFunc(ident){var func=Module[\"_\"+ident];assert(func,\"Cannot call unknown function \"+ident+\", make sure it is exported\");return func}function ccall(ident,returnType,argTypes,args,opts){var toC={\"string\":function(str){var ret=0;if(str!==null&&str!==undefined&&str!==0){var len=(str.length<<2)+1;ret=stackAlloc(len);stringToUTF8(str,ret,len)}return ret},\"array\":function(arr){var ret=stackAlloc(arr.length);writeArrayToMemory(arr,ret);return ret}};function convertReturnValue(ret){if(returnType===\"string\")return UTF8ToString(ret);if(returnType===\"boolean\")return Boolean(ret);return ret}var func=getCFunc(ident);var cArgs=[];var stack=0;if(args){for(var i=0;i<args.length;i++){var converter=toC[argTypes[i]];if(converter){if(stack===0)stack=stackSave();cArgs[i]=converter(args[i])}else{cArgs[i]=args[i]}}}var ret=func.apply(null,cArgs);ret=convertReturnValue(ret);if(stack!==0)stackRestore(stack);return ret}function cwrap(ident,returnType,argTypes,opts){argTypes=argTypes||[];var numericArgs=argTypes.every(function(type){return type===\"number\"});var numericRet=returnType!==\"string\";if(numericRet&&numericArgs&&!opts){return getCFunc(ident)}return function(){return ccall(ident,returnType,argTypes,arguments,opts)}}function UTF8ArrayToString(heap,idx,maxBytesToRead){var endIdx=idx+maxBytesToRead;var str=\"\";while(!(idx>=endIdx)){var u0=heap[idx++];if(!u0)return str;if(!(u0&128)){str+=String.fromCharCode(u0);continue}var u1=heap[idx++]&63;if((u0&224)==192){str+=String.fromCharCode((u0&31)<<6|u1);continue}var u2=heap[idx++]&63;if((u0&240)==224){u0=(u0&15)<<12|u1<<6|u2}else{u0=(u0&7)<<18|u1<<12|u2<<6|heap[idx++]&63}if(u0<65536){str+=String.fromCharCode(u0)}else{var ch=u0-65536;str+=String.fromCharCode(55296|ch>>10,56320|ch&1023)}}return str}function UTF8ToString(ptr,maxBytesToRead){return ptr?UTF8ArrayToString(GROWABLE_HEAP_U8(),ptr,maxBytesToRead):\"\"}function stringToUTF8Array(str,heap,outIdx,maxBytesToWrite){if(!(maxBytesToWrite>0))return 0;var startIdx=outIdx;var endIdx=outIdx+maxBytesToWrite-1;for(var i=0;i<str.length;++i){var u=str.charCodeAt(i);if(u>=55296&&u<=57343){var u1=str.charCodeAt(++i);u=65536+((u&1023)<<10)|u1&1023}if(u<=127){if(outIdx>=endIdx)break;heap[outIdx++]=u}else if(u<=2047){if(outIdx+1>=endIdx)break;heap[outIdx++]=192|u>>6;heap[outIdx++]=128|u&63}else

if(u<=65535){if(outIdx+2>=endIdx)break;heap[outIdx++]=224|u>>12;heap[outIdx++]=128|u>>6&63;heap[outIdx++]=128|u&63}else{if(outIdx+3>=endIdx)break;heap[outIdx++]=240|u>>18;heap[outIdx++]=128|u>>12&63;heap[outIdx++]=128|u>>6&63;heap[outIdx++]=128|u&63}}heap[outIdx]=0;return outIdx-startIdx}function stringToUTF8(str,outPtr,maxBytesToWrite){return stringToUTF8Array(str,GROWABLE_HEAP_U8(),outPtr,maxBytesToWrite)}function lengthBytesUTF8(str){var len=0;for(var i=0;i<str.length;++i){var u=str.charCodeAt(i);if(u>=55296&&u<=57343)u=65536+((u&1023)<<10)|str.charCodeAt(++i)&1023;if(u<=127)++len;else if(u<=2047)len+=2;else if(u<=65535)len+=3;else len+=4}return len}function writeArrayToMemory(array,buffer){GROWABLE_HEAP_I8().set(array,buffer)}function alignUp(x,multiple){if(x%multiple>0){x+=multiple-x%multiple}return x}var buffer,HEAP8,HEAPU8,HEAP16,HEAPU16,HEAP32,HEAPU32,HEAPF32,HEAPF64;function updateGlobalBufferAndViews(buf){buffer=buf;Module[\"HEAP8\"]=HEAP8=new Int8Array(buf);Module[\"HEAP16\"]=HEAP16=new Int16Array(buf);Module[\"HEAP32\"]=HEAP32=new Int32Array(buf);Module[\"HEAPU8\"]=HEAPU8=new Uint8Array(buf);Module[\"HEAPU16\"]=HEAPU16=new Uint16Array(buf);Module[\"HEAPU32\"]=HEAPU32=new Uint32Array(buf);Module[\"HEAPF32\"]=HEAPF32=new Float32Array(buf);Module[\"HEAPF64\"]=HEAPF64=new Float64Array(buf)}var INITIAL_MEMORY=Module[\"INITIAL_MEMORY\"]||16777216;if(ENVIRONMENT_IS_PTHREAD){wasmMemory=Module[\"wasmMemory\"];buffer=Module[\"buffer\"]}else{if(Module[\"wasmMemory\"]){wasmMemory=Module[\"wasmMemory\"]}else{wasmMemory=new WebAssembly.Memory({\"initial\":INITIAL_MEMORY/65536,\"maximum\":2147483648/65536,\"shared\":true});if(!(wasmMemory.buffer instanceof SharedArrayBuffer)){err(\"requested a shared WebAssembly.Memory but the returned buffer is not a SharedArrayBuffer, indicating that while the browser has SharedArrayBuffer it does not have WebAssembly threads support - you may need to set a flag\");if(ENVIRONMENT_IS_NODE){console.log(\"(on node you may need: --experimental-wasm-threads --experimental-wasm-bulk-memory and also use a recent version)\")}throw Error(\"bad memory\")}}}if(wasmMemory){buffer=wasmMemory.buffer}INITIAL_MEMORY=buffer.byteLength;updateGlobalBufferAndViews(buffer);var wasmTable;var __ATPRERUN__=[];var __ATINIT__=[];var __ATMAIN__=[];var __ATEXIT__=[];var __ATPOSTRUN__=[];var runtimeInitialized=false;var runtimeExited=false;if(!ENVIRONMENT_IS_PTHREAD)__ATINIT__.push({func:function(){___wasm_call_ctors()}});function preRun(){if(ENVIRONMENT_IS_PTHREAD)return;if(Module[\"preRun\"]){if(typeof Module[\"preRun\"]==\"function\")Module[\"preRun\"]=[Module[\"preRun\"]];while(Module[\"preRun\"].length){addOnPreRun(Module[\"preRun\"].shift())}}callRuntimeCallbacks(__ATPRERUN__)}function initRuntime(){runtimeInitialized=true;if(ENVIRONMENT_IS_PTHREAD)return;callRuntimeCallbacks(__ATINIT__)}function preMain(){if(ENVIRONMENT_IS_PTHREAD)return;callRuntimeCallbacks(__ATMAIN__)}function exitRuntime(){if(ENVIRONMENT_IS_PTHREAD)return;runtimeExited=true}function postRun(){if(ENVIRONMENT_IS_PTHREAD)return;if(Module[\"postRun\"]){if(typeof Module[\"postRun\"]==\"function\")Module[\"postRun\"]=[Module[\"postRun\"]];while(Module[\"postRun\"].length){addOnPostRun(Module[\"postRun\"].shift())}}callRuntimeCallbacks(__ATPOSTRUN__)}function addOnPreRun(cb){__ATPRERUN__.unshift(cb)}function addOnPostRun(cb){__ATPOSTRUN__.unshift(cb)}var runDependencies=0;var runDependencyWatcher=null;var dependenciesFulfilled=null;function addRunDependency(id){assert(!ENVIRONMENT_IS_PTHREAD,\"addRunDependency cannot be used in a pthread worker\");runDependencies++;if(Module[\"monitorRunDependencies\"]){Module[\"monitorRunDependencies\"](runDependencies)}}function removeRunDependency(id){runDependencies--;if(Module[\"monitorRunDependencies\"]){Module[\"monitorRunDependencies\"](runDependencies)}if(runDepend

encies==0){if(runDependencyWatcher!==null){clearInterval(runDependencyWatcher);runDependencyWatcher=nul
l}if(dependenciesFulfilled){var
callback=dependenciesFulfilled;dependenciesFulfilled=null;callback()}}}Module[\"preloadedImages\"]={};Module
[\"preloadedAudios\"]={};function
abort(what){if(Module[\"onAbort\"]){Module[\"onAbort\"](what)}if(ENVIRONMENT_IS_PTHREAD)console.err
or(\"Pthread
aborting at \"+(new Error).stack);what+=\"\";err(what);ABORT=true;EXITSTATUS=1;what=\"abort(\"+what+\").
Build with -s ASSERTIONS=1 for more info.\";var e=new
WebAssembly.RuntimeError(what);readyPromiseReject(e);throw e}function hasPrefix(str,prefix){return
String.prototype.startsWith?str.startsWith(prefix):str.indexOf(prefix)===0}var
dataURIPrefix=\"data:application/octet-stream; base64,\";function isDataURI(filename){return
hasPrefix(filename,dataURIPrefix)}var fileURIPrefix=\"file://\";function isFileURI(filename){return
hasPrefix(filename,fileURIPrefix)}var wasmBinaryFile=\"tfjs-backend-wasm-threaded-
simd.wasm\";if(!isDataURI(wasmBinaryFile)){wasmBinaryFile=locateFile(wasmBinaryFile)}function
getBinary(file){try{if(file==wasmBinaryFile&&wasmBinary){return new
Uint8Array(wasmBinary)}if(readBinary){return readBinary(file)}else{throw\"both async and sync fetching of the
wasm failed\"}}catch(err){abort(err)}}function
getBinaryPromise(){if(!wasmBinary&&(ENVIRONMENT_IS_WEB||ENVIRONMENT_IS_WORKER)){if(typeof
fetch===\"function\"&&!isFileURI(wasmBinaryFile)){return fetch(wasmBinaryFile,{credentials:\"same-
origin\"}).then(function(response){if(!response[\"ok\"]){throw\"failed to load wasm binary file at
\"+wasmBinaryFile+\"\"\"}return response[\"arrayBuffer\"]()}).catch(function(){return
getBinary(wasmBinaryFile)})}else{if(readAsync){return new
Promise(function(resolve,reject){readAsync(wasmBinaryFile,function(response){resolve(new
Uint8Array(response))},reject)})}}}return Promise.resolve().then(function(){return
getBinary(wasmBinaryFile)})}function createWasm(){var info={\"a\":asmLibraryArg};function
receiveInstance(instance,module){var
exports=instance.exports;Module[\"asm\"]=exports;wasmTable=Module[\"asm\"][\"I\"];wasmModule=module;if(!E
NVIRONMENT_IS_PTHREAD){var
numWorkersToLoad=PThread.unusedWorkers.length;PThread.unusedWorkers.forEach(function(w){PThread.load
WasmModuleToWorker(w,function(){if(!--numWorkersToLoad)removeRunDependency(\"wasm-
instantiate\")})})}if(!ENVIRONMENT_IS_PTHREAD){addRunDependency(\"wasm-instantiate\")}function
receiveInstantiatedSource(output){receiveInstance(output[\"instance\"],output[\"module\"])}function
instantiateArrayBuffer(receiver){return getBinaryPromise().then(function(binary){return
WebAssembly.instantiate(binary,info)}).then(receiver,function(reason){err(\"failed to asynchronously prepare
wasm: \"+reason);abort(reason)})}function instantiateAsync(){if(!wasmBinary&&typeof
WebAssembly.instantiateStreaming===\"function\"&&!isDataURI(wasmBinaryFile)&&!isFileURI(wasmBinaryFil
e)&&typeof fetch===\"function\"){return fetch(wasmBinaryFile,{credentials:\"same-
origin\"}).then(function(response){var result=WebAssembly.instantiateStreaming(response,info);return
result.then(receiveInstantiatedSource,function(reason){err(\"wasm streaming compile failed: \"+reason);err(\"falling
back to ArrayBuffer instantiation\");return instantiateArrayBuffer(receiveInstantiatedSource)})})}else{return
instantiateArrayBuffer(receiveInstantiatedSource)}}if(Module[\"instantiateWasm\"]){try{var
exports=Module[\"instantiateWasm\"](info,receiveInstance);return exports}catch(e){err(\"Module.instantiateWasm
callback failed with error: \"+e);return false}}instantiateAsync().catch(readyPromiseReject);return{}}var
ASM_CONSTS={10520:function(){throw\"Canceled!\"},10538:function($0,$1){setTimeout(function(){__emscript
en_do_dispatch_to_thread($0,$1)},0)}};function initPthreadsJS(){PThread.initRuntime()}function
callRuntimeCallbacks(callbacks){while(callbacks.length>0){var callback=callbacks.shift();if(typeof
callback==\"function\"){callback(Module);continue}var func=callback.func;if(typeof
func===\"number\"){if(callback.arg===undefined){wasmTable.get(func)()}else{wasmTable.get(func)(callback.arg)

}}else{func(callback.arg===undefined?null:callback.arg)}}}var
ERRNO_CODES={EPERM:63,ENOENT:44,ESRCH:71,EINTR:27,EIO:29,ENXIO:60,E2BIG:1,ENOEXEC:45,E
BADF:8,ECHILD:12,EAGAIN:6,EWOULDBLOCK:6,ENOMEM:48,EACCES:2,EFAULT:21,ENOTBLK:105,EB
USY:10,EEXIST:20,EXDEV:75,ENODEV:43,ENOTDIR:54,EISDIR:31,EINVAL:28,ENFILE:41,EMFILE:33,EN
OTTY:59,ETXTBSY:74,EFBIG:22,ENOSPC:51,ESPIPE:70,EROFS:69,EMLINK:34,EPIPE:64,EDOM:18,ERAN
GE:68,ENOMSG:49,EIDRM:24,ECHRNG:106,EL2NSYNC:156,EL3HLT:107,EL3RST:108,ELNRNG:109,EUNA
TCH:110,ENOCSI:111,EL2HLT:112,EDEADLK:16,ENOLCK:46,EBADE:113,EBADR:114,EXFULL:115,ENOA
NO:104,EBADRQC:103,EBADSLT:102,EDEADLOCK:16,EBFONT:101,ENOSTR:100,ENODATA:116,ETIME:
117,ENOSR:118,ENONET:119,ENOPKG:120,EREMOTE:121,ENOLINK:47,EADV:122,ESRMNT:123,ECOMM
:124,EPROTO:65,EMULTIHOP:36,EDOTDOT:125,EBADMSG:9,ENOTUNIQ:126,EBADFD:127,EREMCHG:1
28,ELIBACC:129,ELIBBAD:130,ELIBSCN:131,ELIBMAX:132,ELIBEXEC:133,ENOSYS:52,ENOTEMPTY:55,
ENAMETOOLONG:37,ELOOP:32,EOPNOTSUPP:138,EPFNOSUPPORT:139,ECONNRESET:15,ENOBUFS:42,
EAFNOSUPPORT:5,EPROTOTYPE:67,ENOTSOCK:57,ENOPROTOOPT:50,ESHUTDOWN:140,ECONNREFU
SED:14,EADDRINUSE:3,ECONNABORTED:13,ENETUNREACH:40,ENETDOWN:38,ETIMEDOUT:73,EHOS
TDOWN:142,EHOSTUNREACH:23,EINPROGRESS:26,EALREADY:7,EDESTADDRREQ:17,EMSGSIZE:35,E
PROTONOSUPPORT:66,ESOCKTNOSUPPORT:137,EADDRNOTAVAIL:4,ENETRESET:39,EISCONN:30,EN
OTCONN:53,ETOOMANYREFS:141,EUSERS:136,EDQUOT:19,ESTALE:72,ENOTSUP:138,ENOMEDIUM:14
8,EILSEQ:25,EOVERFLOW:61,ECANCELED:11,ENOTRECOVERABLE:56,EOWNERDEAD:62,ESTRPIPE:13
5};function
_emscripten_futex_wake(addr,count){if(addr<=0||addr>GROWABLE_HEAP_I8().length||addr&3!=0||count<0)retu
rn-28;if(count==0)return 0;if(count>=2147483647)count=Infinity;var
mainThreadWaitAddress=Atomics.load(GROWABLE_HEAP_I32(),__emscripten_main_thread_futex>>2);var
mainThreadWoken=0;if(mainThreadWaitAddress==addr){var
loadedAddr=Atomics.compareExchange(GROWABLE_HEAP_I32(),__emscripten_main_thread_futex>>2,mainTh
readWaitAddress,0);if(loadedAddr==mainThreadWaitAddress){--count;mainThreadWoken=1;if(count<=0)return
1}}var ret=Atomics.notify(GROWABLE_HEAP_I32(),addr>>2,count);if(ret>=0)return
ret+mainThreadWoken;throw\"Atomics.notify returned an unexpected value
\"+ret}Module[\"_emscripten_futex_wake\"]=_emscripten_futex_wake;function
killThread(pthread_ptr){if(ENVIRONMENT_IS_PTHREAD)throw\"Internal Error! killThread() can only ever be
called from main application thread!\";if(!pthread_ptr)throw\"Internal Error! Null pthread_ptr in
killThread!\";GROWABLE_HEAP_I32()[pthread_ptr+12>>2]=0;var
pthread=PThread.pthreads[pthread_ptr];pthread.worker.terminate();PThread.freeThreadData(pthread);PThread.runni
ngWorkers.splice(PThread.runningWorkers.indexOf(pthread.worker),1);pthread.worker.pthread=undefined}functio
n cancelThread(pthread_ptr){if(ENVIRONMENT_IS_PTHREAD)throw\"Internal Error! cancelThread() can only
ever be called from main application thread!\";if(!pthread_ptr)throw\"Internal Error! Null pthread_ptr in
cancelThread!\";var
pthread=PThread.pthreads[pthread_ptr];pthread.worker.postMessage({\"cmd\":\"cancel\"})}function
cleanupThread(pthread_ptr){if(ENVIRONMENT_IS_PTHREAD)throw\"Internal Error! cleanupThread() can only
ever be called from main
application thread!\";if(!pthread_ptr)throw\"Internal Error! Null pthread_ptr in cleanupThread!\";var
pthread=PThread.pthreads[pthread_ptr];if(pthread){GROWABLE_HEAP_I32()[pthread_ptr+12>>2]=0;var
worker=pthread.worker;PThread.returnWorkerToPool(worker)}}var
PThread={unusedWorkers:[],runningWorkers:[],initMainThreadBlock:function(){var pthreadPoolSize=8;for(var
i=0;i<pthreadPoolSize;++i){PThread.allocateUnusedWorker()}},initRuntime:function(){var
tb=_malloc(228);for(var
i=0;i<228/4;++i)GROWABLE_HEAP_U32()[tb/4+i]=0;GROWABLE_HEAP_I32()[tb+12>>2]=tb;var
headPtr=tb+152;GROWABLE_HEAP_I32()[headPtr>>2]=headPtr;var tlsMemory=_malloc(512);for(var
i=0;i<128;++i)GROWABLE_HEAP_U32()[tlsMemory/4+i]=0;Atomics.store(GROWABLE_HEAP_U32(),tb+100

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>>2,tlsMemory);Atomics.store(GROWABLE_HEAP_U32(),tb+40>>2,tb);__emscripten_thread_init(tb,!ENVIRONMENT_IS_WORKER,1);_emscripten_register_main_browser_thread_id(tb)},initWorker:function(){},pthreads:{},threadExitHandlers:[],setThreadStatus:function(){},runExitHandlers:function(){while(PThread.threadExitHandlers.length>0){PThread.threadExitHandlers.pop()()}if(ENVIRONMENT_IS_PTHREAD&&_pthread_self())___pthread_tsd_run_dtors()},runExitHandlersAndDeinitThread:function(tb,exitCode){Atomics.store(GROWABLE_HEAP_U32(),tb+56>>2,1);Atomics.store(GROWABLE_HEAP_U32(),tb+60>>2,0);PThread.runExitHandlers();Atomics.store(GROWABLE_HEAP_U32(),tb+4>>2,exitCode);Atomics.store(GROWABLE_HEAP_U32(),tb+0>>2,1);_emscripten_futex_wake(tb+0,2147483647);__emscripten_thread_init(0,0,0)},threadExit:function(exitCode){var tb=_pthread_self();if(tb){PThread.runExitHandlersAndDeinitThread(tb,exitCode);if(ENVIRONMENT_IS_PTHREAD){postMessage({\"cmd\":\"exit\"})}}},threadCancel:function(){PThread.runExitHandlersAndDeinitThread(_pthread_self(),-1);postMessage({\"cmd\":\"cancelDone\"})},terminateAllThreads:function(){for(var t in PThread.pthreads){var pthread=PThread.pthreads[t];if(pthread&&pthread.worker){PThread.returnWorkerToPool(pthread.worker)}}PThread.pthreads={};for(var i=0;i<PThread.unusedWorkers.length;++i){var worker=PThread.unusedWorkers[i];worker.terminate()}PThread.unusedWorkers=[];for(var i=0;i<PThread.runningWorkers.length;++i){var worker=PThread.runningWorkers[i];var pthread=worker.pthread;PThread.freeThreadData(pthread);worker.terminate()}PThread.runningWorkers=[]},freeThreadData:function(pthread){if(!pthread)return;if(pthread.threadInfoStruct){var tlsMemory=GROWABLE_HEAP_I32()[pthread.threadInfoStruct+100>>2];GROWABLE_HEAP_I32()[pthread.threadInfoStruct+100>>2]=0;_free(tlsMemory);_free(pthread.threadInfoStruct)}pthread.threadInfoStruct=0;if(pthread.allocatedOwnStack&&pthread.stackBase)_free(pthread.stackBase);pthread.stackBase=0;if(pthread.worker)pthread.worker.pthread=null},returnWorkerToPool:function(worker){PThread.runWithoutMainThreadQueuedCalls(function(){delete PThread.pthreads[worker.pthread.threadInfoStruct];PThread.unusedWorkers.push(worker);PThread.runningWorkers.splice(PThread.runningWorkers.indexOf(worker),1);PThread.freeThreadData(worker.pthread);worker.pthread=undefined})},runWithoutMainThreadQueuedCalls:function(func){GROWABLE_HEAP_I32()[__emscripten_allow_main_runtime_queued_calls>>2]=0;try{func()}finally{GROWABLE_HEAP_I32()[__emscripten_allow_main_runtime_queued_calls>>2]=1}},receiveObjectTransfer:function(data){},loadWasmModuleToWorker:function(worker,onFinishedLoading){worker.onmessage=function(e){var d=e[\"data\"];var cmd=d[\"cmd\"];if(worker.pthread)PThread.currentProxiedOperationCallerThread=worker.pthread.threadInfoStruct;if(d[\"targetThread\"]&&d[\"targetThread\"]!=_pthread_self()){var thread=PThread.pthreads[d.targetThread];if(thread){thread.worker.postMessage(e.data,d[\"transferList\"])}else{console.error('Internal error! Worker sent a message \"'+cmd+'\" to target pthread '+d[\"targetThread\"]+\", but that thread no longer exists!\")}PThread.currentProxiedOperationCallerThread=undefined;return}if(cmd===\"processQueuedMainThreadWork\"){_emscripten_main_thread_process_queued_calls()}else if(cmd===\"spawnThread\"){spawnThread(e.data)}else if(cmd===\"cleanupThread\"){cleanupThread(d[\"thread\"])}else if(cmd===\"killThread\"){killThread(d[\"thread\"])}else if(cmd===\"cancelThread\"){cancelThread(d[\"thread\"])}else if(cmd===\"loaded\"){worker.loaded=true;if(onFinishedLoading)onFinishedLoading(worker);if(worker.runPthread){worker.runPthread();delete worker.runPthread}}else if(cmd===\"print\"){out(\"Thread \"+d[\"threadId\"]+\": \"+d[\"text\"])}else if(cmd===\"printErr\"){err(\"Thread \"+d[\"threadId\"]+\": \"+d[\"text\"])}else if(cmd===\"alert\"){alert(\"Thread \"+d[\"threadId\"]+\": \"+d[\"text\"])}else if(cmd===\"exit\"){var detached=worker.pthread&&Atomics.load(GROWABLE_HEAP_U32(),worker.pthread.threadInfoStruct+64>>2);if(detached){PThread.returnWorkerToPool(worker)}}else
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if(cmd===\"exitProcess\"){try{exit(d[\"returnCode\"])}catch(e){if(e instanceof ExitStatus)return;throw e}}else if(cmd===\"cancelDone\"){PThread.returnWorkerToPool(worker)}else if(cmd===\"objectTransfer\"){PThread.receiveObjectTransfer(e.data)}else if(e.data.target===\"setimmediate\"){worker.postMessage(e.data)}else{err(\"worker sent an unknown command \"+cmd)}PThread.currentProxiedOperationCallerThread=undefined};worker.onerror=function(e){err(\"pthread sent an error! \"+e.filename+\":\"+e.lineno+\": \"+e.message)};if(ENVIRONMENT_IS_NODE){worker.on(\"message\",function(data){worker.onmessage({data:data})});worker.on(\"error\",function(data){worker.onerror(data)});worker.on(\"exit\",function(data){})}worker.postMessage({\"cmd\":\"load\",\"urlOrBlob\":Module[\"mainScriptUrlOrBlob\"]||_scriptDir,\"wasmMemory\":wasmMemory,\"wasmModule\":wasmModule})},allocateUnusedWorker:function(){var pthreadMainJs=locateFile(\"tfjs-backend-wasm-threaded-simd.worker.js\");PThread.unusedWorkers.push(new Worker(pthreadMainJs))},getNewWorker:function(){if(PThread.unusedWorkers.length==0){PThread.allocateUnusedWorker();PThread.loadWasmModuleToWorker(PThread.unusedWorkers[0])}if(PThread.unusedWorkers.length>0)return PThread.unusedWorkers.pop();else return null},busySpinWait:function(msecs){var t=performance.now()+msecs;while(performance.now()<t){}}};function establishStackSpace(stackTop,stackMax){_emscripten_stack_set_limits(stackTop,stackMax);stackRestore(stackTop)}Module[\"establishStackSpace\"]=establishStackSpace;function getNoExitRuntime(){return noExitRuntime}Module[\"getNoExitRuntime\"]=getNoExitRuntime;function invokeEntryPoint(ptr,arg){return wasmTable.get(ptr)(arg)}Module[\"invokeEntryPoint\"]=invokeEntryPoint;function ___assert_fail(condition,filename,line,func){abort(\"Assertion failed: \"+UTF8ToString(condition)+\", at: \"+[filename?UTF8ToString(filename):\"unknown filename\",line,func?UTF8ToString(func):\"unknown function\"])}function ___call_main(argc,argv){var returnCode=_main(argc,argv)}var _emscripten_get_now;if(ENVIRONMENT_IS_NODE){_emscripten_get_now=function(){var t=process[\"hrtime\"]();return t[0]*1e3+t[1]/1e6}}else if(ENVIRONMENT_IS_PTHREAD){_emscripten_get_now=function(){return performance.now()-Module[\"__performance_now_clock_drift\"]}}else if(typeof dateNow!==\"undefined\"){_emscripten_get_now=dateNow}else _emscripten_get_now=function(){return performance.now()};function setErrNo(value){GROWABLE_HEAP_I32()[___errno_location()>>2]=value;return value}function _atexit(func,arg){if(ENVIRONMENT_IS_PTHREAD)return _emscripten_proxy_to_main_thread_js(1,1,func,arg)}function __emscripten_notify_thread_queue(targetThreadId,mainThreadId){if(targetThreadId==mainThreadId){postMessage({\"cmd\":\"processQueuedMainThreadWork\"})}else if(ENVIRONMENT_IS_PTHREAD){postMessage({\"targetThread\":targetThreadId,\"cmd\":\"processThreadQueue\"})}else{var pthread=PThread.pthreads[targetThreadId];var worker=pthread&&pthread.worker;if(!worker){return}worker.postMessage({\"cmd\":\"processThreadQueue\"})}return 1}function _abort(){abort()}function _emscripten_asm_const_int(code,sigPtr,argbuf){var args=readAsmConstArgs(sigPtr,argbuf);return ASM_CONSTS[code].apply(null,args)}function _emscripten_conditional_set_current_thread_status(expectedStatus,newStatus){}function _emscripten_futex_wait(addr,val,timeout){if(addr<=0||addr>GROWABLE_HEAP_I8().length||addr&3!=0)return-28;if(!ENVIRONMENT_IS_WEB){var ret=Atomics.wait(GROWABLE_HEAP_I32(),addr>>2,val,timeout);if(ret===\"timed-out\")return-73;if(ret===\"not-equal\")return-6;if(ret===\"ok\")return 0;throw\"Atomics.wait returned an unexpected value \"+ret}else{if(Atomics.load(GROWABLE_HEAP_I32(),addr>>2)!=val){return-6}var tNow=performance.now();var tEnd=tNow+timeout;var lastAddr=Atomics.exchange(GROWABLE_HEAP_I32(),__emscripten_main_thread_futex>>2,addr);while(1){tNow=performance.now();if(tNow>tEnd){lastAddr=Atomics.exchange(GROWABLE_HEAP_I32(),__emscripten_main_thread_futex>>2,0);return-

73}lastAddr=Atomics.exchange(GROWABLE_HEAP_I32(),__emscripten_main_thread_futex>>2,0);if(lastAddr==0){break}_emscripten_main_thread_process_queued_calls();if(Atomics.load(GROWABLE_HEAP_I32(),addr>>2)!=val){return-6}lastAddr=Atomics.exchange(GROWABLE_HEAP_I32(),__emscripten_main_thread_futex>>2,addr)}return 0}}function _emscripten_memcpy_big(dest,src,num){GROWABLE_HEAP_U8().copyWithin(dest,src,src+num)}function _emscripten_num_logical_cores(){if(ENVIRONMENT_IS_NODE)return require(\"os\").cpus().length;return navigator[\"hardwareConcurrency\"]}function _emscripten_proxy_to_main_thread_js(index,sync){var numCallArgs=arguments.length-2;var stack=stackSave();var serializedNumCallArgs=numCallArgs;var args=stackAlloc(serializedNumCallArgs*8);var b=args>>3;for(var i=0;i<numCallArgs;i++){var arg=arguments[2+i];GROWABLE_HEAP_F64()[b+i]=arg}var ret=_emscripten_run_in_main_runtime_thread_js(index,serializedNumCallArgs,args,sync);stackRestore(stack);return ret}var _emscripten_receive_on_main_thread_js_callArgs=[];var readAsmConstArgsArray=[];function readAsmConstArgs(sigPtr,buf){readAsmConstArgsArray.length=0;var ch;buf>>=2;while(ch=GROWABLE_HEAP_U8()[sigPtr++]){var double=ch<105;if(double&&buf&1)buf++;readAsmConstArgsArray.push(double?GROWABLE_HEAP_F64()[buf++>>1]:GROWABLE_HEAP_I32()[buf]);++buf}return readAsmConstArgsArray}function _emscripten_receive_on_main_thread_js(index,numCallArgs,args){_emscripten_receive_on_main_thread_js_callArgs.length=numCallArgs;var b=args>>3;for(var i=0;i<numCallArgs;i++){_emscripten_receive_on_main_thread_js_callArgs[i]=GROWABLE_HEAP_F64()[b+i]}var isEmAsmConst=index<0;var func=!isEmAsmConst?proxiedFunctionTable[index]:ASM_CONSTS[-index-1];return func.apply(null,_emscripten_receive_on_main_thread_js_callArgs)}function _emscripten_get_heap_size(){return GROWABLE_HEAP_U8().length}function emscripten_realloc_buffer(size){try{wasmMemory.grow(size-buffer.byteLength+65535>>>16);updateGlobalBufferAndViews(wasmMemory.buffer);return 1}catch(e){}}function _emscripten_resize_heap(requestedSize){var oldSize=_emscripten_get_heap_size();if(requestedSize<=oldSize){return false}var maxHeapSize=2147483648;if(requestedSize>maxHeapSize){return false}for(var cutDown=1;cutDown<=4;cutDown*=2){var overGrownHeapSize=oldSize*(1+.2/cutDown);overGrownHeapSize=Math.min(overGrownHeapSize,requestedSize+100663296);var newSize=Math.min(maxHeapSize,alignUp(Math.max(requestedSize,overGrownHeapSize),65536));var replacement=emscripten_realloc_buffer(newSize);if(replacement){return true}}return false}var JSEvents={inEventHandler:0,removeAllEventListeners:function(){for(var i=JSEvents.eventHandlers.length-1;i>=0;--i){JSEvents._removeHandler(i)}JSEvents.eventHandlers=[];JSEvents.deferredCalls=[]},registerRemoveEventListeners:function(){if(!JSEvents.removeEventListenersRegistered){__ATEXIT__.push(JSEvents.removeAllEventListeners);JSEvents.removeEventListenersRegistered=true}},deferredCalls:[],deferCall:function(targetFunction,precedence,argsList){function arraysHaveEqualContent(arrA,arrB){if(arrA.length!=arrB.length)return false;for(var i in arrA){if(arrA[i]!=arrB[i])return false}return true}for(var i in JSEvents.deferredCalls){var call=JSEvents.deferredCalls[i];if(call.targetFunction==targetFunction&&arraysHaveEqualContent(call.argsList,argsList)){return}}JSEvents.deferredCalls.push({targetFunction:targetFunction,precedence:precedence,argsList:argsList});JSEvents.deferredCalls.sort(function(x,y){return x.precedence<y.precedence})},removeDeferredCalls:function(targetFunction){for(var i=0;i<JSEvents.deferredCalls.length;++i){if(JSEvents.deferredCalls[i].targetFunction==targetFunction){JSEvents.deferredCalls.splice(i,1);--i}}},canPerformEventHandlerRequests:function(){return JSEvents.inEventHandler&&JSEvents.currentEventHandler.allowsDeferredCalls},runDeferredCalls:function(){if(!J

SEvents.canPerformEventHandlerRequests()){return}for(var i=0;i<JSEvents.deferredCalls.length;++i){var call=JSEvents.deferredCalls[i];JSEvents.deferredCalls.splice(i,1);--i;call.targetFunction.apply(null,call.argsList)}},eventHandlers:[],removeAllHandlersOnTarget:function(target,eventTypeString){for(var i=0;i<JSEvents.eventHandlers.length;++i){if(JSEvents.eventHandlers[i].target==target&&(!eventTypeString||eventTypeString==JSEvents.eventHandlers[i].eventTypeString)){JSEvents._removeHandler(i--)}}},_removeHandler:function(i){var h=JSEvents.eventHandlers[i];h.target.removeEventListener(h.eventTypeString,h.eventListenerFunc,h.useCapture);JSEvents.eventHandlers.splice(i,1)},registerOrRemoveHandler:function(eventHandler){var jsEventHandler=function jsEventHandler(event){++JSEvents.inEventHandler;JSEvents.currentEventHandler=eventHandler;JSEvents.runDeferredCalls();eventHandler.handlerFunc(event);JSEvents.runDeferredCalls();--JSEvents.inEventHandler};if(eventHandler.callbackfunc){eventHandler.eventListenerFunc=jsEventHandler;eventHandler.target.addEventListener(eventHandler.eventTypeString,jsEventHandler,eventHandler.useCapture);JSEvents.eventHandlers.push(eventHandler);JSEvents.registerRemoveEventListeners()}else{for(var i=0;i<JSEvents.eventHandlers.length;++i){if(JSEvents.eventHandlers[i].target==eventHandler.target&&JSEvents.eventHandlers[i].eventTypeString==eventHandler.eventTypeString){JSEvents._removeHandler(i--)}}}},queueEventHandlerOnThread_iiii:function(targetThread,eventHandlerFunc,eventTypeId,eventData,userData){var
 stackTop=stackSave();var varargs=stackAlloc(12);GROWABLE_HEAP_I32()[varargs>>2]=eventTypeId;GROWABLE_HEAP_I32()[varargs+4>>2]=eventData;GROWABLE_HEAP_I32()[varargs+8>>2]=userData;__emscripten_call_on_thread(0,targetThread,637534208,eventHandlerFunc,eventData,varargs);stackRestore(stackTop)},getTargetThreadForEventCallback:function(targetThread){switch(targetThread){case 1:return 0;case 2:return PThread.currentProxiedOperationCallerThread;default:return targetThread}},getNodeNameForTarget:function(target){if(!target)return\"\";if(target==window)return\"#window\";if(target==screen)return\"#screen\";return target&&target.nodeName?target.nodeName:\"\"},fullscreenEnabled:function(){return document.fullscreenEnabled||document.webkitFullscreenEnabled}};function stringToNewUTF8(jsString){var length=lengthBytesUTF8(jsString)+1;var cString=_malloc(length);stringToUTF8(jsString,cString,length);return
 cString}function _emscripten_set_offscreencanvas_size_on_target_thread_js(targetThread,targetCanvas,width,height){var stackTop=stackSave();var varargs=stackAlloc(12);var targetCanvasPtr=0;if(targetCanvas){targetCanvasPtr=stringToNewUTF8(targetCanvas)}GROWABLE_HEAP_I32()[varargs>>2]=targetCanvasPtr;GROWABLE_HEAP_I32()[varargs+4>>2]=width;GROWABLE_HEAP_I32()[varargs+8>>2]=height;__emscripten_call_on_thread(0,targetThread,657457152,0,targetCanvasPtr,varargs);stackRestore(stackTop)}function _emscripten_set_offscreencanvas_size_on_target_thread(targetThread,targetCanvas,width,height){targetCanvas=targetCanvas?UTF8ToString(targetCanvas):\"\";_emscripten_set_offscreencanvas_size_on_target_thread_js(targetThread,targetCanvas,width,height)}function maybeCStringToJsString(cString){return cString>2?UTF8ToString(cString):cString}var specialHTMLTargets=[0,typeof document!==\"undefined\"?document:0,typeof window!==\"undefined\"?window:0];function findEventTarget(target){target=maybeCStringToJsString(target);var
 domElement=specialHTMLTargets[target]||(typeof document!==\"undefined\"?document.querySelector(target):undefined);return domElement}function findCanvasEventTarget(target){return findEventTarget(target)}function _emscripten_set_canvas_element_size_calling_thread(target,width,height){var canvas=findCanvasEventTarget(target);if(!canvas)return-4;if(canvas.canvasSharedPtr){GROWABLE_HEAP_I32()[canvas.canvasSharedPtr>>2]=width;GROWABLE_HEA

P_I32()[canvas.canvasSharedPtr+4>>2]=height}if(canvas.offscreenCanvas||!canvas.controlTransferredOffscreen){if(canvas.offscreenCanvas)canvas=canvas.offscreenCanvas;var autoResizeViewport=false;if(canvas.GLctxObject&&canvas.GLctxObject.GLctx){var prevViewport=canvas.GLctxObject.GLctx.getParameter(2978);autoResizeViewport=prevViewport[0]===0&&prevViewport[1]===0&&prevViewport[2]===canvas.width&&prevViewport[3]===canvas.height}canvas.width=width;canvas.height=height;if(autoResizeViewport){canvas.GLctxObject.GLctx.viewport(0,0,width,height)}}else if(canvas.canvasSharedPtr){var targetThread=GROWABLE_HEAP_I32()[canvas.canvasSharedPtr+8>>2];_emscripten_set_offscreencanvas_size_on_target_thread(targetThread,target,width,height);return 1}else{return-4}return 0}function _emscripten_set_canvas_element_size_main_thread(target,width,height){if(ENVIRONMENT_IS_PTHREAD)return _emscripten_proxy_to_main_thread_js(2,1,target,width,height);return _emscripten_set_canvas_element_size_calling_thread(target,width,height)}function _emscripten_set_canvas_element_size(target,width,height){var canvas=findCanvasEventTarget(target);if(canvas){return _emscripten_set_canvas_element_size_calling_thread(target,width,height)}else{return _emscripten_set_canvas_element_size_main_thread(target,width,height)}}function _emscripten_set_current_thread_status(newStatus){}function _emscripten_set_thread_name(threadId,name){}function __webgl_enable_ANGLE_instanced_arrays(ctx){var ext=ctx.getExtension(\"ANGLE_instanced_arrays\");if(ext){ctx[\"vertexAttribDivisor\"]=function(index,divisor){ext[\"vertexAttribDivisorANGLE\"](index,divisor)};ctx[\"drawArraysInstanced\"]=function(mode,first,count,primcount){ext[\"drawArraysInstancedANGLE\"](mode,first,count,primcount)};ctx[\"drawElementsInstanced\"]=function(mode,count,type,indices,primcount){ext[\"drawElementsInstancedANGLE\"](mode,count,type,indices,primcount)};return 1}}function __webgl_enable_OES_vertex_array_object(ctx){var ext=ctx.getExtension(\"OES_vertex_array_object\");if(ext){ctx[\"createVertexArray\"]=function(){return ext[\"createVertexArrayOES\"]()};ctx[\"deleteVertexArray\"]=function(vao){ext[\"deleteVertexArrayOES\"](vao)};ctx[\"bindVertexArray\"]=function(vao){ext[\"bindVertexArrayOES\"](vao)};ctx[\"isVertexArray\"]=function(vao){return ext[\"isVertexArrayOES\"](vao)};return 1}}function __webgl_enable_WEBGL_draw_buffers(ctx){var ext=ctx.getExtension(\"WEBGL_draw_buffers\");if(ext){ctx[\"drawBuffers\"]=function(n,bufs){ext[\"drawBuffersWEBGL\"](n,bufs)};return 1}}function __webgl_enable_WEBGL_multi_draw(ctx){return!!(ctx.multiDrawWebgl=ctx.getExtension(\"WEBGL_multi_draw\"))}var GL={counter:1,buffers:[],programs:[],framebuffers:[],renderbuffers:[],textures:[],uniforms:[],shaders:[],vaos:[],contexts:{},offscreenCanvases:{},timerQueriesEXT:[],programInfos:{},stringCache:{},unpackAlignment:4,recordError:function recordError(errorCode){if(!GL.lastError){GL.lastError=errorCode}},getNewId:function(table){var ret=GL.counter++;for(var i=table.length;i<ret;i++){table[i]=null}return ret},getSource:function(shader,count,string,length){var source=\"\";for(var i=0;i<count;++i){var len=length?GROWABLE_HEAP_I32()[length+i*4>>2]:-1;source+=UTF8ToString(GROWABLE_HEAP_I32()[string+i*4>>2],len<0?undefined:len)}return source},createContext:function(canvas,webGLContextAttributes){var ctx=canvas.getContext(\"webgl\",webGLContextAttributes);if(!ctx)return 0;var handle=GL.registerContext(ctx,webGLContextAttributes);return handle},registerContext:function(ctx,webGLContextAttributes){var handle=_malloc(8);GROWABLE_HEAP_I32()[handle+4>>2]=_pthread_self();var context={handle:handle,attributes:webGLContextAttributes,version:webGLContextAttributes.majorVersion,GLctx:ctx};if(ctx.canvas)ctx.canvas.GLctxObject=context;GL.contexts[handle]=context;if(typeof webGLContextAttributes.enableExtensionsByDefault===\"undefined\"||webGLContextAttributes.enableExtensions

ByDefault){GL.initExtensions(context)}return
handle},makeContextCurrent:function(contextHandle){GL.currentContext=GL.contexts[contextHandle];Module.ctx
=GLctx=GL.currentContext&&GL.currentContext.GLctx;return!(contextHandle&&!GLctx)},getContext:function(c
ontextHandle){return
GL.contexts[contextHandle]},deleteContext:function(contextHandle){if(GL.currentContext===GL.contexts[context
Handle])GL.currentContext=null;if(typeof
JSEvents===\"object\")JSEvents.removeAllHandlersOnTarget(GL.contexts[contextHandle].GLctx.canvas);if(GL.co
ntexts[contextHandle]&&GL.contexts[contextHandle].GLctx.canvas)GL.contexts[contextHandle].GLctx.canvas.GL
ctxObject=undefined;_free(GL.contexts[contextHandle].handle);GL.contexts[contextHandle]=null},initExtensions:f
unction(context){if(!context)context=GL.currentContext;if(context.initExtensionsDone)return;context.initExtension
sDone=true;var
GLctx=context.GLctx;__webgl_enable_ANGLE_instanced_arrays(GLctx);__webgl_enable_OES_vertex_array_obj
ect(GLctx);__webgl_enable_WEBGL_draw_buffers(GLctx);GLctx.disjointTimerQueryExt=GLctx.getExtension(\"
EXT_disjoint_timer_query\");__webgl_enable_WEBGL_multi_draw(GLctx);var
exts=GLctx.getSupportedExtensions()||[];exts.forEach(function(ext){if(ext.indexOf(\"lose_context\")<0&&ext.inde
xOf(\"debug\")<0){GLctx.getExtension(ext)}})},populateUniformTable:function(program){var
p=GL.programs[program];var
ptable=GL.programInfos[program]={uniforms:{},maxUniformLength:0,maxAttributeLength:-
1,maxUniformBlockNameLength:-1};var utable=ptable.uniforms;var
numUniforms=GLctx.getProgramParameter(p,35718);for(var i=0;i<numUniforms;++i){var
u=GLctx.getActiveUniform(p,i);var
name=u.name;ptable.maxUniformLength=Math.max(ptable.maxUniformLength,name.length+1);if(name.slice(-
1)==\"]\"){name=name.slice(0,name.lastIndexOf(\"[\"))}var loc=GLctx.getUniformLocation(p,name);if(loc){var
id=GL.getNewId(GL.uniforms);utable[name]=[u.size,id];GL.uniforms[id]=loc;for(var j=1;j<u.size;++j){var
n=name+\"[\"+j+\"]\";loc=GLctx.getUniformLocation(p,n);id=GL.getNewId(GL.uniforms);GL.uniforms[id]=loc}}
}};var __emscripten_webgl_power_preferences=[\"default\",\"low-power\",\"high-performance\"];function
_emscripten_webgl_do_create_context(target,attributes){var a=attributes>>2;var
powerPreference=GROWABLE_HEAP_I32()[a+(24>>2)];var
contextAttributes={\"alpha\":!!GROWABLE_HEAP_I32()[a+(0>>2)],\"depth\":!!GROWABLE_HEAP_I32()[a+(4
>>2)],\"stencil\":!!GROWABLE_HEAP_I32()[a+(8>>2)],\"antialias\":!!GROWABLE_HEAP_I32()[a+(12>>2)],\"p
remultipliedAlpha\":!!GROWABLE_HEAP_I32()[a+(16>>2)],\"preserveDrawingBuffer\":!!GROWABLE_HEAP_
I32()[a+(20>>2)],\"powerPreference\":__emscripten_webgl_power_preferences[powerPreference],\"failIfMajorPerf
ormanceCaveat\":!!GROWABLE_HEAP_I32()[a+(28>>2)],majorVersion:GROWABLE_HEAP_I32()[a+(32>>2)],
minorVersion:GROWABLE_HEAP_I32()[a+(36>>2)],enableExtensionsByDefault:GROWABLE_HEAP_I32()[a+(
40>>2)],explicitSwapControl:GROWABLE_HEAP_I32()[a+(44>>2)],proxyContextToMainThread:GROWABLE_
HEAP_I32()[a+(48>>2)],renderViaOffscreenBackBuffer:GROWABLE_HEAP_I32()[a+(52>>2)]};var
canvas=findCanvasEventTarget(target);if(!canvas){return 0}if(contextAttributes.explicitSwapControl){return
0}var contextHandle=GL.createContext(canvas,contextAttributes);return contextHandle}function
_emscripten_webgl_create_context(a0,a1){return _emscripten_webgl_do_create_context(a0,a1)}var
SYSCALLS={mappings:{},buffers:[null,[],[]],printChar:function(stream,curr){var
buffer=SYSCALLS.buffers[stream];if(curr===0||curr===10){(stream===1?out:err)(UTF8ArrayToString(buffer,0));
buffer.length=0}else{buffer.push(curr)}},varargs:undefined,get:function(){SYSCALLS.varargs+=4;var
ret=GROWABLE_HEAP_I32()[SYSCALLS.varargs-4>>2];return ret},getStr:function(ptr){var
ret=UTF8ToString(ptr);return ret},get64:function(low,high){return low}};function
_fd_close(fd){if(ENVIRONMENT_IS_PTHREAD)return _emscripten_proxy_to_main_thread_js(3,1,fd);return
0}function _fd_seek(fd,offset_low,offset_high,whence,newOffset){if(ENVIRONMENT_IS_PTHREAD)return
_emscripten_proxy_to_main_thread_js(4,1,fd,offset_low,offset_high,whence,newOffset)}function
_fd_write(fd,iov,iovcnt,pnum){if(ENVIRONMENT_IS_PTHREAD)return

_emscripten_proxy_to_main_thread_js(5,1,fd,iov,iovcnt,pnum);var num=0;for(var i=0;i<iovcnt;i++){var ptr=GROWABLE_HEAP_I32()[iov+i*8>>2];var len=GROWABLE_HEAP_I32()[iov+(i*8+4)>>2];for(var j=0;j<len;j++){SYSCALLS.printChar(fd,GROWABLE_HEAP_U8()[ptr+j])}num+=len}GROWABLE_HEAP_I32()[pnum>>2]=num;return 0}function _pthread_cleanup_pop(execute){var routine=PThread.threadExitHandlers.pop();if(execute)routine()}function _pthread_cleanup_push(routine,arg){PThread.threadExitHandlers.push(function(){wasmTable.get(routine)(arg)})}function spawnThread(threadParams){if(ENVIRONMENT_IS_PTHREAD)throw\"Internal Error! spawnThread() can only ever be called from main application thread!\";var worker=PThread.getNewWorker();if(worker.pthread!==undefined)throw\"Internal error!\";if(!threadParams.pthread_ptr)throw\"Internal error, no pthread ptr!\";PThread.runningWorkers.push(worker);var tlsMemory=_malloc(128*4);for(var i=0;i<128;++i){GROWABLE_HEAP_I32()[tlsMemory+i*4>>2]=0}var stackHigh=threadParams.stackBase+threadParams.stackSize;var pthread=PThread.pthreads[threadParams.pthread_ptr]={worker:worker,stackBase:threadParams.stackBase,stackSize:threadParams.stackSize,allocatedOwnStack:threadParams.allocatedOwnStack,threadInfoStruct:threadParams.pthread_ptr};var tis=pthread.threadInfoStruct>>2;Atomics.store(GROWABLE_HEAP_U32(),tis+(64>>2),threadParams.detached);Atomics.store(GROWABLE_HEAP_U32(),tis+(100>>2),tlsMemory);Atomics.store(GROWABLE_HEAP_U32(),tis+(40>>2),pthread.threadInfoStruct);Atomics.store(GROWABLE_HEAP_U32(),tis+(80>>2),threadParams.stackSize);Atomics.store(GROWABLE_HEAP_U32(),tis+(76>>2),stackHigh);Atomics.store(GROWABLE_HEAP_U32(),tis+(104>>2),threadParams.stackSize);Atomics.store(GROWABLE_HEAP_U32(),tis+(104+8>>2),stackHigh);Atomics.store(GROWABLE_HEAP_U32(),tis+(104+12>>2),threadParams.detached);var global_libc=_emscripten_get_global_libc();var global_locale=global_libc+40;Atomics.store(GROWABLE_HEAP_U32(),tis+(172>>2),global_locale);worker.pthread=pthread;var msg={\"cmd\":\"run\",\"start_routine\":threadParams.startRoutine,\"arg\":threadParams.arg,\"threadInfoStruct\":threadParams.pthread_ptr,\"stackBase\":threadParams.stackBase,\"stackSize\":threadParams.stackSize};worker.runPthread=function(){msg.time=performance.now();worker.postMessage(msg,threadParams.transferList)};if(worker.loaded){worker.runPthread();delete worker.runPthread}}function _pthread_create(pthread_ptr,attr,start_routine,arg){if(typeof SharedArrayBuffer===\"undefined\"){err(\"Current environment does not support SharedArrayBuffer, pthreads are not available!\");return 6}if(!pthread_ptr){err(\"pthread_create called with a null thread pointer!\");return 28}var transferList=[];var error=0;if(ENVIRONMENT_IS_PTHREAD&&(transferList.length===0||error)){return _emscripten_sync_run_in_main_thread_4(687865856,pthread_ptr,attr,start_routine,arg)}if(error)return error;var stackSize=0;var stackBase=0;var detached=0;if(attr&&attr!=-1){stackSize=GROWABLE_HEAP_I32()[attr>>2];stackSize+=81920;stackBase=GROWABLE_HEAP_I32()[attr+8>>2];detached=GROWABLE_HEAP_I32()[attr+12>>2]!==0}else{stackSize=2097152}var allocatedOwnStack=stackBase==0;if(allocatedOwnStack){stackBase=_memalign(16,stackSize)}else{stackBase-=stackSize;assert(stackBase>0)}var threadInfoStruct=_malloc(228);for(var i=0;i<228>>2;++i)GROWABLE_HEAP_U32()[(threadInfoStruct>>2)+i]=0;GROWABLE_HEAP_I32()[pthread_ptr>>2]=threadInfoStruct;GROWABLE_HEAP_I32()[threadInfoStruct+12>>2]=threadInfoStruct;var headPtr=threadInfoStruct+152;GROWABLE_HEAP_I32()[headPtr>>2]=headPtr;var threadParams={stackBase:stackBase,stackSize:stackSize,allocatedOwnStack:allocatedOwnStack,detached:detached,startRoutine:start_routine,pthread_ptr:threadInfoStruct,arg:arg,transferList:transferList};if(ENVIRONMENT_IS_PTHREAD){threadParams.cmd=\"spawnThread\";postMessage(threadParams,transferList)}else{spawnThread(threadParams)}return 0}function __pthread_testcancel_js(){if(!ENVIRONMENT_IS_PTHREAD)return;var tb=_pthread_self();if(!tb)return;var

cancelDisabled=Atomics.load(GROWABLE_HEAP_U32(),tb+56>>2);if(cancelDisabled)return;var canceled=Atomics.load(GROWABLE_HEAP_U32(),tb+0>>2);if(canceled==2)throw\"Canceled!\"}function _emscripten_check_blocking_allowed(){if(ENVIRONMENT_IS_NODE)return;if(ENVIRONMENT_IS_WORKER)return;warnOnce(\"Blocking on the main thread is very dangerous, see https://emscripten.org/docs/porting/pthreads.html#blocking-on-the-main-browser-thread\")}function __emscripten_do_pthread_join(thread,status,block){if(!thread){err(\"pthread_join attempted on a null thread pointer!\");return ERRNO_CODES.ESRCH}if(ENVIRONMENT_IS_PTHREAD&&_pthread_self()==thread){err(\"PThread \"+thread+\" is attempting to join to itself!\");return ERRNO_CODES.EDEADLK}else if(!ENVIRONMENT_IS_PTHREAD&&_emscripten_main_browser_thread_id()==thread){err(\"Main thread \"+thread+\" is attempting to join to itself!\");return ERRNO_CODES.EDEADLK}var self=GROWABLE_HEAP_I32()[thread+12>>2];if(self!==thread){err(\"pthread_join attempted on thread \"+thread+\", which does not point to a valid thread, or does not exist anymore!\");return ERRNO_CODES.ESRCH}var detached=Atomics.load(GROWABLE_HEAP_U32(),thread+64>>2);if(detached){err(\"Attempted to join thread \"+thread+\", which was already detached!\");return ERRNO_CODES.EINVAL}if(block){_emscripten_check_blocking_allowed()}for(;;){var threadStatus=Atomics.load(GROWABLE_HEAP_U32(),thread+0>>2);if(threadStatus==1){var threadExitCode=Atomics.load(GROWABLE_HEAP_U32(),thread+4>>2);if(status)GROWABLE_HEAP_I32()[status>>2]=threadExitCode;Atomics.store(GROWABLE_HEAP_U32(),thread+64>>2,1);if(!ENVIRONMENT_IS_PTHREAD)cleanupThread(thread);else postMessage({\"cmd\":\"cleanupThread\",\"thread\":thread});return 0}if(!block){return ERRNO_CODES.EBUSY}__pthread_testcancel_js();if(!ENVIRONMENT_IS_PTHREAD)_emscripten_main_thread_process_queued_calls();_emscripten_futex_wait(thread+0,threadStatus,ENVIRONMENT_IS_PTHREAD?100:1)}}function _pthread_join(thread,status){return __emscripten_do_pthread_join(thread,status,true)}function _sysconf(name){if(ENVIRONMENT_IS_PTHREAD)return _emscripten_proxy_to_main_thread_js(6,1,name);switch(name){case 30:return 16384;case 85:var maxHeapSize=2147483648;return maxHeapSize/16384;case 132:case 133:case 12:case 137:case 138:case 15:case 235:case 16:case 17:case 18:case 19:case 20:case 149:case 13:case 10:case 236:case 153:case 9:case 21:case 22:case 159:case 154:case 14:case 77:case 78:case 139:case 82:case 68:case 67:case 164:case 11:case 29:case 47:case 48:case 95:case 52:case 51:case 46:return 200809;case 27:case 246:case 127:case 128:case 23:case 24:case 160:case 161:case 181:case 182:case 242:case 183:case 184:case 243:case 244:case 245:case 165:case 178:case 179:case 49:case 50:case 168:case 169:case 175:case 170:case 171:case 172:case 97:case 76:case 32:case 173:case 35:case 80:case 81:case 79:return-1;case 176:case 177:case 7:case 155:case 8:case 157:case 125:case 126:case 92:case 93:case 129:case 130:case 131:case 94:case 91:return 1;case 74:case 60:case 69:case 70:case 4:return 1024;case 31:case 42:case 72:return 32;case 87:case 26:case 33:return 2147483647;case 34:case 1:return 47839;case 38:case 36:return 99;case 43:case 37:return 2048;case 0:return 2097152;case 3:return 65536;case 28:return 32768;case 44:return 32767;case 75:return 16384;case 39:return 1e3;case 89:return 700;case 71:return 256;case 40:return 255;case 2:return 100;case 180:return 64;case 25:return 20;case 5:return 16;case 6:return 6;case 73:return 4;case 84:{if(typeof navigator===\"object\")return navigator[\"hardwareConcurrency\"]||1;return 1}}setErrNo(28);return-1}if(!ENVIRONMENT_IS_PTHREAD)PThread.initMainThreadBlock();var GLctx;var proxiedFunctionTable=[null,_atexit,_emscripten_set_canvas_element_size_main_thread,_fd_close,_fd_seek,_fd_write,_sysconf];var asmLibraryArg={\"e\":___assert_fail,\"r\":___call_main,\"x\":__emscripten_notify_thread_queue,\"b\":_abort,\"y\":_emscripten_asm_const_int,\"j\":_emscripten_conditional_set_current_thread_status,\"d\":_emscripten_futex_wait,\"c\":_emscripten_futex_wake,\"f\":_emscripten_get_now,\"p\":_emscripten_memcpy_big,\"A\":_emscripten_num_logical_cores,\"u\":_emscripten_receive_on_main_thread_js,\"q\":_emscripten_resize_heap,\"v\":_emscripten_set_ca

nvas_element_size,\"i\":_emscripten_set_current_thread_status,\"s\":_emscripten_set_thread_name,\"w\":_emscripten_webgl_create_context,\"l\":_fd_close,\"n\":_fd_seek,\"g\":_fd_write,\"o\":initPthreadsJS,\"a\":wasmMemory||Module[\"wasmMemory\"],\"z\":_pthread_cleanup_pop,\"k\":_pthread_cleanup_push,\"h\":_pthread_create,\"m\":_pthread_join,\"t\":_sysconf};var
asm=createWasm();var
___wasm_call_ctors=Module[\"___wasm_call_ctors\"]=function(){return(___wasm_call_ctors=Module[\"___wasm_call_ctors\"]=Module[\"asm\"][\"B\"]).apply(null,arguments)};var
_init=Module[\"_init\"]=function(){return(_init=Module[\"_init\"]=Module[\"asm\"][\"C\"]).apply(null,arguments)};var
_init_with_threads_count=Module[\"_init_with_threads_count\"]=function(){return(_init_with_threads_count=Module[\"_init_with_threads_count\"]=Module[\"asm\"][\"D\"]).apply(null,arguments)};var
_get_threads_count=Module[\"_get_threads_count\"]=function(){return(_get_threads_count=Module[\"_get_threads_count\"]=Module[\"asm\"][\"E\"]).apply(null,arguments)};var
_register_tensor=Module[\"_register_tensor\"]=function(){return(_register_tensor=Module[\"_register_tensor\"]=Module[\"asm\"][\"F\"]).apply(null,arguments)};var
_dispose_data=Module[\"_dispose_data\"]=function(){return(_dispose_data=Module[\"_dispose_data\"]=Module[\"asm\"][\"G\"]).apply(null,arguments)};var
_dispose=Module[\"_dispose\"]=function(){return(_dispose=Module[\"_dispose\"]=Module[\"asm\"][\"H\"]).apply(null,arguments)};var
_Abs=Module[\"_Abs\"]=function(){return(_Abs=Module[\"_Abs\"]=Module[\"asm\"][\"J\"]).apply(null,arguments)};var
_Add=Module[\"_Add\"]=function(){return(_Add=Module[\"_Add\"]=Module[\"asm\"][\"K\"]).apply(null,arguments)};var
_AddN=Module[\"_AddN\"]=function(){return(_AddN=Module[\"_AddN\"]=Module[\"asm\"][\"L\"]).apply(null,arguments)};var
_All=Module[\"_All\"]=function(){return(_All=Module[\"_All\"]=Module[\"asm\"][\"M\"]).apply(null,arguments)};var
_Any=Module[\"_Any\"]=function(){return(_Any=Module[\"_Any\"]=Module[\"asm\"][\"N\"]).apply(null,arguments)};var
_ArgMax=Module[\"_ArgMax\"]=function(){return(_ArgMax=Module[\"_ArgMax\"]=Module[\"asm\"][\"O\"]).apply(null,arguments)};var
_AvgPool=Module[\"_AvgPool\"]=function(){return(_AvgPool=Module[\"_AvgPool\"]=Module[\"asm\"][\"P\"]).apply(null,arguments)};var
_BatchMatMul=Module[\"_BatchMatMul\"]=function(){return(_BatchMatMul=Module[\"_BatchMatMul\"]=Module[\"asm\"][\"Q\"]).apply(null,arguments)};var
_Ceil=Module[\"_Ceil\"]=function(){return(_Ceil=Module[\"_Ceil\"]=Module[\"asm\"][\"R\"]).apply(null,arguments)};var
_ClipByValue=Module[\"_ClipByValue\"]=function(){return(_ClipByValue=Module[\"_ClipByValue\"]=Module[\"asm\"][\"S\"]).apply(null,arguments)};var
_Conv2D=Module[\"_Conv2D\"]=function(){return(_Conv2D=Module[\"_Conv2D\"]=Module[\"asm\"][\"T\"]).apply(null,arguments)};var
_Conv2DBackpropInput=Module[\"_Conv2DBackpropInput\"]=function(){return(_Conv2DBackpropInput=Module[\"_Conv2DBackpropInput\"]=Module[\"asm\"][\"U\"]).apply(null,arguments)};var
_Cos=Module[\"_Cos\"]=function(){return(_Cos=Module[\"_Cos\"]=Module[\"asm\"][\"V\"]).apply(null,arguments)};var
_Cosh=Module[\"_Cosh\"]=function(){return(_Cosh=Module[\"_Cosh\"]=Module[\"asm\"][\"W\"]).apply(null,arguments)};var

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_CropAndResize=Module[\"_CropAndResize\"]=function(){return(_CropAndResize=Module[\"_CropAndResize\"]
=Module[\"asm\"][\"X\"]).apply(null,arguments)};var
_Cumsum=Module[\"_Cumsum\"]=function(){return(_Cumsum=Module[\"_Cumsum\"]=Module[\"asm\"][\"Y\"]).a
pply(null,arguments)};var
_DepthToSpace=Module[\"_DepthToSpace\"]=function(){return(_DepthToSpace=Module[\"_DepthToSpace\"]=M
odule[\"asm\"][\"Z\"]).apply(null,arguments)};var
_DepthwiseConv2dNative=Module[\"_DepthwiseConv2dNative\"]=function(){return(_DepthwiseConv2dNative=M
odule[\"_DepthwiseConv2dNative\"]=Module[\"asm\"][\"_\"]).apply(null,arguments)};var
_Elu=Module[\"_Elu\"]=function(){return(_Elu=Module[\"_Elu\"]=Module[\"asm\"][\"$\"]).apply(null,arguments)}
;var
_Equal=Module[\"_Equal\"]=function(){return(_Equal=Module[\"_Equal\"]=Module[\"asm\"][\"aa\"]).apply(null,ar
guments)};var
_Exp=Module[\"_Exp\"]=function(){return(_Exp=Module[\"_Exp\"]=Module[\"asm\"][\"ba\"]).apply(null,argument
s)};var
_FlipLeftRight=Module[\"_FlipLeftRight\"]=function(){return(_FlipLeftRight=Module[\"_FlipLeftRight\"]=Modul
e[\"asm\"][\"ca\"]).apply(null,arguments)};var
_Floor=Module[\"_Floor\"]=function(){return(_Floor=Module[\"_Floor\"]=Module[\"asm\"][\"da\"]).apply(null,arg
uments)};var
_FloorDiv=Module[\"_FloorDiv\"]=function(){return(_FloorDiv=Module[\"_FloorDiv\"]=Module[\"asm\"][\"ea\"]).
apply(null,arguments)};var
_FusedBatchNorm=Module[\"_FusedBatchNorm\"]=function(){return(_FusedBatchNorm=Module[\"_FusedBatchN
orm\"]=Module[\"asm\"][\"fa\"]).apply(null,arguments)};var
_FusedConv2D=Module[\"_FusedConv2D\"]=function(){return(_FusedConv2D=Module[\"_FusedConv2D\"]=Mod
ule[\"asm\"][\"ga\"]).apply(null,arguments)};var
_FusedDepthwiseConv2D=Module[\"_FusedDepthwiseConv2D\"]=function(){return(_FusedDepthwiseConv2D=M
odule[\"_FusedDepthwiseConv2D\"]=Module[\"asm\"][\"ha\"]).apply(null,arguments)};var
_Gather=Module[\"_Gather\"]=function(){return(_Gather=Module[\"_Gather\"]=Module[\"asm\"][\"ia\"]).apply(nul
l,arguments)};var
_GatherNd=Module[\"_GatherNd\"]=function(){return(_GatherNd=Module[\"_GatherNd\"]=Module[\"asm\"][\"ja\"
]).apply(null,arguments)};var
_Greater=Module[\"_Greater\"]=function(){return(_Greater=Module[\"_Greater\"]=Module[\"asm\"][\"ka\"]).apply(
null,arguments)};var
_GreaterEqual=Module[\"_GreaterEqual\"]=function(){return(_GreaterEqual=Module[\"_GreaterEqual\"]=Module[\
"asm\"][\"la\"]).apply(null,arguments)};var
_LeakyRelu=Module[\"_LeakyRelu\"]=function(){return(_LeakyRelu=Module[\"_LeakyRelu\"]=Module[\"asm\"][\
"ma\"]).apply(null,arguments)};var
_Less=Module[\"_Less\"]=function(){return(_Less=Module[\"_Less\"]=Module[\"asm\"][\"na\"]).apply(null,argume
nts)};var
_LessEqual=Module[\"_LessEqual\"]=function(){return(_LessEqual=Module[\"_LessEqual\"]=Module[\"asm\"][\"o
a\"]).apply(null,arguments)};var
_Log=Module[\"_Log\"]=function(){return(_Log=Module[\"_Log\"]=Module[\"asm\"][\"pa\"]).apply(null,argument
s)};var
_LogicalAnd=Module[\"_LogicalAnd\"]=function(){return(_LogicalAnd=Module[\"_LogicalAnd\"]=Module[\"asm
\"][\"qa\"]).apply(null,arguments)};var
_Max=Module[\"_Max\"]=function(){return(_Max=Module[\"_Max\"]=Module[\"asm\"][\"ra\"]).apply(null,argume
nts)};var
_MaxPool=Module[\"_MaxPool\"]=function(){return(_MaxPool=Module[\"_MaxPool\"]=Module[\"asm\"][\"sa\"]).
apply(null,arguments)};var
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_Maximum=Module[\"_Maximum\"]=function(){return(_Maximum=Module[\"_Maximum\"]=Module[\"asm\"][\"ta\"]).apply(null,arguments)};var
_Mean=Module[\"_Mean\"]=function(){return(_Mean=Module[\"_Mean\"]=Module[\"asm\"][\"ua\"]).apply(null,arguments)};var
_Min=Module[\"_Min\"]=function(){return(_Min=Module[\"_Min\"]=Module[\"asm\"][\"va\"]).apply(null,arguments)};var
_Minimum=Module[\"_Minimum\"]=function(){return(_Minimum=Module[\"_Minimum\"]=Module[\"asm\"][\"wa\"]).apply(null,arguments)};var
_MirrorPad=Module[\"_MirrorPad\"]=function(){return(_MirrorPad=Module[\"_MirrorPad\"]=Module[\"asm\"][\"xa\"]).apply(null,arguments)};var
_Multiply=Module[\"_Multiply\"]=function(){return(_Multiply=Module[\"_Multiply\"]=Module[\"asm\"][\"ya\"]).apply(null,arguments)};var
_Neg=Module[\"_Neg\"]=function(){return(_Neg=Module[\"_Neg\"]=Module[\"asm\"][\"za\"]).apply(null,arguments)};var
_NonMaxSuppressionV3=Module[\"_NonMaxSuppressionV3\"]=function(){return(_NonMaxSuppressionV3=Module[\"_NonMaxSuppressionV3\"]=Module[\"asm\"][\"Aa\"]).apply(null,arguments)};var
_NonMaxSuppressionV4=Module[\"_NonMaxSuppressionV4\"]=function(){return(_NonMaxSuppressionV4=Module[\"_NonMaxSuppressionV4\"]=Module[\"asm\"][\"Ba\"]).apply(null,arguments)};var
_NonMaxSuppressionV5=Module[\"_NonMaxSuppressionV5\"]=function(){return(_NonMaxSuppressionV5=Module[\"_NonMaxSuppressionV5\"]=Module[\"asm\"][\"Ca\"]).apply(null,arguments)};var
_NotEqual=Module[\"_NotEqual\"]=function(){return(_NotEqual=Module[\"_NotEqual\"]=Module[\"asm\"][\"Da\"]).apply(null,arguments)};var
_OneHot=Module[\"_OneHot\"]=function(){return(_OneHot=Module[\"_OneHot\"]=Module[\"asm\"][\"Ea\"]).apply(null,arguments)};var
_PadV2=Module[\"_PadV2\"]=function(){return(_PadV2=Module[\"_PadV2\"]=Module[\"asm\"][\"Fa\"]).apply(null,arguments)};var
_Pow=Module[\"_Pow\"]=function(){return(_Pow=Module[\"_Pow\"]=Module[\"asm\"][\"Ga\"]).apply(null,arguments)};var
_Prelu=Module[\"_Prelu\"]=function(){return(_Prelu=Module[\"_Prelu\"]=Module[\"asm\"][\"Ha\"]).apply(null,arguments)};var
_Prod=Module[\"_Prod\"]=function(){return(_Prod=Module[\"_Prod\"]=Module[\"asm\"][\"Ia\"]).apply(null,arguments)};var
_RealDiv=Module[\"_RealDiv\"]=function(){return(_RealDiv=Module[\"_RealDiv\"]=Module[\"asm\"][\"Ja\"]).apply(null,arguments)};var
_Relu=Module[\"_Relu\"]=function(){return(_Relu=Module[\"_Relu\"]=Module[\"asm\"][\"Ka\"]).apply(null,arguments)};var
_Relu6=Module[\"_Relu6\"]=function(){return(_Relu6=Module[\"_Relu6\"]=Module[\"asm\"][\"La\"]).apply(null,arguments)};var
_ResizeBilinear=Module[\"_ResizeBilinear\"]=function(){return(_ResizeBilinear=Module[\"_ResizeBilinear\"]=Module[\"asm\"][\"Ma\"]).apply(null,arguments)};var
_Reverse=Module[\"_Reverse\"]=function(){return(_Reverse=Module[\"_Reverse\"]=Module[\"asm\"][\"Na\"]).apply(null,arguments)};var
_RotateWithOffset=Module[\"_RotateWithOffset\"]=function(){return(_RotateWithOffset=Module[\"_RotateWithOffset\"]=Module[\"asm\"][\"Oa\"]).apply(null,arguments)};var
_Round=Module[\"_Round\"]=function(){return(_Round=Module[\"_Round\"]=Module[\"asm\"][\"Pa\"]).apply(null,arguments)};var
_Rsqrt=Module[\"_Rsqrt\"]=function(){return(_Rsqrt=Module[\"_Rsqrt\"]=Module[\"asm\"][\"Qa\"]).apply(null,arguments)};var

_ScatterNd=Module[\"_ScatterNd\"]=function(){return(_ScatterNd=Module[\"_ScatterNd\"]=Module[\"asm\"][\"Ra\"]).apply(null,arguments)};var
_SelectV2=Module[\"_SelectV2\"]=function(){return(_SelectV2=Module[\"_SelectV2\"]=Module[\"asm\"][\"Sa\"]).apply(null,arguments)};var
_Sigmoid=Module[\"_Sigmoid\"]=function(){return(_Sigmoid=Module[\"_Sigmoid\"]=Module[\"asm\"][\"Ta\"]).apply(null,arguments)};var
_Sin=Module[\"_Sin\"]=function(){return(_Sin=Module[\"_Sin\"]=Module[\"asm\"][\"Ua\"]).apply(null,arguments)};var
_Softmax=Module[\"_Softmax\"]=function(){return(_Softmax=Module[\"_Softmax\"]=Module[\"asm\"][\"Va\"]).apply(null,arguments)};var
_Sqrt=Module[\"_Sqrt\"]=function(){return(_Sqrt=Module[\"_Sqrt\"]=Module[\"asm\"][\"Wa\"]).apply(null,arguments)};var
_Square=Module[\"_Square\"]=function(){return(_Square=Module[\"_Square\"]=Module[\"asm\"][\"Xa\"]).apply(null,arguments)};var
_SquaredDifference=Module[\"_SquaredDifference\"]=function(){return(_SquaredDifference=Module[\"_SquaredDifference\"]=Module[\"asm\"][\"Ya\"]).apply(null,arguments)};var
_Step=Module[\"_Step\"]=function(){return(_Step=Module[\"_Step\"]=Module[\"asm\"][\"Za\"]).apply(null,arguments)};var
_StridedSlice=Module[\"_StridedSlice\"]=function(){return(_StridedSlice=Module[\"_StridedSlice\"]=Module[\"asm\"][\"_a\"]).apply(null,arguments)};var
_Sub=Module[\"_Sub\"]=function(){return(_Sub=Module[\"_Sub\"]=Module[\"asm\"][\"$a\"]).apply(null,arguments)};var
_Sum=Module[\"_Sum\"]=function(){return(_Sum=Module[\"_Sum\"]=Module[\"asm\"][\"ab\"]).apply(null,arguments)};var
_Tan=Module[\"_Tan\"]=function(){return(_Tan=Module[\"_Tan\"]=Module[\"asm\"][\"bb\"]).apply(null,arguments)};var
_Tanh=Module[\"_Tanh\"]=function(){return(_Tanh=Module[\"_Tanh\"]=Module[\"asm\"][\"cb\"]).apply(null,arguments)};var
_Tile=Module[\"_Tile\"]=function(){return(_Tile=Module[\"_Tile\"]=Module[\"asm\"][\"db\"]).apply(null,arguments)};var
_TopK=Module[\"_TopK\"]=function(){return(_TopK=Module[\"_TopK\"]=Module[\"asm\"][\"eb\"]).apply(null,arguments)};var
_Transform=Module[\"_Transform\"]=function(){return(_Transform=Module[\"_Transform\"]=Module[\"asm\"][\"fb\"]).apply(null,arguments)};var
_Transpose=Module[\"_Transpose\"]=function(){return(_Transpose=Module[\"_Transpose\"]=Module[\"asm\"][\"gb\"]).apply(null,arguments)};var
__FusedMatMul=Module[\"__FusedMatMul\"]=function(){return(__FusedMatMul=Module[\"__FusedMatMul\"]=Module[\"asm\"][\"hb\"]).apply(null,arguments)};var
_malloc=Module[\"_malloc\"]=function(){return(_malloc=Module[\"_malloc\"]=Module[\"asm\"][\"ib\"]).apply(null,arguments)};var
_free=Module[\"_free\"]=function(){return(_free=Module[\"_free\"]=Module[\"asm\"][\"jb\"]).apply(null,arguments)};var
___errno_location=Module[\"___errno_location\"]=function(){return(___errno_location=Module[\"___errno_location\"]=Module[\"asm\"][\"kb\"]).apply(null,arguments)};var
_emscripten_get_global_libc=Module[\"_emscripten_get_global_libc\"]=function(){return(_emscripten_get_global_libc=Module[\"_emscripten_get_global_libc\"]=Module[\"asm\"][\"lb\"]).apply(null,arguments)};var
_pthread_self=Module[\"_pthread_self\"]=function(){return(_pthread_self=Module[\"_pthread_self\"]=Module[\"asm\"][\"mb\"]).apply(null,arguments)};var

___pthread_tsd_run_dtors=Module[\"___pthread_tsd_run_dtors\"]=function(){return(___pthread_tsd_run_dtors=Module[\"___pthread_tsd_run_dtors\"]=Module[\"asm\"][\"nb\"]).apply(null,arguments)};var
_emscripten_main_thread_process_queued_calls=Module[\"_emscripten_main_thread_process_queued_calls\"]=function(){return(_emscripten_main_thread_process_queued_calls=Module[\"_emscripten_main_thread_process_queued_calls\"]=Module[\"asm\"][\"ob\"]).apply(null,arguments)};var
_emscripten_current_thread_process_queued_calls=Module[\"_emscripten_current_thread_process_queued_calls\"]=function(){return(_emscripten_current_thread_process_queued_calls=Module[\"_emscripten_current_thread_process_queued_calls\"]=Module[\"asm\"][\"pb\"]).apply(null,arguments)};var
_emscripten_register_main_browser_thread_id=Module[\"_emscripten_register_main_browser_thread_id\"]=function(){return(_emscripten_register_main_browser_thread_id=Module[\"_emscripten_register_main_browser_thread_id\"]=Module[\"asm\"][\"qb\"]).apply(null,arguments)};var
_emscripten_main_browser_thread_id=Module[\"_emscripten_main_browser_thread_id\"]=function(){return(_emscripten_main_browser_thread_id=Module[\"_emscripten_main_browser_thread_id\"]=Module[\"asm\"][\"rb\"]).apply(null,arguments)};var
__emscripten_do_dispatch_to_thread=Module[\"__emscripten_do_dispatch_to_thread\"]=function(){return(__emscripten_do_dispatch_to_thread=Module[\"__emscripten_do_dispatch_to_thread\"]=Module[\"asm\"][\"sb\"]).apply(null,arguments)};var
_emscripten_sync_run_in_main_thread_4=Module[\"_emscripten_sync_run_in_main_thread_4\"]=function(){return(_emscripten_sync_run_in_main_thread_4=Module[\"_emscripten_sync_run_in_main_thread_4\"]=Module[\"asm\"][\"tb\"]).apply(null,arguments)};var
_emscripten_run_in_main_runtime_thread_js=Module[\"_emscripten_run_in_main_runtime_thread_js\"]=function(){return(_emscripten_run_in_main_runtime_thread_js=Module[\"_emscripten_run_in_main_runtime_thread_js\"]=Module[\"asm\"][\"ub\"]).apply(null,arguments)};var
__emscripten_call_on_thread=Module[\"__emscripten_call_on_thread\"]=function(){return(__emscripten_call_on_thread=Module[\"__emscripten_call_on_thread\"]=Module[\"asm\"][\"vb\"]).apply(null,arguments)};var
_emscripten_tls_init=Module[\"_emscripten_tls_init\"]=function(){return(_emscripten_tls_init=Module[\"_emscripten_tls_init\"]=Module[\"asm\"][\"wb\"]).apply(null,arguments)};var
__emscripten_thread_init=Module[\"__emscripten_thread_init\"]=function(){return(__emscripten_thread_init=Module[\"__emscripten_thread_init\"]=Module[\"asm\"][\"xb\"]).apply(null,arguments)};var
stackSave=Module[\"stackSave\"]=function(){return(stackSave=Module[\"stackSave\"]=Module[\"asm\"][\"yb\"]).apply(null,arguments)};var
stackRestore=Module[\"stackRestore\"]=function(){return(stackRestore=Module[\"stackRestore\"]=Module[\"asm\"][\"zb\"]).apply(null,arguments)};var
stackAlloc=Module[\"stackAlloc\"]=function(){return(stackAlloc=Module[\"stackAlloc\"]=Module[\"asm\"][\"Ab\"]).apply(null,arguments)};var
_emscripten_stack_set_limits=Module[\"_emscripten_stack_set_limits\"]=function(){return(_emscripten_stack_set_limits=Module[\"_emscripten_stack_set_limits\"]=Module[\"asm\"][\"Bb\"]).apply(null,arguments)};var
_memalign=Module[\"_memalign\"]=function(){return(_memalign=Module[\"_memalign\"]=Module[\"asm\"][\"Cb\"]).apply(null,arguments)};var
__emscripten_allow_main_runtime_queued_calls=Module[\"__emscripten_allow_main_runtime_queued_calls\"]=10512;var
__emscripten_main_thread_futex=Module[\"__emscripten_main_thread_futex\"]=12148;Module[\"cwrap\"]=cwrap;Module[\"PThread\"]=PThread;Module[\"PThread\"]=PThread;Module[\"wasmMemory\"]=wasmMemory;Module[\"ExitStatus\"]=ExitStatus;var calledRun;function
ExitStatus(status){this.name=\"ExitStatus\";this.message=\"Program terminated with
exit(\"+status+\")\";this.status=status}dependenciesFulfilled=function
runCaller(){if(!calledRun)run();if(!calledRun)dependenciesFulfilled=runCaller};function
run(args){args=args||arguments_;if(runDependencies>0){return}if(ENVIRONMENT_IS_PTHREAD){readyPromis

eResolve(Module);initRuntime();postMessage({\"cmd\":\"loaded\"});return}preRun();if(runDependencies>0){retur
n}function
doRun(){if(calledRun)return;calledRun=true;Module[\"calledRun\"]=true;if(ABORT)return;initRuntime();preMain(
);readyPromiseResolve(Module);if(Module[\"onRuntimeInitialized\"])Module[\"onRuntimeInitialized\"]();postRun(
)}if(Module[\"setStatus\"]){Module[\"setStatus\"](\"Running...\");setTimeout(function(){setTimeout(function(){Mo
dule[\"setStatus\"](\"\")},1);doRun()},1)}else{doRun()}}Module[\"run\"]=run;function
exit(status,implicit){if(implicit&&noExitRuntime&&status===0){return}if(!implicit){if(ENVIRONMENT_IS_PT
HREAD){postMessage({\"cmd\":\"exitProcess\",\"returnCode\":status});throw new
ExitStatus(status)}else{}}if(noExitRuntime){}else{PThread.terminateAllThreads();EXITSTATUS=status;exitRunti
me();if(Module[\"onExit\"])Module[\"onExit\"](status);ABORT=true}quit_(status,new
ExitStatus(status))}if(Module[\"preInit\"]){if(typeof
Module[\"preInit\"]==\"function\")Module[\"preInit\"]=[Module[\"preInit\"]];while(Module[\"preInit\"].length>0){
Module[\"preInit\"].pop()()}}if(ENVIRONMENT_IS_PTHREAD){noExitRuntime=false;PThread.initWorker()}run
();\n\n\n return WasmBackendModuleThreadedSimd.ready\n}\n);\n})();\nif
 (typeof exports === 'object' && typeof module === 'object')\n module.exports =
WasmBackendModuleThreadedSimd;\nelse if (typeof define === 'function' && define['amd'])\n define([],
function() { return WasmBackendModuleThreadedSimd; });\nelse if (typeof exports === 'object')\n
exports[\"WasmBackendModuleThreadedSimd\"] = WasmBackendModuleThreadedSimd;\n","export const
wasmWorkerContents = 'var Module={};function threadPrintErr(){var
text=Array.prototype.slice.call(arguments).join(\" \");console.error(text)}function threadAlert(){var
text=Array.prototype.slice.call(arguments).join(\"
\");postMessage({cmd:\"alert\",text:text,threadId:Module[\"_pthread_self\"]()})}var
err=threadPrintErr;this.alert=threadAlert;Module[\"instantiateWasm\"]=function(info,receiveInstance){var
instance=new
WebAssembly.Instance(Module[\"wasmModule\"],info);Module[\"wasmModule\"]=null;receiveInstance(instance);r
eturn instance.exports};function
moduleLoaded(){}this.onmessage=function(e){try{if(e.data.cmd===\"load\"){Module[\"wasmModule\"]=e.data.wa
smModule;Module[\"wasmMemory\"]=e.data.wasmMemory;Module[\"buffer\"]=Module[\"wasmMemory\"].buffer;
Module[\"ENVIRONMENT_IS_PTHREAD\"]=true;if(typeof
 e.data.urlOrBlob===\"string\"){importScripts(e.data.urlOrBlob)}else{var
objectUrl=URL.createObjectURL(e.data.urlOrBlob);importScripts(objectUrl);URL.revokeObjectURL(objectUrl)}
WasmBackendModuleThreadedSimd(Module).then(function(instance){Module=instance;moduleLoaded()})}else
if(e.data.cmd===\"objectTransfer\"){Module[\"PThread\"].receiveObjectTransfer(e.data)}else
if(e.data.cmd===\"run\"){Module[\"__performance_now_clock_drift\"]=performance.now()-
e.data.time;Module[\"__emscripten_thread_init\"](e.data.threadInfoStruct,0,0);var max=e.data.stackBase;var
top=e.data.stackBase+e.data.stackSize;Module[\"establishStackSpace\"](top,max);Module[\"_emscripten_tls_init\"](
);Module[\"PThread\"].receiveObjectTransfer(e.data);Module[\"PThread\"].setThreadStatus(Module[\"_pthread_self
\"](),1);try{var
result=Module[\"invokeEntryPoint\"](e.data.start_routine,e.data.arg);if(!Module[\"getNoExitRuntime\"]())Module[\
\"PThread\"].threadExit(result)}catch(ex){if(ex===\"Canceled!\"){Module[\"PThread\"].threadCancel()}else
if(ex!=\"unwind\"){if(ex instanceof
Module[\"ExitStatus\"]){if(Module[\"getNoExitRuntime\"]()){}else{Module[\"PThread\"].threadExit(ex.status)}}el
se{Module[\"PThread\"].threadExit(-2);throw ex}}}}else
if(e.data.cmd===\"cancel\"){if(Module[\"_pthread_self\"]()){Module[\"PThread\"].threadCancel()}}else
if(e.data.target===\"setimmediate\"){}else
if(e.data.cmd===\"processThreadQueue\"){if(Module[\"_pthread_self\"]()){Module[\"_emscripten_current_thread_
process_queued_calls\"]()}}else{err(\"worker.js received unknown command
\"+e.data.cmd);err(e.data)}}catch(ex){err(\"worker.js onmessage() captured an uncaught exception:

\"+ex);if(ex&&ex.stack)err(ex.stack);throw ex}};if(typeof process===\"object\"&&typeof process.versions===\"object\"&&typeof process.versions.node===\"string\"){self={location:{href:__filename}};var onmessage=this.onmessage;var nodeWorkerThreads=require(\"worker_threads\");global.Worker=nodeWorkerThreads.Worker;var parentPort=nodeWorkerThreads.parentPort;parentPort.on(\"message\",function(data){onmessage({data:data})});var nodeFS=require(\"fs\");var nodeRead=function(filename){return nodeFS.readFileSync(filename,\"utf8\")};function globalEval(x){global.require=require;global.Module=Module;eval.call(null,x)}importScripts=function(f){globalEval(nodeRead(f))};postMessage=function(msg){parentPort.postMessage(msg)};if(typeof performance===\"undefined\"){performance={now:function(){return Date.now()}}}';","\nvar WasmBackendModule = (function() {\n var _scriptDir = typeof document !== 'undefined' && document.currentScript ? document.currentScript.src : undefined;\n if (typeof __filename !== 'undefined') _scriptDir = _scriptDir || __filename;\n return (\nfunction(WasmBackendModule) {\n WasmBackendModule = WasmBackendModule || {};\n\n\nvar Module=typeof WasmBackendModule!==\"undefined\"?WasmBackendModule:{};var readyPromiseResolve,readyPromiseReject;Module[\"ready\"]=new Promise(function(resolve,reject){readyPromiseResolve=resolve;readyPromiseReject=reject});var moduleOverrides={};var key;for(key in Module){if(Module.hasOwnProperty(key)){moduleOverrides[key]=Module[key]}}var arguments_=[];var thisProgram=\"./this.program\";var quit_=function(status,toThrow){throw toThrow};var ENVIRONMENT_IS_WEB=false;var ENVIRONMENT_IS_WORKER=false;var ENVIRONMENT_IS_NODE=false;var ENVIRONMENT_IS_SHELL=false;ENVIRONMENT_IS_WEB=typeof window===\"object\";ENVIRONMENT_IS_WORKER=typeof importScripts===\"function\";ENVIRONMENT_IS_NODE=typeof process===\"object\"&&typeof process.versions===\"object\"&&typeof process.versions.node===\"string\";ENVIRONMENT_IS_SHELL=!ENVIRONMENT_IS_WEB&&!ENVIRONMENT_IS_NODE&&!ENVIRONMENT_IS_WORKER;var scriptDirectory=\"\";function locateFile(path){if(Module[\"locateFile\"]){return Module[\"locateFile\"](path,scriptDirectory)}return scriptDirectory+path}var read_,readAsync,readBinary,setWindowTitle;var nodeFS;var nodePath;if(ENVIRONMENT_IS_NODE){if(ENVIRONMENT_IS_WORKER){scriptDirectory=require(\"path\").dirname(scriptDirectory)+\"/\"}else{scriptDirectory=__dirname+\"/\"}read_=function shell_read(filename,binary){if(!nodeFS)nodeFS=require(\"fs\");if(!nodePath)nodePath=require(\"path\");filename=nodePath[\"normalize\"](filename);return nodeFS[\"readFileSync\"](filename,binary?null:\"utf8\")};readBinary=function readBinary(filename){var ret=read_(filename,true);if(!ret.buffer){ret=new Uint8Array(ret)}assert(ret.buffer);return ret};if(process[\"argv\"].length>1){thisProgram=process[\"argv\"][1].replace(/\\\\/g,\"/\")}arguments_=process[\"argv\"].slice(2);process[\"on\"](\"uncaughtException\",function(ex){if(!(ex instanceof ExitStatus)){throw ex}});process[\"on\"](\"unhandledRejection\",abort);quit_=function(status){process[\"exit\"](status)};Module[\"inspect\"]=function(){return\"[Emscripten Module object]\"}}else if(ENVIRONMENT_IS_SHELL){if(typeof read!=\"undefined\"){read_=function shell_read(f){return read(f)}}readBinary=function readBinary(f){var data;if(typeof readbuffer===\"function\"){return new Uint8Array(readbuffer(f))}data=read(f,\"binary\");assert(typeof data===\"object\");return data};if(typeof scriptArgs!=\"undefined\"){arguments_=scriptArgs}else if(typeof arguments!=\"undefined\"){arguments_=arguments}if(typeof quit===\"function\"){quit_=function(status){quit(status)}}if(typeof print!==\"undefined\"){if(typeof console===\"undefined\")console={};console.log=print;console.warn=console.error=typeof printErr!==\"undefined\"?printErr:print}}else if(ENVIRONMENT_IS_WEB||ENVIRONMENT_IS_WORKER){if(ENVIRONMENT_IS_WORKER){scriptDirectory=self.location.href}else if(typeof

document!==\"undefined\"&&document.currentScript){scriptDirectory=document.currentScript.src}if(_scriptDir){s
criptDirectory=_scriptDir}if(scriptDirectory.indexOf(\"blob:\")!==0){scriptDirectory=scriptDirectory.substr(0,script
Directory.lastIndexOf(\"/\")+1)}else{scriptDirectory=\"\"}{read_=function(url){var
xhr=new XMLHttpRequest;xhr.open(\"GET\",url,false);xhr.send(null);return
xhr.responseText};if(ENVIRONMENT_IS_WORKER){readBinary=function(url){var xhr=new
XMLHttpRequest;xhr.open(\"GET\",url,false);xhr.responseType=\"arraybuffer\";xhr.send(null);return new
Uint8Array(xhr.response)}}readAsync=function(url,onload,onerror){var xhr=new
XMLHttpRequest;xhr.open(\"GET\",url,true);xhr.responseType=\"arraybuffer\";xhr.onload=function(){if(xhr.status
==200||xhr.status==0&&xhr.response){onload(xhr.response);return}onerror()};xhr.onerror=onerror;xhr.send(null)}
}setWindowTitle=function(title){document.title=title}}else{}var
out=Module[\"print\"]||console.log.bind(console);var err=Module[\"printErr\"]||console.warn.bind(console);for(key
in
moduleOverrides){if(moduleOverrides.hasOwnProperty(key)){Module[key]=moduleOverrides[key]}}moduleOverr
ides=null;if(Module[\"arguments\"])arguments_=Module[\"arguments\"];if(Module[\"thisProgram\"])thisProgram=
Module[\"thisProgram\"];if(Module[\"quit\"])quit_=Module[\"quit\"];var
wasmBinary;if(Module[\"wasmBinary\"])wasmBinary=Module[\"wasmBinary\"];var
noExitRuntime=Module[\"noExitRuntime\"]||true;if(typeof WebAssembly!==\"object\"){abort(\"no native wasm
support detected\")}var wasmMemory;var ABORT=false;var EXITSTATUS;function
assert(condition,text){if(!condition){abort(\"Assertion failed: \"+text)}}function getCFunc(ident){var
func=Module[\"_\"+ident];assert(func,\"Cannot call unknown function \"+ident+\", make sure it is exported\");return
func}function ccall(ident,returnType,argTypes,args,opts){var toC={\"string\":function(str){var
ret=0;if(str!==null&&str!==undefined&&str!==0){var
len=(str.length<<2)+1;ret=stackAlloc(len);stringToUTF8(str,ret,len)}return ret},\"array\":function(arr){var
ret=stackAlloc(arr.length);writeArrayToMemory(arr,ret);return ret}};function
convertReturnValue(ret){if(returnType===\"string\")return UTF8ToString(ret);if(returnType===\"boolean\")return
Boolean(ret);return ret}var func=getCFunc(ident);var cArgs=[];var stack=0;if(args){for(var
i=0;i<args.length;i++){var
converter=toC[argTypes[i]];if(converter){if(stack===0)stack=stackSave();cArgs[i]=converter(args[i])}else{cArgs[i
]=args[i]}}}var ret=func.apply(null,cArgs);ret=convertReturnValue(ret);if(stack!==0)stackRestore(stack);return
ret}function cwrap(ident,returnType,argTypes,opts){argTypes=argTypes||[];var
numericArgs=argTypes.every(function(type){return type===\"number\"});var
numericRet=returnType!==\"string\";if(numericRet&&numericArgs&&!opts){return getCFunc(ident)}return
function(){return ccall(ident,returnType,argTypes,arguments,opts)}}var UTF8Decoder=typeof
TextDecoder!==\"undefined\"?new TextDecoder(\"utf8\"):undefined;function
UTF8ArrayToString(heap,idx,maxBytesToRead){var endIdx=idx+maxBytesToRead;var
endPtr=idx;while(heap[endPtr]&&!(endPtr>=endIdx))++endPtr;if(endPtr-
idx>16&&heap.subarray&&UTF8Decoder){return UTF8Decoder.decode(heap.subarray(idx,endPtr))}else{var
str=\"\";while(idx<endPtr){var u0=heap[idx++];if(!(u0&128)){str+=String.fromCharCode(u0);continue}var
u1=heap[idx++]&63;if((u0&224)==192){str+=String.fromCharCode((u0&31)<<6|u1);continue}var
u2=heap[idx++]&63;if((u0&240)==224){u0=(u0&15)<<12|u1<<6|u2}else{u0=(u0&7)<<18|u1<<12|u2<<6|heap[id
x++]&63}if(u0<65536){str+=String.fromCharCode(u0)}else{var ch=u0-
65536;str+=String.fromCharCode(55296|ch>>10,56320|ch&1023)}}}return str}function
UTF8ToString(ptr,maxBytesToRead){return
ptr?UTF8ArrayToString(HEAPU8,ptr,maxBytesToRead):\"\"}function
stringToUTF8Array(str,heap,outIdx,maxBytesToWrite){if(!(maxBytesToWrite>0))return 0;var startIdx=outIdx;var
endIdx=outIdx+maxBytesToWrite-1;for(var i=0;i<str.length;++i){var
u=str.charCodeAt(i);if(u>=55296&&u<=57343){var
u1=str.charCodeAt(++i);u=65536+((u&1023)<<10)|u1&1023}if(u<=127){if(outIdx>=endIdx)break;heap[outIdx++]

=u}else if(u<=2047){if(outIdx+1>=endIdx)break;heap[outIdx++]=192|u>>6;heap[outIdx++]=128|u&63}else if(u<=65535){if(outIdx+2>=endIdx)break;heap[outIdx++]=224|u>>12;heap[outIdx++]=128|u>>6&63;heap[outIdx++]=128|u&63}else{if(outIdx+3>=endIdx)break;heap[outIdx++]=240|u>>18;heap[outIdx++]=128|u>>12&63;heap[outIdx++]=128|u>>6&63;heap[outIdx++]=128|u&63}}heap[outIdx]=0;return outIdx-startIdx}function stringToUTF8(str,outPtr,maxBytesToWrite){return stringToUTF8Array(str,HEAPU8,outPtr,maxBytesToWrite)}function writeArrayToMemory(array,buffer){HEAP8.set(array,buffer)}function alignUp(x,multiple){if(x%multiple>0){x+=multiple-x%multiple}return x}var buffer,HEAP8,HEAPU8,HEAP16,HEAPU16,HEAP32,HEAPU32,HEAPF32,HEAPF64;function updateGlobalBufferAndViews(buf){buffer=buf;Module[\"HEAP8\"]=HEAP8=new Int8Array(buf);Module[\"HEAP16\"]=HEAP16=new Int16Array(buf);Module[\"HEAP32\"]=HEAP32=new Int32Array(buf);Module[\"HEAPU8\"]=HEAPU8=new Uint8Array(buf);Module[\"HEAPU16\"]=HEAPU16=new Uint16Array(buf);Module[\"HEAPU32\"]=HEAPU32=new Uint32Array(buf);Module[\"HEAPF32\"]=HEAPF32=new Float32Array(buf);Module[\"HEAPF64\"]=HEAPF64=new Float64Array(buf)}var INITIAL_MEMORY=Module[\"INITIAL_MEMORY\"]||16777216;var wasmTable;var __ATPRERUN__=[];var __ATINIT__=[];var __ATMAIN__=[];var __ATPOSTRUN__=[];var runtimeInitialized=false;__ATINIT__.push({func:function(){___wasm_call_ctors()}});function preRun(){if(Module[\"preRun\"]){if(typeof Module[\"preRun\"]==\"function\")Module[\"preRun\"]=[Module[\"preRun\"]];while(Module[\"preRun\"].length){addOnPreRun(Module[\"preRun\"].shift())}}callRuntimeCallbacks(__ATPRERUN__)}function initRuntime(){runtimeInitialized=true;callRuntimeCallbacks(__ATINIT__)}function preMain(){callRuntimeCallbacks(__ATMAIN__)}function postRun(){if(Module[\"postRun\"]){if(typeof Module[\"postRun\"]==\"function\")Module[\"postRun\"]=[Module[\"postRun\"]];while(Module[\"postRun\"].length){addOnPostRun(Module[\"postRun\"].shift())}}callRuntimeCallbacks(__ATPOSTRUN__)}function addOnPreRun(cb){__ATPRERUN__.unshift(cb)}function addOnPostRun(cb){__ATPOSTRUN__.unshift(cb)}var runDependencies=0;var runDependencyWatcher=null;var dependenciesFulfilled=null;function addRunDependency(id){runDependencies++;if(Module[\"monitorRunDependencies\"]){Module[\"monitorRunDependencies\"](runDependencies)}}function removeRunDependency(id){runDependencies--;if(Module[\"monitorRunDependencies\"]){Module[\"monitorRunDependencies\"](runDependencies)}if(runDependencies==0){if(runDependencyWatcher!==null){clearInterval(runDependencyWatcher);runDependencyWatcher=null}if(dependenciesFulfilled){var callback=dependenciesFulfilled;dependenciesFulfilled=null;callback()}}}Module[\"preloadedImages\"]={};Module[\"preloadedAudios\"]={};function abort(what){if(Module[\"onAbort\"]){Module[\"onAbort\"](what)}what+=\"\";err(what);ABORT=true;EXITSTATUS=1;what=\"abort(\"+what+\"). Build with -s ASSERTIONS=1 for more info.\";var e=new WebAssembly.RuntimeError(what);readyPromiseReject(e);throw e}function hasPrefix(str,prefix){return String.prototype.startsWith?str.startsWith(prefix):str.indexOf(prefix)===0}var dataURIPrefix=\"data:application/octet-stream; base64,\";function isDataURI(filename){return hasPrefix(filename,dataURIPrefix)}var fileURIPrefix=\"file://\";function isFileURI(filename){return hasPrefix(filename,fileURIPrefix)}var wasmBinaryFile=\"tfjs-backend-wasm.wasm\";if(!isDataURI(wasmBinaryFile)){wasmBinaryFile=locateFile(wasmBinaryFile)}function getBinary(file){try{if(file==wasmBinaryFile&&wasmBinary){return new Uint8Array(wasmBinary)}if(readBinary){return readBinary(file)}else{throw\"both async and sync fetching of the wasm failed\"}}catch(err){abort(err)}}function getBinaryPromise(){if(!wasmBinary&&(ENVIRONMENT_IS_WEB||ENVIRONMENT_IS_WORKER)){if(typeof fetch===\"function\"&&!isFileURI(wasmBinaryFile)){return fetch(wasmBinaryFile,{credentials:\"same-

origin\"}).then(function(response){if(!response[\"ok\"]){throw\"failed to load wasm binary file at \"+wasmBinaryFile+\"\"\"}return response[\"arrayBuffer\"]()}).catch(function(){return getBinary(wasmBinaryFile)})}else{if(readAsync){return new Promise(function(resolve,reject){readAsync(wasmBinaryFile,function(response){resolve(new Uint8Array(response))},reject)})}}}return Promise.resolve().then(function(){return getBinary(wasmBinaryFile)})}function createWasm(){var info={\"a\":asmLibraryArg};function receiveInstance(instance,module){var exports=instance.exports;Module[\"asm\"]=exports;wasmMemory=Module[\"asm\"][\"j\"];updateGlobalBufferAndViews(wasmMemory.buffer);wasmTable=Module[\"asm\"][\"r\"];removeRunDependency(\"wasm-instantiate\")}addRunDependency(\"wasm-instantiate\");function receiveInstantiatedSource(output){receiveInstance(output[\"instance\"])}function instantiateArrayBuffer(receiver){return getBinaryPromise().then(function(binary){return WebAssembly.instantiate(binary,info)}).then(receiver,function(reason){err(\"failed to asynchronously prepare wasm: \"+reason);abort(reason)})}function instantiateAsync(){if(!wasmBinary&&typeof WebAssembly.instantiateStreaming===\"function\"&&!isDataURI(wasmBinaryFile)&&!isFileURI(wasmBinaryFile)&&typeof fetch===\"function\"){return fetch(wasmBinaryFile,{credentials:\"same-origin\"}).then(function(response){var result=WebAssembly.instantiateStreaming(response,info);return result.then(receiveInstantiatedSource,function(reason){err(\"wasm streaming compile failed: \"+reason);err(\"falling back to ArrayBuffer instantiation\");return instantiateArrayBuffer(receiveInstantiatedSource)})})}else{return instantiateArrayBuffer(receiveInstantiatedSource)}}if(Module[\"instantiateWasm\"]){try{var exports=Module[\"instantiateWasm\"](info,receiveInstance);return exports}catch(e){err(\"Module.instantiateWasm callback failed with error: \"+e);return false}}instantiateAsync().catch(readyPromiseReject);return{}}function callRuntimeCallbacks(callbacks){while(callbacks.length>0){var callback=callbacks.shift();if(typeof callback==\"function\"){callback(Module);continue}var func=callback.func;if(typeof func===\"number\"){if(callback.arg===undefined){wasmTable.get(func)()}else{wasmTable.get(func)(callback.arg)}}else{func(callback.arg===undefined?null:callback.arg)}}}function _abort(){abort()}function _emscripten_memcpy_big(dest,src,num){HEAPU8.copyWithin(dest,src,src+num)}function _emscripten_get_heap_size(){return HEAPU8.length}function emscripten_realloc_buffer(size){try{wasmMemory.grow(size-buffer.byteLength+65535>>>16);updateGlobalBufferAndViews(wasmMemory.buffer);return 1}catch(e){}}function _emscripten_resize_heap(requestedSize){var oldSize=_emscripten_get_heap_size();var maxHeapSize=2147483648;if(requestedSize>maxHeapSize){return false}for(var cutDown=1;cutDown<=4;cutDown*=2){var overGrownHeapSize=oldSize*(1+.2/cutDown);overGrownHeapSize=Math.min(overGrownHeapSize,requestedSize+100663296);var newSize=Math.min(maxHeapSize,alignUp(Math.max(requestedSize,overGrownHeapSize),65536));var replacement=emscripten_realloc_buffer(newSize);if(replacement){return true}}return false}var SYSCALLS={mappings:{},buffers:[null,[],[]],printChar:function(stream,curr){var buffer=SYSCALLS.buffers[stream];if(curr===0||curr===10){(stream===1?out:err)(UTF8ArrayToString(buffer,0));buffer.length=0}else{buffer.push(curr)}},varargs:undefined,get:function(){SYSCALLS.varargs+=4;var ret=HEAP32[SYSCALLS.varargs-4>>2];return ret},getStr:function(ptr){var ret=UTF8ToString(ptr);return ret},get64:function(low,high){return low}};function _fd_close(fd){return 0}function _fd_seek(fd,offset_low,offset_high,whence,newOffset){}function _fd_write(fd,iov,iovcnt,pnum){var num=0;for(var i=0;i<iovcnt;i++){var ptr=HEAP32[iov+i*8>>2];var len=HEAP32[iov+(i*8+4)>>2];for(var j=0;j<len;j++){SYSCALLS.printChar(fd,HEAPU8[ptr+j])}num+=len}HEAP32[pnum>>2]=num;return 0}function _pthread_create(){return 6}function _pthread_join(){return 28}function

setErrNo(value){HEAP32[___errno_location()>>2]=value;return value}function
_sysconf(name){switch(name){case 30:return 16384;case 85:var maxHeapSize=2147483648;return
maxHeapSize/16384;case 132:case 133:case 12:case 137:case 138:case 15:case 235:case 16:case
17:case 18:case 19:case 20:case 149:case 13:case 10:case 236:case 153:case 9:case 21:case 22:case 159:case
154:case 14:case 77:case 78:case 139:case 82:case 68:case 67:case 164:case 11:case 29:case 47:case 48:case 95:case
52:case 51:case 46:return 200809;case 27:case 246:case 127:case 128:case 23:case 24:case 160:case 161:case
181:case 182:case 242:case 183:case 184:case 243:case 244:case 245:case 165:case 178:case 179:case 49:case
50:case 168:case 169:case 175:case 170:case 171:case 172:case 97:case 76:case 32:case 173:case 35:case 80:case
81:case 79:return-1;case 176:case 177:case 7:case 155:case 8:case 157:case 125:case 126:case 92:case 93:case
129:case 130:case 131:case 94:case 91:return 1;case 74:case 60:case 69:case 70:case 4:return 1024;case 31:case
42:case 72:return 32;case 87:case 26:case 33:return 2147483647;case 34:case 1:return 47839;case 38:case 36:return
99;case 43:case 37:return 2048;case 0:return 2097152;case 3:return 65536;case 28:return 32768;case 44:return
32767;case
75:return 16384;case 39:return 1e3;case 89:return 700;case 71:return 256;case 40:return 255;case 2:return 100;case
180:return 64;case 25:return 20;case 5:return 16;case 6:return 6;case 73:return 4;case 84:{if(typeof
navigator===\"object\")return navigator[\"hardwareConcurrency\"]||1;return 1}}setErrNo(28);return-1}var
asmLibraryArg={\"a\":_abort,\"d\":_emscripten_memcpy_big,\"e\":_emscripten_resize_heap,\"f\":_fd_close,\"c\":_f
d_seek,\"b\":_fd_write,\"h\":_pthread_create,\"g\":_pthread_join,\"i\":_sysconf};var asm=createWasm();var
___wasm_call_ctors=Module[\"___wasm_call_ctors\"]=function(){return(___wasm_call_ctors=Module[\"___wasm
_call_ctors\"]=Module[\"asm\"][\"k\"]).apply(null,arguments)};var
_init=Module[\"_init\"]=function(){return(_init=Module[\"_init\"]=Module[\"asm\"][\"l\"]).apply(null,arguments)};
var
_init_with_threads_count=Module[\"_init_with_threads_count\"]=function(){return(_init_with_threads_count=Mod
ule[\"_init_with_threads_count\"]=Module[\"asm\"][\"m\"]).apply(null,arguments)};var
_get_threads_count=Module[\"_get_threads_count\"]=function(){return(_get_threads_count=Module[\"_get_threads
_count\"]=Module[\"asm\"][\"n\"]).apply(null,arguments)};var
_register_tensor=Module[\"_register_tensor\"]=function(){return(_register_tensor=Module[\"_register_tensor\"]=M
odule[\"asm\"][\"o\"]).apply(null,arguments)};var
_dispose_data=Module[\"_dispose_data\"]=function(){return(_dispose_data=Module[\"_dispose_data\"]=Module[\"
asm\"][\"p\"]).apply(null,arguments)};var
_dispose=Module[\"_dispose\"]=function(){return(_dispose=Module[\"_dispose\"]=Module[\"asm\"][\"q\"]).apply(n
ull,arguments)};var
_Abs=Module[\"_Abs\"]=function(){return(_Abs=Module[\"_Abs\"]=Module[\"asm\"][\"s\"]).apply(null,arguments
)};var
_Add=Module[\"_Add\"]=function(){return(_Add=Module[\"_Add\"]=Module[\"asm\"][\"t\"]).apply(null,argument
s)};var
_AddN=Module[\"_AddN\"]=function(){return(_AddN=Module[\"_AddN\"]=Module[\"asm\"][\"u\"]).apply(null,ar
guments)};var
_All=Module[\"_All\"]=function(){return(_All=Module[\"_All\"]=Module[\"asm\"][\"v\"]).apply(null,arguments)};
var
_Any=Module[\"_Any\"]=function(){return(_Any=Module[\"_Any\"]=Module[\"asm\"][\"w\"]).apply(null,argumen
ts)};var
_ArgMax=Module[\"_ArgMax\"]=function(){return(_ArgMax=Module[\"_ArgMax\"]=Module[\"asm\"][\"x\"]).app
ly(null,arguments)};var
_AvgPool=Module[\"_AvgPool\"]=function(){return(_AvgPool=Module[\"_AvgPool\"]=Module[\"asm\"][\"y\"]).a
pply(null,arguments)};var
_BatchMatMul=Module[\"_BatchMatMul\"]=function(){return(_BatchMatMul=Module[\"_BatchMatMul\"]=Modu
le[\"asm\"][\"z\"]).apply(null,arguments)};var

_Ceil=Module[\"_Ceil\"]=function(){return(_Ceil=Module[\"_Ceil\"]=Module[\"asm\"][\"A\"]).apply(null,arguments)};var
_ClipByValue=Module[\"_ClipByValue\"]=function(){return(_ClipByValue=Module[\"_ClipByValue\"]=Module[\"asm\"][\"B\"]).apply(null,arguments)};var
_Conv2D=Module[\"_Conv2D\"]=function(){return(_Conv2D=Module[\"_Conv2D\"]=Module[\"asm\"][\"C\"]).apply(null,arguments)};var
_Conv2DBackpropInput=Module[\"_Conv2DBackpropInput\"]=function(){return(_Conv2DBackpropInput=Module[\"_Conv2DBackpropInput\"]=Module[\"asm\"][\"D\"]).apply(null,arguments)};var
_Cos=Module[\"_Cos\"]=function(){return(_Cos=Module[\"_Cos\"]=Module[\"asm\"][\"E\"]).apply(null,arguments)};var
_Cosh=Module[\"_Cosh\"]=function(){return(_Cosh=Module[\"_Cosh\"]=Module[\"asm\"][\"F\"]).apply(null,arguments)};var
_CropAndResize=Module[\"_CropAndResize\"]=function(){return(_CropAndResize=Module[\"_CropAndResize\"]=Module[\"asm\"][\"G\"]).apply(null,arguments)};var
_Cumsum=Module[\"_Cumsum\"]=function(){return(_Cumsum=Module[\"_Cumsum\"]=Module[\"asm\"][\"H\"]).apply(null,arguments)};var
_DepthToSpace=Module[\"_DepthToSpace\"]=function(){return(_DepthToSpace=Module[\"_DepthToSpace\"]=Module[\"asm\"][\"I\"]).apply(null,arguments)};var
_DepthwiseConv2dNative=Module[\"_DepthwiseConv2dNative\"]=function(){return(_DepthwiseConv2dNative=Module[\"_DepthwiseConv2dNative\"]=Module[\"asm\"][\"J\"]).apply(null,arguments)};var
_Elu=Module[\"_Elu\"]=function(){return(_Elu=Module[\"_Elu\"]=Module[\"asm\"][\"K\"]).apply(null,arguments)};var
_Equal=Module[\"_Equal\"]=function(){return(_Equal=Module[\"_Equal\"]=Module[\"asm\"][\"L\"]).apply(null,arguments)};var
_Exp=Module[\"_Exp\"]=function(){return(_Exp=Module[\"_Exp\"]=Module[\"asm\"][\"M\"]).apply(null,arguments)};var
_FlipLeftRight=Module[\"_FlipLeftRight\"]=function(){return(_FlipLeftRight=Module[\"_FlipLeftRight\"]=Module[\"asm\"][\"N\"]).apply(null,arguments)};var
_Floor=Module[\"_Floor\"]=function(){return(_Floor=Module[\"_Floor\"]=Module[\"asm\"][\"O\"]).apply(null,arguments)};var
_FloorDiv=Module[\"_FloorDiv\"]=function(){return(_FloorDiv=Module[\"_FloorDiv\"]=Module[\"asm\"][\"P\"]).apply(null,arguments)};var
_FusedBatchNorm=Module[\"_FusedBatchNorm\"]=function(){return(_FusedBatchNorm=Module[\"_FusedBatchNorm\"]=Module[\"asm\"][\"Q\"]).apply(null,arguments)};var
_FusedConv2D=Module[\"_FusedConv2D\"]=function(){return(_FusedConv2D=Module[\"_FusedConv2D\"]=Module[\"asm\"][\"R\"]).apply(null,arguments)};var
_FusedDepthwiseConv2D=Module[\"_FusedDepthwiseConv2D\"]=function(){return(_FusedDepthwiseConv2D=Module[\"_FusedDepthwiseConv2D\"]=Module[\"asm\"][\"S\"]).apply(null,arguments)};var
_Gather=Module[\"_Gather\"]=function(){return(_Gather=Module[\"_Gather\"]=Module[\"asm\"][\"T\"]).apply(null,arguments)};var
_GatherNd=Module[\"_GatherNd\"]=function(){return(_GatherNd=Module[\"_GatherNd\"]=Module[\"asm\"][\"U\"]).apply(null,arguments)};var
_Greater=Module[\"_Greater\"]=function(){return(_Greater=Module[\"_Greater\"]=Module[\"asm\"][\"V\"]).apply(null,arguments)};var
_GreaterEqual=Module[\"_GreaterEqual\"]=function(){return(_GreaterEqual=Module[\"_GreaterEqual\"]=Module[\"asm\"][\"W\"]).apply(null,arguments)};var
_LeakyRelu=Module[\"_LeakyRelu\"]=function(){return(_LeakyRelu=Module[\"_LeakyRelu\"]=Module[\"asm\"][\"X\"]).apply(null,arguments)};var

_Less=Module[\"_Less\"]=function(){return(_Less=Module[\"_Less\"]=Module[\"asm\"][\"Y\"]).apply(null,arguments)};var
_LessEqual=Module[\"_LessEqual\"]=function(){return(_LessEqual=Module[\"_LessEqual\"]=Module[\"asm\"][\"Z\"]).apply(null,arguments)};var
_Log=Module[\"_Log\"]=function(){return(_Log=Module[\"_Log\"]=Module[\"asm\"][\"_\"]).apply(null,arguments)};var
_LogicalAnd=Module[\"_LogicalAnd\"]=function(){return(_LogicalAnd=Module[\"_LogicalAnd\"]=Module[\"asm\"][\"$\"]).apply(null,arguments)};var
_Max=Module[\"_Max\"]=function(){return(_Max=Module[\"_Max\"]=Module[\"asm\"][\"aa\"]).apply(null,arguments)};var
_MaxPool=Module[\"_MaxPool\"]=function(){return(_MaxPool=Module[\"_MaxPool\"]=Module[\"asm\"][\"ba\"]).apply(null,arguments)};var
_Maximum=Module[\"_Maximum\"]=function(){return(_Maximum=Module[\"_Maximum\"]=Module[\"asm\"][\"ca\"]).apply(null,arguments)};var
_Mean=Module[\"_Mean\"]=function(){return(_Mean=Module[\"_Mean\"]=Module[\"asm\"][\"da\"]).apply(null,arguments)};var
_Min=Module[\"_Min\"]=function(){return(_Min=Module[\"_Min\"]=Module[\"asm\"][\"ea\"]).apply(null,arguments)};var
_Minimum=Module[\"_Minimum\"]=function(){return(_Minimum=Module[\"_Minimum\"]=Module[\"asm\"][\"fa\"]).apply(null,arguments)};var
_MirrorPad=Module[\"_MirrorPad\"]=function(){return(_MirrorPad=Module[\"_MirrorPad\"]=Module[\"asm\"][\"ga\"]).apply(null,arguments)};var
_Multiply=Module[\"_Multiply\"]=function(){return(_Multiply=Module[\"_Multiply\"]=Module[\"asm\"][\"ha\"]).apply(null,arguments)};var
_Neg=Module[\"_Neg\"]=function(){return(_Neg=Module[\"_Neg\"]=Module[\"asm\"][\"ia\"]).apply(null,arguments)};var
_NonMaxSuppressionV3=Module[\"_NonMaxSuppressionV3\"]=function(){return(_NonMaxSuppressionV3=Module[\"_NonMaxSuppressionV3\"]=Module[\"asm\"][\"ja\"]).apply(null,arguments)};var
_NonMaxSuppressionV4=Module[\"_NonMaxSuppressionV4\"]=function(){return(_NonMaxSuppressionV4=Module[\"_NonMaxSuppressionV4\"]=Module[\"asm\"][\"ka\"]).apply(null,arguments)};var
_NonMaxSuppressionV5=Module[\"_NonMaxSuppressionV5\"]=function(){return(_NonMaxSuppressionV5=Module[\"_NonMaxSuppressionV5\"]=Module[\"asm\"][\"la\"]).apply(null,arguments)};var
_NotEqual=Module[\"_NotEqual\"]=function(){return(_NotEqual=Module[\"_NotEqual\"]=Module[\"asm\"][\"ma\"]).apply(null,arguments)};var
_OneHot=Module[\"_OneHot\"]=function(){return(_OneHot=Module[\"_OneHot\"]=Module[\"asm\"][\"na\"]).apply(null,arguments)};var
_PadV2=Module[\"_PadV2\"]=function(){return(_PadV2=Module[\"_PadV2\"]=Module[\"asm\"][\"oa\"]).apply(null,arguments)};var
_Pow=Module[\"_Pow\"]=function(){return(_Pow=Module[\"_Pow\"]=Module[\"asm\"][\"pa\"]).apply(null,arguments)};var
_Prelu=Module[\"_Prelu\"]=function(){return(_Prelu=Module[\"_Prelu\"]=Module[\"asm\"][\"qa\"]).apply(null,arguments)};var
_Prod=Module[\"_Prod\"]=function(){return(_Prod=Module[\"_Prod\"]=Module[\"asm\"][\"ra\"]).apply(null,arguments)};var
_RealDiv=Module[\"_RealDiv\"]=function(){return(_RealDiv=Module[\"_RealDiv\"]=Module[\"asm\"][\"sa\"]).apply(null,arguments)};var
_Relu=Module[\"_Relu\"]=function(){return(_Relu=Module[\"_Relu\"]=Module[\"asm\"][\"ta\"]).apply(null,arguments)};var

_Relu6=Module[\"_Relu6\"]=function(){return(_Relu6=Module[\"_Relu6\"]=Module[\"asm\"][\"ua\"]).apply(null,arguments)};var
_ResizeBilinear=Module[\"_ResizeBilinear\"]=function(){return(_ResizeBilinear=Module[\"_ResizeBilinear\"]=Module[\"asm\"][\"va\"]).apply(null,arguments)};var
_Reverse=Module[\"_Reverse\"]=function(){return(_Reverse=Module[\"_Reverse\"]=Module[\"asm\"][\"wa\"]).apply(null,arguments)};var
_RotateWithOffset=Module[\"_RotateWithOffset\"]=function(){return(_RotateWithOffset=Module[\"_RotateWithOffset\"]=Module[\"asm\"][\"xa\"]).apply(null,arguments)};var
_Round=Module[\"_Round\"]=function(){return(_Round=Module[\"_Round\"]=Module[\"asm\"][\"ya\"]).apply(null,arguments)};var
_Rsqrt=Module[\"_Rsqrt\"]=function(){return(_Rsqrt=Module[\"_Rsqrt\"]=Module[\"asm\"][\"za\"]).apply(null,arguments)};var
_ScatterNd=Module[\"_ScatterNd\"]=function(){return(_ScatterNd=Module[\"_ScatterNd\"]=Module[\"asm\"][\"Aa\"]).apply(null,arguments)};var
_SelectV2=Module[\"_SelectV2\"]=function(){return(_SelectV2=Module[\"_SelectV2\"]=Module[\"asm\"][\"Ba\"]).apply(null,arguments)};var
_Sigmoid=Module[\"_Sigmoid\"]=function(){return(_Sigmoid=Module[\"_Sigmoid\"]=Module[\"asm\"][\"Ca\"]).apply(null,arguments)};var
_Sin=Module[\"_Sin\"]=function(){return(_Sin=Module[\"_Sin\"]=Module[\"asm\"][\"Da\"]).apply(null,arguments)};var
_Softmax=Module[\"_Softmax\"]=function(){return(_Softmax=Module[\"_Softmax\"]=Module[\"asm\"][\"Ea\"]).apply(null,arguments)};var
_Sqrt=Module[\"_Sqrt\"]=function(){return(_Sqrt=Module[\"_Sqrt\"]=Module[\"asm\"][\"Fa\"]).apply(null,arguments)};var
_Square=Module[\"_Square\"]=function(){return(_Square=Module[\"_Square\"]=Module[\"asm\"][\"Ga\"]).apply(null,arguments)};var
_SquaredDifference=Module[\"_SquaredDifference\"]=function(){return(_SquaredDifference=Module[\"_SquaredDifference\"]=Module[\"asm\"][\"Ha\"]).apply(null,arguments)};var
_Step=Module[\"_Step\"]=function(){return(_Step=Module[\"_Step\"]=Module[\"asm\"][\"Ia\"]).apply(null,arguments)};var
_StridedSlice=Module[\"_StridedSlice\"]=function(){return(_StridedSlice=Module[\"_StridedSlice\"]=Module[\"asm\"][\"Ja\"]).apply(null,arguments)};var
_Sub=Module[\"_Sub\"]=function(){return(_Sub=Module[\"_Sub\"]=Module[\"asm\"][\"Ka\"]).apply(null,arguments)};var
_Sum=Module[\"_Sum\"]=function(){return(_Sum=Module[\"_Sum\"]=Module[\"asm\"][\"La\"]).apply(null,arguments)};var
_Tan=Module[\"_Tan\"]=function(){return(_Tan=Module[\"_Tan\"]=Module[\"asm\"][\"Ma\"]).apply(null,arguments)};var
_Tanh=Module[\"_Tanh\"]=function(){return(_Tanh=Module[\"_Tanh\"]=Module[\"asm\"][\"Na\"]).apply(null,arguments)};var
_Tile=Module[\"_Tile\"]=function(){return(_Tile=Module[\"_Tile\"]=Module[\"asm\"][\"Oa\"]).apply(null,arguments)};var
_TopK=Module[\"_TopK\"]=function(){return(_TopK=Module[\"_TopK\"]=Module[\"asm\"][\"Pa\"]).apply(null,arguments)};var
_Transform=Module[\"_Transform\"]=function(){return(_Transform=Module[\"_Transform\"]=Module[\"asm\"][\"Qa\"]).apply(null,arguments)};var
_Transpose=Module[\"_Transpose\"]=function(){return(_Transpose=Module[\"_Transpose\"]=Module[\"asm\"][\"Ra\"]).apply(null,arguments)};var

__FusedMatMul=Module[\"__FusedMatMul\"]=function(){return(__FusedMatMul=Module[\"__FusedMatMul\"]=Module[\"asm\"][\"Sa\"]).apply(null,arguments)};var _malloc=Module[\"_malloc\"]=function(){return(_malloc=Module[\"_malloc\"]=Module[\"asm\"][\"Ta\"]).apply(null,arguments)};var _free=Module[\"_free\"]=function(){return(_free=Module[\"_free\"]=Module[\"asm\"][\"Ua\"]).apply(null,arguments)};var ___errno_location=Module[\"___errno_location\"]=function(){return(___errno_location=Module[\"___errno_location\"]=Module[\"asm\"][\"Va\"]).apply(null,arguments)};var stackSave=Module[\"stackSave\"]=function(){return(stackSave=Module[\"stackSave\"]=Module[\"asm\"][\"Wa\"]).apply(null,arguments)};var stackRestore=Module[\"stackRestore\"]=function(){return(stackRestore=Module[\"stackRestore\"]=Module[\"asm\"][\"Xa\"]).apply(null,arguments)};var stackAlloc=Module[\"stackAlloc\"]=function(){return(stackAlloc=Module[\"stackAlloc\"]=Module[\"asm\"][\"Ya\"]).apply(null,arguments)};Module[\"cwrap\"]=cwrap;var calledRun;function ExitStatus(status){this.name=\"ExitStatus\";this.message=\"Program terminated with exit(\"+status+\")\";this.status=status}dependenciesFulfilled=function runCaller(){if(!calledRun)run();if(!calledRun)dependenciesFulfilled=runCaller};function run(args){args=args||arguments_;if(runDependencies>0){return}preRun();if(runDependencies>0){return}function doRun(){if(calledRun)return;calledRun=true;Module[\"calledRun\"]=true;if(ABORT)return;initRuntime();preMain();readyPromiseResolve(Module);if(Module[\"onRuntimeInitialized\"])Module[\"onRuntimeInitialized\"]();postRun()}if(Module[\"setStatus\"]){Module[\"setStatus\"](\"Running...\");setTimeout(function(){setTimeout(function(){Module[\"setStatus\"](\"\")},1);doRun()},1)}else{doRun()}}Module[\"run\"]=run;if(Module[\"preInit\"]){if(typeof Module[\"preInit\"]==\"function\")Module[\"preInit\"]=[Module[\"preInit\"]];while(Module[\"preInit\"].length>0){Module[\"preInit\"].pop()()}}run();\n\n\n
 return WasmBackendModule.ready\n}\n);\n})();\nif (typeof exports === 'object' && typeof module === 'object')\n module.exports = WasmBackendModule;\nelse if (typeof define === 'function' && define['amd'])\n define([], function() { return WasmBackendModule; });\nelse if (typeof exports === 'object')\n exports[\"WasmBackendModule\"] = WasmBackendModule;\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY
 KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n */\nimport './flags_wasm';\n\nimport {backend_util, BackendTimingInfo, DataStorage, DataType, deprecationWarn, engine, env, KernelBackend, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasmModule, WasmFactoryConfig} from '../wasm-out/tfjs-backend-wasm';\nimport {BackendWasmThreadedSimdModule} from '../wasm-out/tfjs-backend-wasm-threaded-simd';\nimport wasmFactoryThreadedSimd from '../wasm-out/tfjs-backend-wasm-threaded-simd.js';\n// @ts-ignore\nimport {wasmWorkerContents} from '../wasm-out/tfjs-backend-wasm-threaded-simd.worker.js';\nimport wasmFactory from '../wasm-out/tfjs-backend-wasm.js';\n\ninterface TensorData {\n id: number;\n memoryOffset: number;\n shape: number[];\n dtype: DataType;\n refCount: number;\n /** Only used for string tensors,
 storing encoded bytes. */\n stringBytes?: Uint8Array[];\n}\n\nexport type DataId = object; // object instead of {} to force non-primitive.\n\nexport class BackendWasm extends KernelBackend {\n // 0 is reserved for null data ids.\n private dataIdNextNumber = 1;\n dataIdMap: DataStorage<TensorData>;\n\n constructor(public wasm: BackendWasmModule|BackendWasmThreadedSimdModule) {\n super();\n

this.wasm.tfjs.initWithThreadsCount(threadsCount);\n actualThreadsCount = this.wasm.tfjs.getThreadsCount();\n this.dataIdMap = new DataStorage(this, engine());\n }\n\n write(values: backend_util.BackendValues, shape: number[], dtype: DataType):\n DataId {\n const dataId = {id: this.dataIdNextNumber++};\n this.move(dataId, values, shape, dtype, 1);\n return dataId;\n }\n\n numDataIds(): number {\n return this.dataIdMap.numDataIds();\n }\n\n async time(f: () => void): Promise<BackendTimingInfo> {\n const start = util.now();\n f();\n const kernelMs = util.now() - start;\n return {kernelMs};\n }\n\n move(\n dataId: DataId, values: backend_util.BackendValues, shape: number[],\n dtype: DataType, refCount: number): void {\n const id = this.dataIdNextNumber++;\n if (dtype === 'string') {\n const stringBytes = values as Uint8Array[];\n this.dataIdMap.set(\n dataId,\n {id, stringBytes, shape, dtype, memoryOffset: null, refCount});\n return;\n }\n\n const size = util.sizeFromShape(shape);\n const numBytes = size * util.bytesPerElement(dtype);\n const memoryOffset = this.wasm._malloc(numBytes);\n\n this.dataIdMap.set(dataId, {id, memoryOffset, shape, dtype, refCount});\n\n this.wasm.tfjs.registerTensor(id, size, memoryOffset);\n\n if (values != null) {\n this.wasm.HEAPU8.set(\n new Uint8Array(\n (values as backend_util.TypedArray).buffer,\n (values as backend_util.TypedArray).byteOffset, numBytes),\n memoryOffset);\n }\n }\n\n async read(dataId: DataId): Promise<backend_util.BackendValues> {\n return this.readSync(dataId);\n }\n\n readSync(dataId: DataId): backend_util.BackendValues {\n const {memoryOffset, dtype, shape, stringBytes} =\n this.dataIdMap.get(dataId);\n if (dtype === 'string') {\n return stringBytes;\n }\n const bytes = this.wasm.HEAPU8.slice(\n memoryOffset,\n memoryOffset + util.sizeFromShape(shape) * util.bytesPerElement(dtype));\n return typedArrayFromBuffer(bytes.buffer, dtype);\n }\n\n /**\n * Dispose the memory if the dataId has 0 refCount. Return true if the memory\n * is released, false otherwise.\n * @param dataId\n * @oaram force Optional, remove the data regardless of refCount\n */\n disposeData(dataId: DataId, force = false): boolean {\n if (this.dataIdMap.has(dataId)) {\n const data = this.dataIdMap.get(dataId);\n data.refCount--;\n if (!force && data.refCount > 0) {\n return false;\n }\n\n this.wasm._free(data.memoryOffset);\n this.wasm.tfjs.disposeData(data.id);\n this.dataIdMap.delete(dataId);\n }\n return true;\n }\n\n /** Return refCount of a `TensorData`. */\n refCount(dataId: DataId): number {\n if (this.dataIdMap.has(dataId)) {\n const tensorData = this.dataIdMap.get(dataId);\n return tensorData.refCount;\n }\n return 0;\n }\n\n incRef(dataId: DataId) {\n const data = this.dataIdMap.get(dataId);\n if (data != null) {\n data.refCount++;\n }\n }\n\n floatPrecision(): 32 {\n return 32;\n }\n\n // Returns the memory offset of a tensor. Useful for debugging and unit\n // testing.\n getMemoryOffset(dataId: DataId): number {\n return this.dataIdMap.get(dataId).memoryOffset;\n }\n\n dispose() {\n this.wasm.tfjs.dispose();\n if ('PThread' in this.wasm) {\n this.wasm.PThread.terminateAllThreads();\n }\n this.wasm = null;\n }\n\n memory() {\n return {unreliable: false};\n }\n\n /**\n * Make a tensor info for the output of an op. If `memoryOffset` is not\n * present, this method allocates memory on the WASM heap. If `memoryOffset`\n * is present, the memory was allocated elsewhere (in c++) and we just record\n * the pointer where that memory lives.\n */\n makeOutput(shape: number[], dtype: DataType, memoryOffset?: number):\n TensorInfo {\n let dataId: {};\n if (memoryOffset == null) {\n dataId = this.write(null /* values */, shape, dtype);\n } else {\n const id = this.dataIdNextNumber++;\n dataId = {id};\n this.dataIdMap.set(dataId, {id, memoryOffset, shape, dtype, refCount: 1});\n const size = util.sizeFromShape(shape);\n this.wasm.tfjs.registerTensor(id, size, memoryOffset);\n }\n return {dataId, shape, dtype};\n }\n\n typedArrayFromHeap({shape, dtype, dataId}: TensorInfo):\n backend_util.TypedArray {\n const buffer = this.wasm.HEAPU8.buffer;\n const {memoryOffset} = this.dataIdMap.get(dataId);\n const size = util.sizeFromShape(shape);\n switch (dtype) {\n case 'float32':\n return new Float32Array(buffer, memoryOffset, size);\n case 'int32':\n return new Int32Array(buffer, memoryOffset, size);\n case 'bool':\n return new Uint8Array(buffer, memoryOffset, size);\n default:\n throw new Error(`Unknown dtype ${dtype}`);\n }\n }\n}\n\nfunction createInstantiateWasmFunc(path: string) {\n // this

```
will be replace by rollup plugin patchWechatWebAssembly in\n  // minprogram's output.\n  // tslint:disable-next-line:no-any\n  return (imports: any, callback: any) => {\n    util.fetch(path, {credentials: 'same-origin'}).then((response) => {\n      if (!response['ok']) {\n        imports.env.a(`failed to load wasm binary file at '${path}'`);\n      }\n      response.arrayBuffer().then(binary => {\n        WebAssembly.instantiate(binary, imports).then(output => {\n          callback(output.instance, output.module);\n
      });\n    });\n  });\n  return {};\n };\n}\n\n/**\n * Returns the path of the WASM binary.\n * @param simdSupported whether SIMD is supported\n * @param threadsSupported whether multithreading is supported\n * @param wasmModuleFolder the directory containing the WASM binaries.\n */\nfunction getPathToWasmBinary(\n  simdSupported: boolean, threadsSupported: boolean,\n    wasmModuleFolder: string) {\n  if (wasmPath != null) {\n    // If wasmPath is defined, the user has supplied a full path to\n    // the vanilla .wasm binary.\n    return wasmPath;\n  }\n\n  let path: WasmBinaryName = 'tfjs-backend-wasm.wasm';\n  if (simdSupported && threadsSupported) {\n    path = 'tfjs-backend-wasm-threaded-simd.wasm';\n  } else if (simdSupported) {\n    path = 'tfjs-backend-wasm-simd.wasm';\n  }\n\n  if (wasmFileMap != null) {\n    if (wasmFileMap[path] != null) {\n      return wasmFileMap[path];\n    }\n  }\n\n  return wasmModuleFolder + path;\n}\n\n/**\n * Initializes the wasm module and creates the js <--> wasm bridge.\n *\n * NOTE: We wrap the wasm module in a object with property 'wasm' instead of\n * returning Promise<BackendWasmModule> to avoid freezing Chrome (last tested\n * in Chrome 76).\n */\nexport async function init(): Promise<{wasm: BackendWasmModule}> {\n  const [simdSupported, threadsSupported] = await Promise.all([\n    env().getAsync('WASM_HAS_SIMD_SUPPORT'),\n    env().getAsync('WASM_HAS_MULTITHREAD_SUPPORT')\n  ]);\n\n  return new Promise((resolve, reject) => {\n    const factoryConfig: WasmFactoryConfig = {};\n\n    /**\n     * This function overrides the Emscripten module locateFile utility.\n     * @param path The relative path to the file that needs to be loaded.\n     * @param prefix The path to the main JavaScript file's directory.\n     */\n    factoryConfig.locateFile = (path, prefix) => {\n      if (path.endsWith('.worker.js')) {\n        const response = wasmWorkerContents;\n        const blob = new Blob([response], {type: 'application/javascript'});\n
      return URL.createObjectURL(blob);\n      }\n\n      if (path.endsWith('.wasm')) {\n        return getPathToWasmBinary(\n            simdSupported as boolean, threadsSupported as boolean,\n            wasmPathPrefix != null ? wasmPathPrefix : prefix);\n      }\n      return prefix + path;\n    };\n\n    // Use the instantiateWasm override when system fetch is not available.\n    // Reference:\n    // https://github.com/emscripten-core/emscripten/blob/2bca083cbbd5a4133db61fbd74d04f7feecfa907/tests/manual_wasm_instantiate.html#L170\n    if (customFetch) {\n      factoryConfig.instantiateWasm =\n          createInstantiateWasmFunc(getPathToWasmBinary(\n              simdSupported as boolean, threadsSupported as boolean,\n              wasmPathPrefix != null ? wasmPathPrefix : ''));\n    }\n\n    let initialized = false;\n    factoryConfig.onAbort = () => {\n      if (initialized) {\n        // Emscripten already called console.warn so no need to double log.\n
      return;\n      }\n      if (initAborted) {\n        // Emscripten calls `onAbort` twice, resulting in double error\n        // messages.\n        return;\n      }\n      initAborted = true;\n      const rejectMsg =\n          'Make sure the server can serve the `.wasm` file relative to the ' +\n          'bundled js file. For more details see https://github.com/tensorflow/tfjs/blob/master/tfjs-backend-wasm/README.md#using-bundlers';\n      reject({message: rejectMsg});\n    };\n\n    let wasm: Promise<BackendWasmModule>;\n    // If `wasmPath` has been defined we must initialize the vanilla module.\n    if (threadsSupported && simdSupported && wasmPath == null) {\n      factoryConfig.mainScriptUrlOrBlob = new Blob(\n          [`var WasmBackendModuleThreadedSimd = ` +\n              wasmFactoryThreadedSimd.toString()],\n          {type: 'text/javascript'});\n      wasm = wasmFactoryThreadedSimd(factoryConfig);\n    } else {\n      // The wasmFactory works for both vanilla and SIMD binaries.\n      wasm = wasmFactory(factoryConfig);\n    }\n\n    // The WASM module has been successfully created by the factory.\n    // Any error will be caught by the onAbort callback defined above.\n    wasm.then((module) => {\n      initialized = true;\n      initAborted = false;\n\n      const voidReturnType: string = null;\n      // Using the tfjs namespace to avoid conflict with emscripten's API.\n      module.tfjs = {\n        init: module.cwrap('init', null, []),\n        initWithThreadsCount:\n            module.cwrap('init_with_threads_count', null,
```

['number']),\n getThreadsCount: module.cwrap('get_threads_count', 'number', []),\n registerTensor: module.cwrap(\n 'register_tensor', null,\n [\n 'number', // id\n 'number', // size\n 'number', // memoryOffset\n]),\n disposeData: module.cwrap('dispose_data', voidReturnType, ['number']),\n dispose: module.cwrap('dispose', voidReturnType, []),\n };\n\n resolve({wasm: module});\n });\n });\n}\n\nfunction typedArrayFromBuffer(\n buffer: ArrayBuffer, dtype: DataType): backend_util.TypedArray {\n switch (dtype) {\n case 'float32':\n return new Float32Array(buffer);\n case 'int32':\n return new Int32Array(buffer);\n case 'bool':\n return new Uint8Array(buffer);\n default:\n throw new Error(`Unknown dtype ${dtype}`);\n }\n}\n\nconst wasmBinaryNames = [\n 'tfjs-backend-wasm.wasm', 'tfjs-backend-wasm-simd.wasm',\n 'tfjs-backend-wasm-threaded-simd.wasm'\n] as const ;\ntype WasmBinaryName = typeof wasmBinaryNames[number];\n\nlet wasmPath: string = null;\nlet wasmPathPrefix: string = null;\nlet wasmFileMap: {[key in WasmBinaryName]?: string} = {};\nlet initAborted = false;\nlet customFetch = false;\n\n/**\n * @deprecated Use `setWasmPaths` instead.\n * Sets the path to the `.wasm` file which will be fetched when the wasm\n * backend is initialized. See\n * https://github.com/tensorflow/tfjs/blob/master/tfjs-backend-wasm/README.md#using-bundlers\n * for more details.\n * @param path wasm file path or url\n * @param usePlatformFetch optional boolean to use platform fetch to download\n * the wasm file, default to false.\n *\n * @doc {heading: 'Environment', namespace: 'wasm'}\n */\nexport function setWasmPath(path: string, usePlatformFetch = false): void {\n deprecationWarn(\n 'setWasmPath has been deprecated in favor of setWasmPaths and' +\n ' will be removed in a future release.');\n if (initAborted) {\n throw new Error(\n 'The WASM backend was already initialized. Make sure you call ' +\n '`setWasmPath()` before you call `tf.setBackend()` or `tf.ready()`');\n }\n wasmPath = path;\n customFetch = usePlatformFetch;\n}\n\n/**\n * Configures the locations of the WASM binaries.\n *\n * ```js\n * setWasmPaths({\n * 'tfjs-backend-wasm.wasm': 'renamed.wasm',\n * 'tfjs-backend-wasm-simd.wasm': 'renamed-simd.wasm',\n * 'tfjs-backend-wasm-threaded-simd.wasm': 'renamed-threaded-simd.wasm'\n * });\n * tf.setBackend('wasm');\n * ```\n *\n * @param prefixOrFileMap This can be either a string or object:\n * - (string) The path to the directory where the WASM binaries are located.\n * Note that this prefix will be used to load each binary (vanilla,\n * SIMD-enabled, threading-enabled, etc.).\n * - (object) Mapping from names of WASM binaries to custom\n * full paths specifying the locations of those binaries. This is useful if\n * your WASM binaries are not all located in the same directory, or if your\n * WASM binaries have been renamed.\n * @param usePlatformFetch optional boolean to use platform fetch to download\n * the wasm file, default to false.\n *\n * @doc {heading: 'Environment', namespace: 'wasm'}\n */\nexport function setWasmPaths(\n prefixOrFileMap: string|{[key in WasmBinaryName]?: string},\n usePlatformFetch = false): void {\n if (initAborted) {\n throw new Error(\n 'The WASM backend was already initialized. Make sure you call ' +\n '`setWasmPaths()` before you call `tf.setBackend()` or ' +\n '`tf.ready()`');\n }\n\n if (typeof prefixOrFileMap === 'string') {\n wasmPathPrefix = prefixOrFileMap;\n } else {\n wasmFileMap = prefixOrFileMap;\n const missingPaths =\n wasmBinaryNames.filter(name => wasmFileMap[name] == null);\n if (missingPaths.length > 0) {\n throw new Error(\n `There were no entries found for the following binaries: ` +\n `${missingPaths.join(',')}. Please either call setWasmPaths with a ` +\n `map providing a path for each binary, or with a string indicating ` +\n `the directory where all the binaries can be found.`);\n }\n }\n\n customFetch = usePlatformFetch;\n}\n\n/** Used in unit tests. */\nexport function resetWasmPath(): void {\n wasmPath = null;\n wasmPathPrefix = null;\n wasmFileMap = {};\n customFetch = false;\n initAborted = false;\n}\n\nlet threadsCount = -1;\nlet actualThreadsCount = -1;\n\n/**\n * Sets the number of threads that will be used by XNNPACK to create\n * threadpool (default to the number of logical CPU cores).\n *\n * This must be called before calling `tf.setBackend('wasm')`.\n */\nexport function setThreadsCount(numThreads: number) {\n threadsCount = numThreads;\n}\n\n/**\n * Gets the actual threads count that is used by XNNPACK.\n *\n * It is set after the backend is intialized.\n */\nexport function getThreadsCount(): number {\n if (actualThreadsCount === -1) {\n throw new Error(`WASM backend not initialized.`);\n }\n return actualThreadsCount;\n}\n","/** @license See the LICENSE file. */\n\n// This code is auto-generated, do not modify this file!\nconst version = '3.11.0';\nexport {version};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n *

Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance
with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport './flags_wasm';\n\nimport {registerBackend} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm, init} from './backend_wasm';\n\nexport {BackendWasm, getThreadsCount, setThreadsCount, setWasmPath, setWasmPaths} from './backend_wasm';\nexport {version as version_wasm} from './version';\n\nconst WASM_PRIORITY = 2;\nregisterBackend('wasm', async () => {\n const {wasm} = await init();\n return new BackendWasm(wasm);\n}, WASM_PRIORITY);\n"],"names":["_FusedMatMul","util","Abs","backend_util","Add","AddN","Identity","setup","Transpose","All","Any","wasmFunc","ArgMax","AvgPool","Reshape","BatchMatMul","slice_util","buffer","sliceImplCPU","Slice","BatchToSpaceND","Cast","Ceil","ClipByValue","concatImplCPU","Concat","Conv2D","Conv2DBackpropInput","Cos","Cosh","CropAndResize","Cumsum","DepthToSpace","DepthwiseConv2dNative","Elu","supportsFullBroadcast","Equal","Exp","ExpandDims","Fill","FlipLeftRight","Floor","FloorDiv","FusedBatchNorm","FusedConv2D","FusedDepthwiseConv2D","GatherNd","GatherV2","Greater","GreaterEqual","setupFunc","LeakyRelu","Less","LessEqual","Log","LogicalAnd","Max","Maximum","MaxPool","Mean","Min","Minimum","MirrorPad","Multiply","Neg","NonMaxSuppressionV3","NonMaxSuppressionV4","NonMaxSuppressionV5","kernelFunc","NotEqual","OneHot","OnesLike","Pack","PadV2","Pow","Prelu","Prod","rangeImplCPU","Range","RealDiv","Relu","Relu6","ResizeBilinear","Reverse","RotateWithOffset","Round","Rsqrt","ScatterNd","Select","Sigmoid","Sin","Softmax","SpaceToBatchND","SplitV","Sqrt","Square","SquaredDifference","Step","StridedSlice","Sub","Sum","Tan","Tanh","Tile","TopK","Transform","Unpack","ZerosLike","registerKernel","env","tslib_1.__extends","DataStorage","engine","KernelBackend","tslib_1.__awaiter","registerBackend"],"mappings":";;;;;;;;;;;;;;;;;;;;;;;;AAAA;;;;;;;;;;;;;;;;AAiBA;AACA,IAAY,QAAMX;AAAN,WAAWA,QAAQ;AAAnB,GAAA,aAAA,WAAA;AAAmB,CAAA,CAAA,CAAA

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filterHeight,\n filterWidth, padTop, padRight, padBottom, padLeft, isSamePad,\n dilationHeight, dilationWidth, strideHeight, strideWidth, inputChannels,\n outputChannels, outId);\n return out;\n}\n\nexport const conv2DConfig: KernelConfig = {\n kernelName: Conv2D,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: conv2d as {} as KernelFunc\n};\n"]}

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No license file was found, but licenses were detected in source scan.

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,SAAS;IACrB,WAAW,EAAE,MAAM;IACnB,UAAU,EAAE,SAA6B;IACzC,SAAS,EAAE,KAAK;CACjB,CAAC","sourcesContent":["/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {KernelConfig, KernelFunc, TensorInfo, Transpose, TransposeAttrs, TransposeInputs} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {identity} from './Identity';\nimport {CppDType} from './types';\n\nlet wasmTranspose: (\n   xId: number, xShape: Uint8Array, xShapeLength: number, dtype: CppDType,\n   outId: number, perm: Uint8Array, permLength: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmTranspose = backend.wasm.cwrap(Transpose, null /* void */, [\n   'number', // xId\n   'array',   // x.shape\n   'number', // x.shape.length\n   'number', // dtype\n   'number', // outId\n   'array',   // perm\n   'number', // perm.length\n]);\n}\n\nexport function transpose(\n   args:\n   {inputs: TransposeInputs, backend: BackendWasm, attrs: TransposeAttrs}):\n   TensorInfo {\n const {inputs, backend, attrs} = args;\n // Reduce any dimensions with size one. Lower-rank transpose kernel performs\n // better due to simpler memory access pattern.\n const [reducedShape, perm] = removeOneSizeDims(inputs.x.shape, attrs.perm);\n\n let permIsNoOp = true;\n for (let i = 0; i < perm.length; i++) {\n   if (perm[i] !== i) {\n   permIsNoOp = false;\n   }\n }\n const outShape = computeOutShape(inputs.x.shape, attrs.perm);\n const x = {\n   dataId: inputs.x.dataId,\n   shape: reducedShape,\n   dtype: inputs.x.dtype\n };\n\n if (permIsNoOp) {\n   const cloned = identity({inputs, backend});\n   cloned.shape = outShape;\n   return cloned;\n }\n\n const out = backend.makeOutput(outShape, x.dtype);\n const xId = backend.dataIdMap.get(x.dataId).id;\n const outId = backend.dataIdMap.get(out.dataId).id;\n const permBytes = new Uint8Array(new Int32Array(perm).buffer);\n const xShapeBytes = new Uint8Array(new Int32Array(x.shape).buffer);\n\n wasmTranspose(\n   xId, xShapeBytes, x.shape.length, CppDType[x.dtype], outId, permBytes,\n   perm.length);\n return out;\n}\n\nfunction computeOutShape(inShape: number[], perm: number[]): number[] {\n const outShape = new Array(inShape.length);\n for (let i = 0; i < outShape.length; i++) {\n   outShape[i] = inShape[perm[i]];\n }\n return outShape;\n}\n\nfunction removeOneSizeDims(\n   shape: number[], perm: number[]): [number[], number[]] {\n const newShape: number[] = [];\n const newPerm: number[] = [];\n for (let i = 0; i < shape.length; ++i) {\n   if (shape[i] !== 1) {\n   newShape.push(shape[i]);\n   }\n   if (shape[perm[i]] !== 1) {\n   newPerm.push(perm[i]);\n   }\n }\n for (let i = 0; i < newPerm.length; ++i) {\n   let minValIdx = -1;\n   for (let j = 0; j < newPerm.length; ++j) {\n   if (newPerm[j] >= i &&\n   (minValIdx === -1 || newPerm[minValIdx] > newPerm[j])) {\n   minValIdx = j;\n   }\n   }\n   newPerm[minValIdx] = i;\n }\n return [newShape, newPerm];\n}\n\nexport const transposeConfig: KernelConfig = {\n kernelName: Transpose,\n backendName: 'wasm',\n kernelFunc: transpose as {} as KernelFunc,\n setupFunc: setup,\n};\n"]}

Found in path(s):
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernels/Transpose.js.map
No license file was found, but licenses were detected in source scan.

{"version":3,"file":"Identity.js","sourceRoot":"","sources":["../../src/kernels/Identity.ts"],"names":[],"mappings":"AAAA;;;;;;;;;;;;;;;GAeG;AAEH,OAAO,EAAC,QAAQ,EAAE,EAA2C,MAAM,uBAAuB,CAAC;AAKzF,MAAM,UAAU,QAAQ,CAAC,IAAgB,EAAE,QAAkB;IAAlB,yBAAA,EAAA,kBAAkB;IAC3D,OAAO,QAAQ,CAAC,IAAI,EAAE,QAAQ,CAAC,CAAC;AAAC,CAAC;AAEpC,MAAM,CAAC,IAAM,cAAc,GAAiB;IAC1C,UAAU,EAAE,QAAQ;IACpB,WAAW,EAAE,MAAM;IACnB,UAAU,EAAE,QAAQ;CACrB,CAAC","sourcesContent":["/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {KernelConfig, KernelFunc, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nexport function identity(args: {inputs: TensorInfo}, backend: BackendWasm) {\n return backend.cloneTensor(args.inputs.x);\n}\n\nexport const identityConfig: KernelConfig = {\n kernelName: 'Identity',\n backendName: 'wasm',\n kernelFunc: identity as {} as KernelFunc,\n};\n"]}

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*/\n\nimport {KernelConfig, KernelFunc, NonMaxSuppressionV3, NonMaxSuppressionV3Attrs,
NonMaxSuppressionV3Inputs, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from
'../backend_wasm';\n\nimport {parseResultStruct} from './NonMaxSuppression_util';\n\nlet wasmFunc: (\n
boxesId: number, scoresId: number, maxOutputSize: number,\n iouThreshold: number, scoreThreshold: number)
=> number;\n\nfunction setup(backend: BackendWasm): void {\n wasmFunc = backend.wasm.cwrap(\n
NonMaxSuppressionV3,\n 'number', // Result*\n [\n 'number', // boxesId\n 'number', // scoresId\n
'number', // maxOutputSize\n 'number', // iouThreshold\n 'number', // scoreThreshold\n
]);\n}\n\nfunction kernelFunc(args: {\n backend: BackendWasm,\n
inputs: NonMaxSuppressionV3Inputs,\n attrs: NonMaxSuppressionV3Attrs\n}): TensorInfo {\n const {backend,
inputs, attrs} = args;\n const {iouThreshold, maxOutputSize, scoreThreshold} = attrs;\n const {boxes, scores} =
inputs;\n\n const boxesId = backend.dataIdMap.get(boxes.dataId).id;\n const scoresId =
backend.dataIdMap.get(scores.dataId).id;\n\n const resOffset =\n wasmFunc(boxesId, scoresId, maxOutputSize,
iouThreshold, scoreThreshold);\n\n const {pSelectedIndices, selectedSize, pSelectedScores, pValidOutputs} =\n
parseResultStruct(backend, resOffset);\n\n // Since we are not using scores for V3, we have to delete it from the
heap.\n backend.wasm._free(pSelectedScores);\n backend.wasm._free(pValidOutputs);\n\n const
selectedIndicesTensor =\n backend.makeOutput([selectedSize], 'int32', pSelectedIndices);\n\n return
selectedIndicesTensor;\n}\n\nexport const nonMaxSuppressionV3Config: KernelConfig = {\n kernelName:
NonMaxSuppressionV3,\n backendName: 'wasm',\n
setupFunc: setup,\n kernelFunc: kernelFunc as {} as KernelFunc,\n};\n"]}

Found in path(s):
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernels/NonMaxSuppressionV3.js.map
No license file was found, but licenses were detected in source scan.

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AQ;KACT,CAAC,CAAC;AACT,CAAC;AAED,SAAS,UAAU,CAAC,IAInB;IACC,MAAM,EAAC,OAAO,EAAE,
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License.\n *
==========\n
*/\n\nimport {KernelConfig, KernelFunc, NonMaxSuppressionV5, NonMaxSuppressionV5Attrs,
NonMaxSuppressionV5Inputs, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from
'../backend_wasm';\n\nimport {parseResultStruct} from './NonMaxSuppression_util';\n\nlet wasmFunc:\n
(boxesId: number, scoresId: number, maxOutputSize: number,\n iouThreshold: number, scoreThreshold: number,
softNmsSigma: number) =>\n number;\n\nfunction setup(backend: BackendWasm): void {\n wasmFunc =
backend.wasm.cwrap(\n NonMaxSuppressionV5,\n 'number', // Result*\n [\n 'number', // boxesId\n
'number', // scoresId\n 'number', // maxOutputSize\n 'number',
// iouThreshold\n 'number', // scoreThreshold\n 'number', // softNmsSigma\n]);\n}\n\nfunction
kernelFunc(args: {\n backend: BackendWasm,\n inputs: NonMaxSuppressionV5Inputs,\n attrs:
NonMaxSuppressionV5Attrs\n}): TensorInfo[] {\n const {backend, inputs, attrs} = args;\n const {iouThreshold,
maxOutputSize, scoreThreshold, softNmsSigma} = attrs;\n const {boxes, scores} = inputs;\n\n const boxesId =
backend.dataIdMap.get(boxes.dataId).id;\n const scoresId = backend.dataIdMap.get(scores.dataId).id;\n\n const
resOffset = wasmFunc(\n boxesId, scoresId, maxOutputSize, iouThreshold, scoreThreshold,\n
softNmsSigma);\n\n const {pSelectedIndices, selectedSize, pSelectedScores, pValidOutputs} =\n
parseResultStruct(backend, resOffset);\n\n // Since we are not using validOutputs for V5, we have to delete it from
the\n // heap.\n backend.wasm._free(pValidOutputs);\n\n const selectedIndicesTensor =\n
backend.makeOutput([selectedSize], 'int32',
pSelectedIndices);\n const selectedScoresTensor =\n backend.makeOutput([selectedSize], 'float32',
pSelectedScores);\n\n return [selectedIndicesTensor, selectedScoresTensor];\n}\n\nexport const
nonMaxSuppressionV5Config: KernelConfig = {\n kernelName: NonMaxSuppressionV5,\n backendName:
'wasm',\n setupFunc: setup,\n kernelFunc: kernelFunc as {} as KernelFunc,\n};\n"]}

Found in path(s):
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernels/NonMaxSuppressionV5.js.map
No license file was found, but licenses were detected in source scan.

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const {backend, inputs, attrs} = args;\n const {dy, filter} = inputs;\n const {strides, pad, dataFormat, dimRoundingMode, inputShape} = attrs;\n\n const dilations = 1;\n\n const $dataFormat = backend_util.convertConv2DDataFormat(dataFormat);\n const convInfo = backend_util.computeConv2DInfo(\n   inputShape, filter.shape as [number, number, number, number], strides,\n   dilations, pad, dimRoundingMode, false /* depthwise */, $dataFormat);\n const {\n   batchSize,\n   filterHeight,\n   filterWidth,\n   inChannels,\n   inHeight,\n   inWidth,\n   outChannels,\n   outHeight,\n   outWidth,\n   strideHeight,\n   strideWidth\n } = convInfo;\n\n const topPad = filterHeight - 1 - convInfo.padInfo.top;\n const leftPad = filterWidth - 1 - convInfo.padInfo.left;\n\n const isChannelsLast = convInfo.dataFormat === 'channelsLast';\n const dxStrides = util.computeStrides(convInfo.inShape);\n const dyStrides = util.computeStrides(dy.shape);\n const [fltS0, fltS1, fltS2] = util.computeStrides(filter.shape);\n const xBatchStride = dxStrides[0];\n const xRowStride = isChannelsLast ? dxStrides[1] : dxStrides[2];\n const xColStride = isChannelsLast ? dxStrides[2] : 1;\n const xChannelStride = isChannelsLast ? 1 : dxStrides[1];\n const yBatchStride = dyStrides[0];\n const yRowStride = isChannelsLast ? dyStrides[1] : dyStrides[2];\n const yColStride = isChannelsLast ? dyStrides[2] : 1;\n const yChannelStride = isChannelsLast ? 1 : dyStrides[1];\n\n const out = backend.makeOutput(convInfo.inShape, 'float32');\n const outId = backend.dataIdMap.get(out.dataId).id;\n const dyId = backend.dataIdMap.get(dy.dataId).id;\n const filterId = backend.dataIdMap.get(filter.dataId).id;\n\n wasmConv2DBackpropInput(\n   dyId, filterId, batchSize, filterHeight, filterWidth, inHeight, inWidth,\n   inChannels, outHeight, outWidth, outChannels, strideHeight, strideWidth,\n   topPad, leftPad, fltS0, fltS1, fltS2, xBatchStride, xRowStride,\n   xColStride, xChannelStride, yBatchStride, yRowStride, yColStride,\n   yChannelStride, outId);\n return out;\n}\n\nexport const conv2DBackpropInputConfig: KernelConfig = {\n kernelName: Conv2DBackpropInput,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: conv2DBackpropInput as {} as KernelFunc\n};\n"]}

Found in path(s):
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernels/Conv2DBackpropInput.js.map
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* WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.
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* limitations under the License.
* ===
*/

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 * ==\n
*/\nimport {KernelConfig, Tan} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\nexport const tanConfig: KernelConfig = createUnaryKernelConfig(Tan);\n"]}

Found in path(s):
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernels/Tan.js.map
No license file was found, but licenses were detected in source scan.

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backend-cpu/dist/kernels/Range_impl.js","../node_modules/@tensorflow/tfjs-backend-cpu/dist/kernels/Slice.js","../src/kernels/Slice.ts","../src/kernels/BatchToSpaceND.ts","../src/kernels/Cast.ts","../src/kernels/Ceil.ts","../src/kernels/ClipByValue.ts","../src/kernels/Concat.ts","../src/kernels/Conv2D.ts","../src/kernels/Conv2DBackpropInput.ts","../src/kernels/Cos.ts","../src/kernels/Cosh.ts","../src/kernels/CropAndResize.ts","../src/kernels/Cumsum.ts","../src/kernels/DepthToSpace.ts","../src/kernels/DepthwiseConv2dNative.ts","../src/kernels/Elu.ts","../src/kernels/Equal.ts","../src/kernels/Exp.ts","../src/kernels/ExpandDims.ts","../src/kernels/Fill.ts","../src/kernels/FlipLeftRight.ts","../src/kernels/Floor.ts","../src/kernels/FloorDiv.ts","../src/kernels/FusedBatchNorm.ts","../src/kernels/FusedConv2D.ts","../src/kernels/FusedDepthwiseConv2D.ts","../src/kernels/GatherNd.ts","../src/kernels/GatherV2.ts","../src/kernels/Greater.ts","../src/kernels/GreaterEqual.ts","../src/kernels/LeakyRelu.ts","../src/kernels/Less.ts","../src/kernels/LessEqual.ts","../src/kernels/Log.ts","../src/kernels/LogicalAnd.ts","../src/kernels/Max.ts","../src/kernels/Maximum.ts","../src/kernels/MaxPool.ts","../src/kernels/Mean.ts","../src/kernels/Min.ts","../src/kernels/Minimum.ts","../src/kernels/MirrorPad.ts","../src/kernels/Multiply.ts","../src/kernels/Neg.ts","../src/kernels/NonMaxSuppression_util.ts","../src/kernels/NonMaxSuppressionV3.ts","../src/kernels/NonMaxSuppressionV4.ts","../src/kernels/NonMaxSuppressionV5.ts","../src/kernels/NotEqual.ts","../src/kernels/OneHot.ts","../src/kernels/OnesLike.ts","../src/kernels/Pack.ts","../src/kernels/PadV2.ts","../src/kernels/Pow.ts","../src/kernels/Prelu.ts","../src/kernels/Prod.ts","../src/kernels/Range.ts","../src/kernels/RealDiv.ts","../src/kernels/Relu.ts","../src/kernels/Relu6.ts","../src/kernels/ResizeBilinear.ts","../src/kernels/Reverse.ts","../src/kernels/RotateWithOffset.ts","../src/kernels/Round.ts","../src/kernels/Rsqrt.ts","../src/kernels/ScatterNd.ts","../src/kernels/Select.ts","../src/kernels/Sigmoid.ts","../src/kernels/Sin.ts","../src/kernels/Softmax.ts","../src/kernels/SpaceToBatchND.ts","../src/kernels/SplitV.ts","../src/kernels/Sqrt.ts","../src/kernels/Square.ts","../src/kernels/SquaredDifference.ts","../src/kernels/Step.ts","../src/kernels/StridedSlice.ts","../src/kernels/Sub.ts","../src/kernels/Sum.ts","../src/kernels/Tan.ts","../src/kernels/Tanh.ts","../src/kernels/Tile.ts","../src/kernels/TopK.ts","../src/kernels/Transform.ts","../src/kernels/Unpack.ts","../src/kernels/ZerosLike.ts","../src/register_all_kernels.ts","../src/flags_wasm.ts","../wasm-out/tfjs-backend-wasm-threaded-simd.js","../wasm-out/tfjs-backend-wasm-threaded-simd.worker.js","../wasm-out/tfjs-backend-wasm.js","../src/backend_wasm.ts","../src/version.ts","../src/base.ts"],"sourcesContent":["/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==*/\n\n// This enum must align with the enum defined in cc/backend.h.\nexport enum CppDType {\n float32 = 0,\n int32 = 1,\n bool = 2,\n string = 3,\n complex64 = 4\n}\n\n// Must match enum in cc/fusable_activations.h.\nexport enum FusableActivation {\n linear = 0,\n relu = 1,\n relu6 = 2,\n prelu = 3,\n leakyrelu = 4,\n sigmoid = 5,\n elu = 6\n}\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==*/\n\nimport {_FusedMatMul, _FusedMatMulAttrs, _FusedMatMulInputs, KernelConfig, KernelFunc} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {FusableActivation} from './types';\n\nlet wasmFusedMatMul:\n   (aId: number, aShape: Uint8Array, aShapeSize: number, bId: number,\n bShape: Uint8Array, bShapeSize: number, transposeA: boolean,\n   transposeB: boolean, activation: number,

biasId: number,\n preluActivationWeightsId: number, leakyreluAlpha: number, outId: number) =>\n void;\n\nfunction setup(backend: BackendWasm) {\n wasmFusedMatMul = backend.wasm.cwrap(_FusedMatMul, null /* void */, [\n 'number',
// a_id\n 'array', // a_shape\n 'number', // a_shape.length\n 'number', // b_id\n 'array', // b_shape\n 'number', // b_shape.length\n 'number', // transpose_a\n 'number', // transpose_b\n 'number', // activation\n 'number', // biasId\n 'number', // preluActivationWeightsId\n 'number', // leakyreluAlpha\n 'number' // out_id\n]);\n}\n\nfunction fusedBatchMatMul(args: {\n inputs: _FusedMatMulInputs,\n backend: BackendWasm,\n attrs: _FusedMatMulAttrs\n}) {\n const {inputs, backend, attrs} = args;\n const {a, b, bias, preluActivationWeights} = inputs;\n\n if (a.dtype !== 'float32' || b.dtype !== 'float32') {\n throw new Error(\n `_FusedMatMul for non non-float32 tensors not yet supported.`);\n }\n\n const {transposeA, transposeB, activation, leakyreluAlpha} = attrs;\n const aId = backend.dataIdMap.get(a.dataId).id;\n const bId = backend.dataIdMap.get(b.dataId).id;\n\n let biasId = 0;\n if (bias != null) {\n const biasData = backend.dataIdMap.get(bias.dataId);\n if (biasData.shape.length !== 1) {\n throw new Error(\n `_FusedMatMul only supports rank-1 bias but got ` +\n `rank ${biasData.shape.length}.`);\n }\n biasId = biasData.id;\n }\n const preluActivationWeightsId = preluActivationWeights == null ?\n 0 :\n backend.dataIdMap.get(preluActivationWeights.dataId).id;\n const fusedActivation =\n FusableActivation[activation as {} as keyof typeof FusableActivation];\n if (fusedActivation == null) {\n throw new Error(\n `${activation} activation not yet supported for FusedConv2D ` +\n `in the wasm backend.`);\n }\n\n const leftDim = transposeA ? a.shape[2] : a.shape[1];\n const rightDim = transposeB ? b.shape[1] : b.shape[2];\n const batchDim = a.shape[0];\n\n const out = backend.makeOutput([batchDim, leftDim, rightDim], a.dtype);\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n const aShapeBytes = new Uint8Array(new Int32Array(a.shape).buffer);\n const bShapeBytes = new Uint8Array(new Int32Array(b.shape).buffer);\n\n wasmFusedMatMul(\n aId, aShapeBytes, a.shape.length, bId, bShapeBytes, b.shape.length,\n transposeA, transposeB, fusedActivation, biasId, preluActivationWeightsId,\n leakyreluAlpha || 0, outId);\n\n return out;\n}\n\nexport const fusedMatMulConfig: KernelConfig = {\n kernelName: _FusedMatMul,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: fusedBatchMatMul as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES
OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n */\n\nimport {DataType, KernelConfig, TensorInfo, UnaryInputs, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {CppDType} from './types';\n\nexport function createUnaryKernelConfig(\n kernelName: string, outType?: DataType): KernelConfig {\n let wasmFunc: (xId: number, dtype: number, outId: number) => void;\n\n function setupFunc(backend: BackendWasm): void {\n wasmFunc = backend.wasm.cwrap(kernelName, null /* void */, [\n 'number', // x_id\n 'number', // dtype\n 'number', // out_id\n]);\n }\n\n function kernelFunc(args: {backend: BackendWasm, inputs: UnaryInputs}):\n TensorInfo {\n const {backend, inputs: {x}} = args;\n const xId = backend.dataIdMap.get(x.dataId).id;\n const out = backend.makeOutput(x.shape, outType || x.dtype);\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n // Short-circuit zero-sized tensors.\n if (util.sizeFromShape(out.shape) === 0) {\n return out;\n }\n\n wasmFunc(xId, CppDType[x.dtype], outId);\n return out;\n }\n\n return {kernelName, backendName: 'wasm', setupFunc, kernelFunc};\n}\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing,

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and\n * limitations under the License.\n *
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*/\nimport {Abs, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\n\nexport const absConfig: KernelConfig = createUnaryKernelConfig(Abs);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n
/\n\nimport {backend_util, BinaryInputs, DataType, KernelConfig, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {CppDType} from './types';\n\nexport function createBinaryKernelConfig(\n kernelName: string, supportsFullBroadcast: boolean,\n dtype?: DataType): KernelConfig {\n let wasmFunc:\n (aId: number, aShape: Uint8Array, aShapeLen: number, bId: number,\n bShape: Uint8Array, bShapeLen: number, dtype: number, outId: number) =>\n void;\n\n function setupFunc(backend: BackendWasm): void {\n wasmFunc = backend.wasm.cwrap(kernelName, null / void */, [\n 'number', // a_id,\n 'array', // a_shape\n 'number', // a_shape.length\n 'number', // b_id\n 'array', // b_shape\n 'number', // b_shape.length\n 'number', // dtype\n 'number' // out_id\n]);\n }\n\n function kernelFunc(args: {backend: BackendWasm, inputs: BinaryInputs}):\n TensorInfo {\n const {backend, inputs} = args;\n const {a, b} = inputs;\n const aId = backend.dataIdMap.get(a.dataId).id;\n const bId = backend.dataIdMap.get(b.dataId).id;\n\n const outputType = dtype != null ? dtype : a.dtype;\n const newShape = backend_util.assertAndGetBroadcastShape(a.shape, b.shape);\n const out = backend.makeOutput(newShape, outputType);\n\n // Short-circuit zero-sized tensors.\n if (util.sizeFromShape(newShape) === 0) {\n return out;\n }\n\n const aShapeBytes = new Uint8Array(new Int32Array(a.shape).buffer);\n const bShapeBytes = new Uint8Array(new Int32Array(b.shape).buffer);\n const outId = backend.dataIdMap.get(out.dataId).id;\n const kernelFunc = () => wasmFunc(\n aId, aShapeBytes, a.shape.length, bId, bShapeBytes, b.shape.length,\n CppDType[a.dtype], outId);\n\n // Currently only some float operations support full broadcast.\n if (supportsFullBroadcast && a.dtype === 'float32') {\n kernelFunc();\n return out;\n }\n\n const aBroadcastDims = backend_util.getBroadcastDims(a.shape, newShape);\n const bBroadcastDims = backend_util.getBroadcastDims(b.shape, newShape);\n const loopsOverAllOfA = aBroadcastDims.every((v, i) => v === i);\n const loopsOverAllOfB = bBroadcastDims.every((v, i) => v === i);\n if (loopsOverAllOfA && loopsOverAllOfB) {\n kernelFunc();\n return out;\n } else {\n throw new Error(\n `Broadcasting along outer dims is not yet ` +\n `supported for ${a.dtype} ${kernelName}.`);\n }\n }\n\n return {kernelName, backendName: 'wasm', setupFunc, kernelFunc};\n}\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required
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==========\n
*/\n\nimport {Add, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from './binary_kernel';\n\nconst supportsFullBroadcast = true;\n\nexport const addConfig: KernelConfig =\n

createBinaryKernelConfig(Add, supportsFullBroadcast);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {AddN, KernelConfig, KernelFunc, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {CppDType} from './types';\n\nlet wasmFunc:\n (inputIds: Uint8Array, inputIdsLen: number, dtype: number, outId: number) =>\n void;\n\nfunction setupFunc(backend: BackendWasm): void {\n wasmFunc = backend.wasm.cwrap(AddN, null /* void */, [\n 'array', // input_ids\n 'number', // input_ids.length\n 'number', // dtype\n 'number', // out_id\n]);\n}\n\nfunction addn(args: {inputs: TensorInfo[], backend: BackendWasm}) {\n const {inputs, backend} = args;\n const out = backend.makeOutput(inputs[0].shape, inputs[0].dtype);\n\n // Short-circuit zero-sized tensors.\n if (util.sizeFromShape(out.shape) === 0) {\n return out;\n }\n\n const inputIds = inputs.map(x => backend.dataIdMap.get(x.dataId).id);\n const inputIdsBytes = new Uint8Array(new Int32Array(inputIds).buffer);\n const outId = backend.dataIdMap.get(out.dataId).id;\n wasmFunc(inputIdsBytes, inputIds.length, CppDType[out.dtype], outId);\n\n return out;\n}\n\nexport const addNConfig: KernelConfig = {\n kernelName: AddN,\n backendName: 'wasm',\n setupFunc,\n kernelFunc: addn as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {Identity, IdentityInputs, KernelConfig, KernelFunc} from '@tensorflow/tfjs-core';\nimport {TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nexport function identity(args: {inputs: IdentityInputs, backend: BackendWasm}):\n TensorInfo {\n const {inputs: {x}, backend} = args;\n const out = backend.makeOutput(x.shape, x.dtype);\n const inVals = backend.typedArrayFromHeap(x);\n const outVals = backend.typedArrayFromHeap(out);\n outVals.set(inVals);\n return out;\n}\n\nexport const identityConfig: KernelConfig = {\n kernelName: Identity,\n backendName: 'wasm',\n kernelFunc: identity as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {KernelConfig, KernelFunc, TensorInfo, Transpose, TransposeAttrs, TransposeInputs} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {identity} from './Identity';\nimport {CppDType} from './types';\n\nlet wasmTranspose: (\n xId: number, xShape: Uint8Array, xShapeLength: number, dtype: CppDType,\n outId: number, perm: Uint8Array, permLength: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmTranspose = backend.wasm.cwrap(Transpose, null /* void */, [\n 'number', // xId\n

'array', // x.shape\n 'number', // x.shape.length\n 'number', // dtype\n 'number', // outId\n 'array', // perm\n 'number', // perm.length\n]);\n}\n\nexport function transpose(\n args:\n {inputs: TransposeInputs, backend: BackendWasm, attrs: TransposeAttrs}):\n TensorInfo {\n const {inputs, backend, attrs} = args;\n // Reduce any dimensions with size one. Lower-rank transpose kernel performs\n // better due to simpler memory access pattern.\n const [reducedShape, perm] = removeOneSizeDims(inputs.x.shape, attrs.perm);\n\n let permIsNoOp = true;\n for (let i = 0; i < perm.length; i++) {\n if (perm[i] !== i) {\n permIsNoOp = false;\n }\n }\n const outShape = computeOutShape(inputs.x.shape, attrs.perm);\n const x = {\n dataId: inputs.x.dataId,\n shape: reducedShape,\n dtype: inputs.x.dtype\n };\n\n if (permIsNoOp) {\n const cloned = identity({inputs, backend});\n cloned.shape = outShape;\n return cloned;\n }\n\n const out = backend.makeOutput(outShape, x.dtype);\n const xId = backend.dataIdMap.get(x.dataId).id;\n const outId = backend.dataIdMap.get(out.dataId).id;\n const permBytes = new Uint8Array(new Int32Array(perm).buffer);\n const xShapeBytes = new Uint8Array(new Int32Array(x.shape).buffer);\n\n wasmTranspose(\n xId, xShapeBytes, x.shape.length, CppDType[x.dtype], outId, permBytes,\n perm.length);\n return out;\n}\n\nfunction computeOutShape(inShape: number[], perm: number[]): number[] {\n const outShape = new Array(inShape.length);\n for (let i = 0; i < outShape.length; i++) {\n outShape[i] = inShape[perm[i]];\n }\n return outShape;\n}\n\nfunction removeOneSizeDims(\n shape: number[], perm: number[]): [number[], number[]] {\n const newShape: number[] = [];\n const newPerm: number[] = [];\n for (let i = 0; i < shape.length; ++i) {\n if (shape[i] !== 1) {\n newShape.push(shape[i]);\n }\n if (shape[perm[i]] !== 1) {\n newPerm.push(perm[i]);\n }\n }\n for (let i = 0; i < newPerm.length; ++i) {\n let minValIdx = -1;\n for (let j = 0; j < newPerm.length; ++j) {\n if (newPerm[j] >= i &&\n (minValIdx === -1 || newPerm[minValIdx] > newPerm[j])) {\n minValIdx = j;\n }\n }\n newPerm[minValIdx] = i;\n }\n return [newShape, newPerm];\n}\n\nexport const transposeConfig: KernelConfig = {\n kernelName: Transpose,\n backendName: 'wasm',\n kernelFunc: transpose as {} as KernelFunc,\n setupFunc: setup,\n};\n","/**\n * @license\n * Copyright 2020 Google Inc. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {backend_util, TensorInfo, util} from '@tensorflow/tfjs-core';\nimport {BackendWasm} from '../backend_wasm';\nimport {transpose} from './Transpose';\n\n/**\n * Compute permutation axes and do a transpose if necessary.\n *\n * Used by reduction ops.\n * @param x input TensorInfo\n * @param axis reduction axes\n * @param backend wasm backend instance\n */\nexport function permuteAxesAndTranspose(\n x: TensorInfo, axis: number|number[],\n backend: BackendWasm): {\n transposed: TensorInfo|null,\n axes: number[],\n originalAxes: number[],\n inputWasTransposed: boolean\n} {\n const xShape = x.shape;\n const xRank = x.shape.length;\n\n const originalAxes = util.parseAxisParam(axis, xShape);\n let axes = originalAxes;\n const permutedAxes = backend_util.getAxesPermutation(axes, xRank);\n let xTransposed = null;\n let inputWasTransposed = false;\n if (permutedAxes != null) {\n const newShape: number[] = new Array(xRank);\n for (let i = 0; i < newShape.length; i++) {\n newShape[i] = xShape[permutedAxes[i]];\n }\n\n axes = backend_util.getInnerMostAxes(axes.length, xRank);\n xTransposed =\n transpose({inputs: {x}, attrs: {perm: permutedAxes}, backend});\n\n const xId = backend.dataIdMap.get(x.dataId).id;\n const transposedId = backend.dataIdMap.get(xTransposed.dataId).id;\n if (transposedId !== xId) {\n inputWasTransposed = true;\n }\n }\n\n return {transposed: xTransposed, originalAxes, axes, inputWasTransposed};\n}\n","/**\n * @license\n * Copyright 2021 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this

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wasmAny(inputId, reduceSize, outId);\n }\n\n if (inputWasTransposed) {\n   // dispose of the transposed tensor.\n backend.disposeData(transposed.dataId);\n
  }\n\n if (keepDims) {\n   // reshape\n   const newShape = backend_util.expandShapeToKeepDim(out.shape, originalAxes);\n   out.shape = newShape;\n }\n\n return out;\n}\n\nexport const anyConfig: KernelConfig = {\n kernelName: Any,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: any as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n
 * ==\n */\n\nimport {ArgMax, ArgMaxAttrs, ArgMaxInputs, KernelConfig, KernelFunc, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {permuteAxesAndTranspose} from './kernel_utils';\nimport {CppDType} from './types';\n\nlet wasmFunc: (\n   xId: number, dtype: number, outerSize: number, innerSize: number,\n   outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmFunc = backend.wasm.cwrap(ArgMax, null /* void */, [\n   'number', // x_id\n   'number', // dtype\n 'number', // outer_size\n   'number', // inner_size\n   'number'   // out_id\n]);\n}\n\nfunction argmax(\n   args: {inputs: ArgMaxInputs, backend: BackendWasm, attrs: ArgMaxAttrs}) {\n const {backend, inputs, attrs} = args;\n const {axis} = attrs as {} as ArgMaxAttrs;\n const {x} = inputs as {} as ArgMaxInputs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n let inputId
 = xId;\n let input = x;\n\n const {transposed, axes, inputWasTransposed} =\n   permuteAxesAndTranspose(x, axis, backend);\n\n if (inputWasTransposed) {\n   const transposedId = backend.dataIdMap.get(transposed.dataId).id;\n   if (transposedId !== xId) {\n   // transpose was not a no-op. We will need to dispose of this\n   // once we are done.\n   input = transposed;\n   inputId = transposedId;\n   }\n }\n\n const outShape = input.shape.slice(0, -1);\n const out = backend.makeOutput(outShape, 'int32');\n const outId = backend.dataIdMap.get(out.dataId).id;\n const outerSize = util.sizeFromShape(out.shape);\n const innerSize = input.shape[axes[0]];\n wasmFunc(inputId, CppDType[input.dtype], outerSize, innerSize, outId);\n\n if (inputWasTransposed) {\n   // dispose of the transposed tensor.\n   backend.disposeData(transposed.dataId);\n }\n\n return out;\n}\n\nexport const argMaxConfig: KernelConfig = {\n kernelName: ArgMax,\n backendName: 'wasm',\n
  kernelFunc: argmax as {} as KernelFunc,\n setupFunc: setup\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
 * ==\n */\n\nimport {AvgPool, AvgPoolAttrs, AvgPoolInputs, backend_util, KernelConfig, KernelFunc, Tensor4D} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmAvgPool: (\n   xId:
 number, batchSize: number, inputHeight: number, inputWidth: number,\n   filterHeight: number, filterWidth: number, padTop: number, padRight: number,\n   padBottom: number, padLeft: number, strideHeight: number,\n stride Width: number, channels: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmAvgPool = backend.wasm.cwrap(AvgPool, null /* void */, [\n   'number', // xId\n   'number', // batchSize\n 'number', // inputHeight\n   'number', // inputWidth\n   'number', // filterHeight\n   'number', // filterWidth\n 'number', // padTop\n   'number', // padRight\n   'number', // padBottom\n   'number', // padLeft\n   'number', //

strideHeight\n 'number', // strideWidth\n 'number', // channels\n 'number', // outId\n]);\n}\n\nfunction avgPool(\n args: {inputs: AvgPoolInputs, backend: BackendWasm, attrs: AvgPoolAttrs}) {\n const {inputs, attrs, backend} = args;\n\n const x = inputs.x as Tensor4D;\n const xId = backend.dataIdMap.get(x.dataId).id;\n\n const {filterSize, strides, pad, dimRoundingMode} = attrs;\n const convInfo = backend_util.computePool2DInfo(\n x.shape, filterSize, strides, 1 /* dilations */, pad, dimRoundingMode);\n\n const filterHeight = convInfo.filterHeight;\n const filterWidth = convInfo.filterWidth;\n const padTop = convInfo.padInfo.top;\n const padRight = convInfo.padInfo.right;\n const padBottom = convInfo.padInfo.bottom;\n const padLeft = convInfo.padInfo.left;\n const strideHeight = convInfo.strideHeight;\n const strideWidth = convInfo.strideWidth;\n const channels = convInfo.inChannels;\n\n if (convInfo.dataFormat !== 'channelsLast') {\n throw new Error(\n `wasm backend does not support dataFormat:` +\n `${convInfo.dataFormat}'. Please use 'channelsLast'.`);\n }\n\n if (convInfo.dilationWidth !== 1 || convInfo.dilationHeight !== 1) {\n throw new Error(\n `was backend only supports average pooling with dilation = [1, 1], ` +\n `got [${convInfo.dilationHeight}, ${convInfo.dilationWidth}].`);\n }\n\n const out = backend.makeOutput(convInfo.outShape, 'float32');\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n wasmAvgPool(\n xId, x.shape[0], x.shape[1], x.shape[2], filterHeight, filterWidth,\n padTop, padRight, padBottom, padLeft, strideHeight, strideWidth, channels,\n outId);\n return out;\n}\n\nexport const avgPoolConfig: KernelConfig = {\n kernelName: AvgPool,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: avgPool as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {KernelConfig, KernelFunc, Reshape, ReshapeAttrs, ReshapeInputs, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nexport function reshape(\n args: {inputs: ReshapeInputs, attrs: ReshapeAttrs, backend: BackendWasm}) {\n const {inputs, attrs} = args;\n const {x} = inputs;\n const {shape} = attrs;\n\n const xSize = util.sizeFromShape(x.shape);\n const $shape = util.inferFromImplicitShape(shape, xSize);\n\n util.assert(\n xSize === util.sizeFromShape($shape),\n () => `new shape: ${$shape}, old shape: ${x.shape}. New shape and old ` +\n `shape must have the same number of elements.`);\n\n // Backend needs to track refCount for the dataId for reshape op\n args.backend.incRef(x.dataId);\n return {dataId: x.dataId, shape: $shape, dtype: x.dtype};\n}\n\nexport const reshapeConfig: KernelConfig = {\n kernelName: Reshape,\n backendName: 'wasm',\n kernelFunc: reshape as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {BatchMatMul, BatchMatMulAttrs, BatchMatMulInputs, KernelConfig, KernelFunc, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {reshape} from './Reshape';\n\nlet wasmBatchMatMul: (\n aId: number, aShape: Uint8Array, aShapeSize: number, bId: number,\n bShape: Uint8Array, bShapeSize: number, transposeA: boolean,\n transposeB: boolean, outId: number) =>

void;\n\nfunction setup(backend: BackendWasm) {\n wasmBatchMatMul = backend.wasm.cwrap(BatchMatMul, null /* void */, [\n   'number', // a_id\n   'array',   // a_shape\n   'number', // a_shape.length\n   'number', // b_id\n   'array',   // b_shape\n   'number', // b_shape.length\n   'number', // transpose_a\n   'number', // transpose_b\n   'number'   // out_id\n]);\n}\n\nfunction batchMatMul(args: {\n inputs: BatchMatMulInputs,\n backend: BackendWasm,\n attrs: BatchMatMulAttrs\n}) {\n const {inputs, backend, attrs} = args;\n const {a, b} = inputs;\n const
 {transposeA, transposeB} = attrs;\n\n if (a.dtype !== 'float32' || b.dtype !== 'float32') {\n   throw new Error(\n`BatchMatMul for non non-float32 tensors not yet supported.`);\n }\n\n const aRank = a.shape.length;\n const bRank = b.shape.length;\n\n const innerShapeA = transposeA ? a.shape[aRank - 2] : a.shape[aRank - 1];\n const innerShapeB = transposeB ? b.shape[bRank - 1] : b.shape[bRank - 2];\n\n const outerShapeA = transposeA ? a.shape[aRank - 1] : a.shape[aRank - 2];\n const outerShapeB = transposeB ? b.shape[bRank - 2] : b.shape[bRank - 1];\n\n const outerDimsA = a.shape.slice(0, -2);\n const outerDimsB = b.shape.slice(0, -2);\n\n const batchDimA = util.sizeFromShape(outerDimsA);\n const batchDimB = util.sizeFromShape(outerDimsB);\n\n const batchDimsCompatible =\n   batchDimA === batchDimB || batchDimA === 1 || batchDimB === 1;\n\n util.assert(\n   aRank >= 2 && bRank >= 2 && batchDimsCompatible,\n   () => `Error in matMul: the input batch dimensions
 must either be the ` +\n          `same or at least one input batch dimension must be 1. Got input ` +\n          `batch dimensions of (${outerDimsA}) and (${outerDimsB}).`);\n\n const outShapeOuterDims =\n   batchDimA > batchDimB ? a.shape.slice(0, -2) : b.shape.slice(0, -2);\n const outShape =
 outShapeOuterDims.concat([outerShapeA, outerShapeB]);\n\n util.assert(\n   innerShapeA === innerShapeB,\n   () => `Error in matMul: inner shapes (${innerShapeA}) and (` +\n   `${innerShapeB}) of Tensors with shapes ${a.shape} and ` +\n   `${b.shape} and transposeA=${transposeA}` +\n   ` and transposeB=${transposeB} must match.`);\n\n const a3dShape = transposeA ? [batchDimA, innerShapeA, outerShapeA] :\n[batchDimA, outerShapeA, innerShapeA];\n const b3dShape = transposeB ? [batchDimB, outerShapeB, innerShapeB] :\n   [batchDimB, innerShapeB, outerShapeB];\n\n // The rest of the implementation is
 designed to operate on rank-3 tensors\n const a3d = reshape({inputs: {x: a}, backend, attrs: {shape: a3dShape}});\n const b3d = reshape({inputs: {x: b}, backend, attrs: {shape: b3dShape}});\n\n const a3dId =
backend.dataIdMap.get(a3d.dataId).id;\n const b3dId = backend.dataIdMap.get(b3d.dataId).id;\n\n const leftDim = transposeA ? a3d.shape[2] : a3d.shape[1];\n const rightDim = transposeB ? b3d.shape[1] : b3d.shape[2];\n const batchDim = Math.max(batchDimA, batchDimB);\n\n const out = backend.makeOutput([batchDim, leftDim, rightDim], a3d.dtype);\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n const aShapeBytes = new Uint8Array(new Int32Array(a3d.shape).buffer);\n const bShapeBytes = new Uint8Array(new Int32Array(b3d.shape).buffer);\n\n wasmBatchMatMul(\n   a3dId, aShapeBytes, a3d.shape.length, b3dId, bShapeBytes,\n   b3d.shape.length, transposeA, transposeB, outId);\n\n backend.disposeData(a3d.dataId);\n backend.disposeData(b3d.dataId);\n\n out.shape =
 outShape;\n return out;\n}\n\nexport const batchMatMulConfig: KernelConfig = {\n kernelName: BatchMatMul,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: batchMatMul as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
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*/\nimport { backend_util, util } from '@tensorflow/tfjs-core';\nexport function

concatImpl(inputs, outShape, dtype, simplyConcat) {\n const outVals = util.getArrayFromDType(dtype, util.sizeFromShape(outShape));\n if (simplyConcat && dtype !== 'string') {\n // Use built-in TypedArray.set() method for speed.\n let offset = 0;\n inputs.forEach(input => {\n const size = util.sizeFromShape(input.shape);\n outVals.set(input.vals, offset);\n offset += size;\n });\n }\n else {\n let colOffset = 0;\n inputs.forEach(input => {\n const decodedData = dtype === 'string' ?\n backend_util.fromUint8ToStringArray(input.vals) :\n input.vals;\n let tIdx = 0;\n for (let row = 0; row < input.shape[0]; ++row) {\n const resIdx = row * outShape[1] + colOffset;\n for (let col = 0; col < input.shape[1]; ++col) {\n outVals[resIdx + col] = decodedData[tIdx++];\n }\n }\n colOffset += input.shape[1];\n });\n }\n return outVals;\n}\n//# sourceMappingURL=data:application/json; base64,eyJ2ZXJzaW9uIjozLCJmaWxlIjoiQ29uY2F0X2ltcGwuanMiLCJzb3VyY2VSb290IjoiIiwic291cmNlcyI6WyIuLi8uLi8uLi8uLi8uLi8uLi90ZmpzLWJhY2tlbmQtY3B1L3NyYy9rZXJuZWxzL0NvbmNhdF9pbXBsLnRzIl0sIm5hbWVzIjpbXSwibWFwcGluZ3MiOiJBQUFBOzs7Ozs7Ozs7Ozs7R0FlRztBQUVIRztBQUVILE9BQU8sRUFBRSxVQUFVLEVBQUUsTUFBTSxFQUFFLFVBQVUsRUFBRSxNQUFNLHVCQUF1QixDQUFDO0FBRXZFLE9BQU8sRUFBRSxzQkFBc0IsRUFBRSxNQUFNLHlCQUF5QixDQUFDO0FBRWp

cnQgZnVuY3Rpb24gY29uY2F0SW1wbChcbiAgICBpbnB1dHM6IEFycmF5PHt2YWxzOiBCYWNrZW5kVmFsdWVzLCBzaGFwZTogbnVtYmVyW119Piwgb3V0U2hhcGU6IG51bWJlcltdLFxuICAgIGR0eXBlOiBEYXRhVHlwZSwgc2ltcGx5Q29uY2F0OiBib29sZWFuKTogVHlwZWRBcnJheXxdHJpbmdbXSB7XG4gIHZhbHMgPSB1dGlsLmdldEFycmF5RnJvbURUeXBlKGR0eXBlLCB1dGlsLnNpemVGcm9tU2hhcGUob3V0U2hhcGUpKTtcbiAgcGUpKTtcblxuICBpZiAoc2ltcGx5Q29uY2F0ICYmIGR0eXBlICE9PSAnc3RyaW5nJykge1xuICAgIGNvbnN0IHZhbHNOdW1iZXIgPSB2YWxzIGFzIG51bWJlcltdO1xuICAgIHJldHVybiBtYWtlVGVuc29yKHZhbHNOdW1iZXIsIHNoYXBlLCBkdHlwZSk7XG4gIH1cblxuICBjb25zdCBvdXRwdXQgPSBidWZmZXIoc2hhcGUsIGR0eXBlKTtcbiAgY29uc3QgdmFsdWVzID0gb3V0cHV0LnZhbHVlcztcbiAgaWYgKGR0eXBlID09PSAnc3RyaW5nJykge1xuICAgIGZvciAobGV0IGkgPSAwOyBpIDwgdmFsdWVzLmxlbmd0aDsgaSsrKSB7XG4gICAgICB2YWx1ZXNbaV0gPSB1dGlsLmVuY29kZVN0cmluZyh2YWx1ZXNbaV0pO1xuICAgIH1cbiAgfVxuICByZXR1cm4gb3V0LnRvVGVuc29yKCk7XG59XG5cbmV4cG9ydCBjb25zdCBmcm9tUGl4ZWxzQ29uZmlnID0ge1xuICBrZXJuZWxOYW1lOiBGcm9tUGl4ZWxzLFxuICBpbXBsOiBmcm9tUGl4ZWxzLFxufTtcblxuZXhwb3J0IGNvbnN0IGZyb21QaXhlbHNDb25maWcgPSB7XG4gIGtlcm5lbE5hbWU6IEZyb21QaXhlbHMsXG4gIGltcGw6IGZyb21QaXhlbHMsXG59O1xuXG5leHBvcnQgY29uc3QgZnVsbHlDb25uZWN0ZWRDb25maWcgPSB7XG4gIGtlcm5lbE5hbWU6IEZ1bGx5Q29ubmVjdGVkLFxuICBpbXBsOiBmdWxseUNvbm5lY3RlZCxcbn07\"","/**\n
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 */\nimport { util } from '@tensorflow/tfjs-core';\nexport function rangeImpl(start, stop, step, dtype) {\n   const sameStartStop = start === stop;\n   const increasingRangeNegativeStep = start < stop && step < 0;\n   const decreasingRangePositiveStep = stop < start && step > 1;\n   if (sameStartStop || increasingRangeNegativeStep ||\n   decreasingRangePositiveStep) {\n   return util.makeZerosTypedArray(0, dtype);\n   }\n   const numElements = Math.abs(Math.ceil((stop - start) / step));\n   const values = util.makeZerosTypedArray(numElements, dtype);\n   if (stop < start && step === 1) {\n   // Auto adjust
 the step's sign if it hasn't been set\n   // (or was set to 1)\n   step = -1;\n   }\n   values[0] = start;\n   for (let i = 1; i < values.length; i++) {\n   values[i] = values[i - 1] + step;\n   }\n   return values;\n}\n//# sourceMappingURL=data:application/json; base64,eyJ2ZXJzaW9uIjozLCJmaWxlIjoiUmFuZ2VfaW1wbC5qcyIsInNvdXJjZVJvb3QiOiIiLCJzb3VyY2VzIjpbIi4uLy4uLy4uLy4uLy4uLy4uL3RmanMtYmFja2VuZC1jcHUvc3JjL2tlcm5lbHMvUmFuZ2VfaW1wbC50cyJdLCJuYW1lcyI6W10sImhcHBpbmdzIjoiQUFBQTs7Ozs7Ozs7Ozs7O0dBZUc7QUFFSCxPQUFPLEVBQUUsSUFBSSxFQUFFLE1BQU0sdUJBQXVCLENBQUM7QUFHN0MsTUFBTSxVVCLENBQUMsQUFBRSxLQUFLLEVBQUUsSUFBSSxFQUFFLElBQUksRUFBRSxLQUFLLEVBQUUsS0FBSyxFQUFFLEtBQUssRUFBRSxLQUFLLEVBQUUsS0FBSyxFQUFFLEtBQUssRUBBUSxTSxVQUFVLVLFNBQVMsQ0FBQyxDQUFDLENBQUMsQ0FBQyxDQUFDLENBQUMsQ0FBQyxDQUFDLENBQU

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BQ3BELG9CQUFvQjtRQUNwQixxJQUFJLEdBQUcsQ0FBQyxDQUFDLENBNBQUM7S0FDWDtJQUVELE1BQU0
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EMuIEFsbCBSaWdodHMgUmVzZXJ2ZWQuXG4gKiBMaWNlbnNlZCB1bmRlciB0aGUgQXBhY2hlIExpY2Vuc
2UsIFZlcnNpb24gMi4wICh0aGUgXCJMaWNlbnNlXCIpO1xuICogeW91IG1heSBub3QgdXNlIHRoaXMgZmlsZ
SBleGNlcHQgaW4gY29tcGxpYW5jZSB3aXRoIHRoZSBMaWNlbnNlLlxuICogWW91IG1heSBvYnRhaW4gYSB
jb3B5IG9mIHRoZSBMaWNlbnNlIGF0XG4gKlxuICogaHR0cDovL3d3dy5hcGFjaGUub3JnL2xpY2Vuc2VzL0xJ
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2luZ1JhbmdlTmVnYXRpdmVTdGVwID0gc3RlcCA+IDA7XG4gIGNvbnN0IHNhbWVTdGFydFN0b3AgPSBzdGFydCA
gKiBsaW1pdGF0aW9ucyB1bmRlciB0aGUgTGljZW5zZS5cbiAgICBzdGFydCA9PT0gc3RvcCAmJiBzdGFydCA9PT09PT09PT09PT09PT09PT09PT09PT09PT09PT09PT09PT09PT09PT09PT09PT09PT09PT09PT09

= dtype === 'string' ?\n backend_util.fromUint8ToStringArray(vals) :\n vals;\n const inBuf = buffer(shape, dtype, decodedData);\n const outBuf = buffer(size, dtype);\n for (let i = 0; i < outBuf.size; ++i) {\n const outLoc = outBuf.indexToLoc(i);\n const inLoc = outLoc.map((idx, j) => idx + begin[j]);\n outBuf.set(inBuf.get(...inLoc), ...outLoc);\n }\n if (dtype === 'string') {\n return backend_util.fromStringArrayToUint8(outBuf.values);\n }\n return outBuf.values;\n}\nexport function slice(args) {\n const { inputs, backend, attrs } = args;\n const { x } = inputs;\n const { begin, size } = attrs;\n assertNotComplex(x, 'slice');\n const [$begin, $size] = slice_util.parseSliceParams(x, begin, size);\n slice_util.assertParamsValid(x, $begin, $size);\n const vals = backend.data.get(x.dataId).values;\n const outVals = sliceImpl(vals, $begin, $size, x.shape, x.dtype);\n return backend.makeTensorInfo($size, x.dtype, outVals);\n}\nexport const sliceConfig = {\n kernelName: Slice,\n backendName: 'cpu',\n kernelFunc: slice\n};\n//# sourceMappingURL=data:application/json; base64,eyJ2ZXJzaW9uIjozLCJmaWxlIjoiU2xpY2UuanMiLCJzb3VyY2VSb290IjoiIiwic291cmNlcyI6WyIuLi8uLi8uLi8uLi8uLi8uLi90ZmpzLWJhY2tlbmQtY3B1L3NyYy9rZXJuZWxzL1NsaWNlLnRzIl0sIm5hbWVzIjpbXSwibWFwcGluZ3MiOiJBQUFBOzs7Ozs7Ozs7Ozs7R0FlRztBQU8sRUFBQyxDQUFDLEVBQUUsQ0FBQyxFQUFFLENBQUMsRUFBRSxDQUFDLEVBQUUsQ

xDQUFDLEtBQUssQ0FBQyxDQUFDO0lBQ2pFLE9BQU8sT0FBTyxDQUFDLGNBQWMsQ0FBQyxLQUFLLE
VBQUUsQ0FBQyxDQUFDLEtBQUssRUFBRSxPQUFPLENBMsQ0FBQztBQUN6RCxjQUNqQixXQUFXLE
UFBTSxDQUFDLE1BQU0sV0FBVyxHQUFpQjtJQUN2QyxVQUFVLEVBQUUsS0FBSztJQUN
VBQUUsS0FBSztJQUNsQixVQUFVLEVBQUUsS0FBeUI7Q0FDdEMsMsQ0FBQyIsInNvdXJjZXNDb250ZW50Ijp
bIi8qKlxuICogQGxpY2Vuc2VcbiAqIENvcHlyaWdodCAyMDIwIEdvb2dsZSBMTEMuIEFsbCBSaWdodHMgUm
VzZXJ2ZWQuXG4gKiBMaWNlbnNlZCB1bmRlciB0aGUgQXBhY2hlIExpY2Vuc2UsIFZlcnNpb24gMi4wICh0a
GUgXCJMaWNlbnNlXCIpO1xuICogeW91IG1heSBub3QgdXNlIHRoaXMgZmlsZSBleGNlcHQgaW4gY29tcGxp
YW5jZSB3aXRoIHRoZSBMaWNlbnNlLlxuICogWW91IG1heSBvYnRhaW4gYSBjb3B5IG9mIHRoZSBMaWNlbnNlIG
nNlIGF0XG4gKlxuICogaHR0cDovL3d3dy5hcGFjaGUub3JnL2xpY2Vuc2VzL0xJQ0VOU0UtMi4wXG4gKlxuIC
ogVW5sZXNzIHJlcXVpcmVkIGJ5IGFwcGxpY2FibGUgbGF3IG9yIGFncmVlZCB0byBpbiB3cml0aW5nLCBzb2
Z0d2FyZVxuICogZGlzdHJpYnV0ZWQgdW5kZXIgdGhlIExpY2Vuc2UgaXMgZGlzdHJpYnV0ZWQgb24gYW4g
XCJBUyBJU1wiIEJBU0lTLFxuICogV0lUSE9VVCBXQVJSQU5USUVTIE9SIENPTkRJVElPTlMgT0YgQU5ZI
EtJTkQsIGVpdGhlciBleHByZXNzIG9yIGltcGxpZWQuXG4gKiBiIExpY2Vuc2UgZm9yIHRoZSBzc
GVjaWZpYyBsYW5ndWFnZSBnb3Zlcm5pbmcgcGVybWlzc2lvbnMgYW5kXG4gKiBsaW1pdGF0aW9ucyB1bm
RlciB0aGUgTGljZW5zZS5cbiAqID09PT09PT09PT09PT09PT09PT09PT09PT09PT09PT09PT09PT09PT09PT09P
T09PT09PT09PT09PT09PT09PT09PT09PT09PT09PT09XG4gKi9cblxuaW1wb3J0IHtiYWNrZW5kX3V0aWwsIE
JhY2tlbmRWYWx1ZXMsIGJ1ZmZlciwgRGF0YVR5cGUsIEtlcm5lbENvbmZpZywgS2VybmVsRnVuYywgU2xp
Y2UsIHNsaWNlX3V0aWwsIFNsaWNlQXR0cnMsIFNsaWNlSW5wdXRzLCBUZW5zb3JJbmZvLCBUeXBlZEF
ycmF5LCB1dGlsSBmcm9tICdAdGVuc29yZmxvdy90ZmpzLWNvcmUnO1xuXG5pbXBvcnQge01hdGhCYWNr
ZW5kQ1BVfSBmcm9tICcuLi9iYWNrZW5kX2NwdSc7XG5pbXBvcnQge2Fzc2VydE5vdENvbXBsZXh9IGZyb2
0gJy4uL2NwdV91dGlsJztcblxuZXhwb3J0IGZ1bmN0aW9uIHNsaWNlSW1wbChcbiAgICB2YWxzdWVzLCBiZWdpbjogbnVtYmVyW10sIHNpemU6IG51bWJlcltdLCBzaGFwZTogbnVtYmVyW10sXG4gICAgZHR5cGU6IERhdGFUeXBlKTogQmFja2VuZENQVURhdGEge1xuICBjb25zdCBuID0gc2l6ZS5yZWR1Y2UoKGEsIGIpID0+IGEgKiBiKTtcbiAgY2
xpY2VfdXRpbC5pc1NsaWNlQ29udGlub3VzKHNoYXBlLCBiZWdpbiwgc2l6ZSk7XG4gIGNvbnN0IHZhbHVlcyA9IG
JhY2tlbmRWYWx1ZXMsIGJ1ZmZlciwgRGF0YVR5cGUsIEtlcm5lbENvbmZpZywgS2VybmVsRnVuYywgU2xp
Y2UsIHNsaWNlX3V0aWwsIFNsaWNlQXR0cnMsIFNsaWNlSW5wdXRzLCBUZW5zb3JJbmZvLCBUeXBlZEF
ycmF5LCB1dGlsSBmcm9tICdAdGVuc29yZmxvdy90ZmpzLWNvcmUnO1xuXG5pbXBvcnQge2Fzc2VydE5vdENvbXBsZXh9IGZyb2
ZW5kQ1BVfSBmcm9tICcuLi9iYWNrZW5kX2NwdSc7XG5pbXBvcnQge2Fzc2VydE5vdENvbXBsZXh9IGZyb2
4gICAgZHR5cGU6IERhdGFUeXBlKTogQmFja2VuZENQVURhdGEge1xuICBjb25zdCBuID0gc2l6ZS5yZWR1Y2UoKGEsIGIpID0+IGEgKiBiKTtcbiAgY2
xpY2VfdXRpbC5pc1NsaWNlQ29udGlub3VzKHNoYXBlLCBiZWdpbiwgc2l6ZSk7XG4gIGNvbnN0IGlzQ29udGlub3VzKHNoYXBlLCBiZWdpbiwgc2l6ZSk7XG4gIGNvbnN0IHZhbHVlcyA9IG
A9IHV0aWwuc2l6ZUZyb21TaGFwZShzaXplKTtcbiAgY29uc3QgeFN0cmlkZXMgPSB1dGlsLmNvbXB1dGVTd
HJpZGVzKHNoYXBlKTtcblxuICBpZiAoaXNDb250aW5vdXMpIHtcbiAgICBjb25zdCBwaXBlKTtcbiAgICBjb25zdCB2Zmc2V0ID0gc2l6ZSk7XG4gIH1cblxuICBjb25zdCB2ZlRpbC5pc1NsaWNlQ29udGlub3VzKHNoYXBlLCBiZWdpbiwgc2l6ZSk7XG4gIGNvbnN0IHZhbHVlcyA9IG
xpY2VfdXRpbC5pc1NsaWNl

VUZW5zb3JJbmZvKCRzaXplLCB4LmR0eXBlLCBvdXRWYWxzKTtcbn1cblxuZXhwb3J0IGNvbnN0IHNsaWNlQ29uZmlnOiBLZXJuZWxDb25maWcgPSB7XG4gIGtlcm5lbE5hbWU6IFNsaWNlLFxuICBiYWNrZW5kTmFtZTogJ3dhc20nLFxuICBrZXJuZWxGdW5jOiBzbGljZSxcbn07XG5leHBvcnQgZnVuY3Rpb24gc2xpY2UoXG4gIGFyZ3M6IHtpbnB1dHM6IFNsaWNlSW5wdXRzLCBhdHRyczogU2xpY2VBdHRycywgYmFja2VuZDogQmFja2VuZFdhc219KSB7XG4gIGNvbnN0IHtpbnB1dHM6IHt4fSwgYXR0cnM6IHtiZWdpbiwgc2l6ZX0sIGJhY2tlbmR9ID0gYXJnczsiLCJmaWxlIjoiIiwiLyoqXG4gKiBAbGljZW5zZVxuICogQ29weXJpZ2h0IDIwMTkgR29vZ2xlIExMQy4gQWxsIFJpZ2h0cyBSZXNlcnZlZC5cbiAqIExpY2Vuc2VkIHVuZGVyIHRoZSBBcGFjaGUgTGljZW5zZSwgVmVyc2lvbiAyLjAgKHRoZSBcIkxpY2Vuc2VcIik7XG4gKiB5b3UgbWF5IG5vdCB1c2UgdGhpcyBmaWxlIGV4Y2VwdCBpbiBjb21wbGlhbmNlIHdpdGggdGhlIExpY2Vuc2UuXG4gKiBZb3UgbWF5IG9idGFpbiBhIGNvcHkgb2YgdGhlIExpY2Vuc2UgYXRcbiAqXG4gKiBodHRwOi8vd3d3LmFwYWNoZS5vcmcvbGljZW5zZXMvTElDRU5TRS0yLjBcbiAqXG4gKiBVbmxlc3MgcmVxdWlyZWQgYnkgYXBwbGljYWJsZSBsYXcgb3IgYWdyZWVkIHRvIGluIHdyaXRpbmcsIHNvZnR3YXJlXG4gKiBkaXN0cmlidXRlZCB1bmRlciB0aGUgTGljZW5zZSBpcyBkaXN0cmlidXRlZCBvbiBhbiBcIkFTIElTXCIgQkFTSVMsXG4gKiBXSVRIT1VUIFdBUlJBTlRJRVMgT1IgQ09ORElUSU9OUyBPRiBBTlkgS0lORCwgZWl0aGVyIGV4cHJlc3Mgb3IgaW1wbGllZC5cbiAqIFNlZSB0aGUgTGljZW5zZSBmb3IgdGhlIHNwZWNpZmljIGxhbmd1YWdlIGdvdmVybmluZyBwZXJtaXNzaW9ucyBhbmRcbiAqIGxpbWl0YXRpb25zIHVuZGVyIHRoZSBMaWNlbnNlLlxuICpcbiA9PT09PT09PT09

outVals.set(xVals.subarray(xOffset, xOffset + size[3]), outOffset);\n outOffset += size[3];\n }\n }\n }\n}\n\nexport const sliceConfig: KernelConfig = {\n kernelName: Slice,\n backendName: 'wasm',\n kernelFunc: slice as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2021 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed
under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n */\n\nimport {backend_util, BatchToSpaceND, BatchToSpaceNDAttrs, BatchToSpaceNDInputs, KernelConfig, KernelFunc} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {reshape} from './Reshape';\nimport {slice} from './Slice';\nimport {transpose} from './Transpose';\n\nfunction batchToSpaceND(args: {\n inputs: BatchToSpaceNDInputs,\n backend: BackendWasm,\n attrs: BatchToSpaceNDAttrs\n}) {\n const {inputs, backend, attrs} = args;\n const {x} = inputs;\n const {blockShape, crops} = attrs;\n\n const prod = blockShape.reduce((a, b) => a * b);\n\n const reshaped = backend_util.getReshaped(x.shape, blockShape, prod);\n const
permuted = backend_util.getPermuted(reshaped.length, blockShape.length);\n const reshapedPermuted =\n backend_util.getReshapedPermuted(x.shape, blockShape, prod);\n const sliceBeginCoords =\n backend_util.getSliceBeginCoords(crops, blockShape.length);\n const sliceSize =\n backend_util.getSliceSize(reshapedPermuted, crops, blockShape.length);\n\n const xReshaped = reshape({inputs: {x}, backend, attrs: {shape: reshaped}});\n const xTransposed =\n transpose({inputs: {x: xReshaped}, backend, attrs: {perm: permuted}});\n const xTransposedReshaped = reshape(\n {inputs: {x: xTransposed}, backend, attrs: {shape: reshapedPermuted}});\n const result = slice({\n inputs: {x: xTransposedReshaped},\n backend,\n attrs: {begin: sliceBeginCoords, size: sliceSize}\n });\n\n backend.disposeData(xReshaped.dataId);\n backend.disposeData(xTransposed.dataId);\n backend.disposeData(xReshaped.dataId);\n\n return result;\n}\n\nexport const batchToSpaceNDConfig: KernelConfig
= {\n kernelName: BatchToSpaceND,\n backendName: 'wasm',\n kernelFunc: batchToSpaceND as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n */\n\nimport {Cast, CastAttrs, CastInputs, KernelConfig, KernelFunc} from '@tensorflow/tfjs-core';\nimport {TensorInfo} from '@tensorflow/tfjs-core';\n\nimport
{BackendWasm} from '../backend_wasm';\n\nexport function cast(\n args: {inputs: CastInputs, attrs: CastAttrs, backend: BackendWasm}):\n TensorInfo {\n const {inputs: {x}, attrs: {dtype}, backend} = args;\n const out = backend.makeOutput(x.shape, dtype);\n const inVals = backend.typedArrayFromHeap(x);\n const outVals = backend.typedArrayFromHeap(out);\n outVals.set(inVals);\n return out;\n}\n\nexport const castConfig: KernelConfig = {\n kernelName: Cast,\n backendName: 'wasm',\n kernelFunc: cast as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2021 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed

on an \"AS IS\" BASIS,\n
 * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n
*/\nimport {KernelConfig, Ceil} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\n\nexport const ceilConfig: KernelConfig = createUnaryKernelConfig(Ceil);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n
 * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n
/\n\nimport {ClipByValue, ClipByValueAttrs, ClipByValueInputs, KernelConfig, KernelFunc} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmClip: (xId: number, min: number, max: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmClip = backend.wasm.cwrap(ClipByValue, null / void */, [\n   'number', // x_id\n   'number', // min\n   'number', // max\n   'number'   // out_id\n]);\n}\n\nfunction clip(args: {\n inputs: ClipByValueInputs,\n backend: BackendWasm,\n attrs: ClipByValueAttrs\n}) {\n const {inputs, backend, attrs} = args;\n const {x} = inputs;\n const {clipValueMin, clipValueMax} = attrs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n const out = backend.makeOutput(x.shape, x.dtype);\n const outId = backend.dataIdMap.get(out.dataId).id;\n
  wasmClip(xId, clipValueMin, clipValueMax, outId);\n return out;\n}\n\nexport const clipByValueConfig: KernelConfig = {\n kernelName: ClipByValue,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: clip as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n
*/\n\nimport
 {backend_util, Concat, ConcatAttrs, ConcatInputs, KernelConfig, KernelFunc, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\nimport {concatImplCPU} from '../kernel_utils/shared';\nimport {identity} from './Identity';\nimport {reshape} from './Reshape';\n\nexport function concat(\n   args: {inputs: ConcatInputs, backend: BackendWasm, attrs: ConcatAttrs}) {\n const {inputs, backend} = args;\n\n const axis = util.parseAxisParam(args.attrs.axis, inputs[0].shape)[0];\n\n let outShape = backend_util.computeOutShape(inputs.map(t => t.shape), axis);\n\n // Keep only non-empty tensors (ignore tensors with 0 in their shape).\n const $inputs = inputs.filter(t => util.sizeFromShape(t.shape) > 0);\n if ($inputs.length === 1) {\n   return identity({inputs: {x: $inputs[0]}, backend});\n }\n\n const out = backend.makeOutput(outShape, inputs[0].dtype);\n\n if (util.sizeFromShape(outShape) === 0) {\n   return out;\n }\n\n const shapes = $inputs.map(t
 => t.shape);\n backend_util.assertParamsConsistent(shapes, axis);\n\n if ($inputs[0].dtype === 'string') {\n   // Any concat of n-dimensional tensors across any axis can be reduced to\n   // a concatenation of two-dimensional tensors across the axis 1 by first\n   // partitioning the axes of the original tensors into those less than the\n   // axis to be concatenated and the rest. Then reshape the tensors\n   // into a two-dimensional tensor by collapsing these two sets of axes and\n   // concatenate the resulting matrices across the axis 1, finally reshaping\n   // the result to have the proper shape.\n   const inputs2D = $inputs.map(t => {\n   const innerSize =

util.sizeFromShape(t.shape.slice(axis));\n const shape = [-1, innerSize];\n return reshape({inputs: {x: t}, backend, attrs: {shape}});\n });\n\n const inputsValShapes = inputs2D.map(t => {\n return {vals: backend.readSync(t.dataId), shape: t.shape};\n });\n\n // Concats 2d tensors along axis=1.\n outShape =\n backend_util.computeOutShape(inputs2D.map(t => t.shape), 1 /* axis */);\n const simplyConcat = inputs2D[0].shape[0] === 1;\n const outVals = concatImplCPU(\n inputsValShapes, outShape, inputs[0].dtype,\n simplyConcat) as string[];\n\n const finalOutShape =\n backend_util.computeOutShape($inputs.map(t => t.shape), axis);\n\n out.shape = finalOutShape;\n const outData = backend.dataIdMap.get(out.dataId);\n outData.stringBytes = backend_util.fromStringArrayToUint8(outVals);\n\n inputs2D.forEach(t => backend.disposeData(t.dataId));\n\n return out;\n }\n\n const batchDim = util.sizeFromShape($inputs[0].shape.slice(0, axis));\n let sumInnerDims = 0;\n const innerDims = $inputs.map(input => {\n const innerDim = util.sizeFromShape(input.shape.slice(axis));\n sumInnerDims += innerDim;\n return innerDim;\n });\n const inVals = $inputs.map(input => backend.typedArrayFromHeap(input));\n const outVals = backend.typedArrayFromHeap(out);\n for (let b = 0; b < batchDim; b++) {\n let outOffset = b * sumInnerDims;\n for (let i = 0; i < inVals.length; i++) {\n const innerDim = innerDims[i];\n const inOffset = b * innerDim;\n const vals = inVals[i].subarray(inOffset, inOffset + innerDim);\n outVals.set(vals, outOffset);\n outOffset += innerDim;\n }\n }\n return out;\n}\n\nexport const concatConfig: KernelConfig = {\n kernelName: Concat,\n backendName: 'wasm',\n kernelFunc: concat as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ===\n */\n\nimport {backend_util, Conv2D, Conv2DAttrs, Conv2DInputs, KernelConfig, KernelFunc, Tensor4D} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmConv2d: (\n xId: number, batchSize: number, inputHeight: number, inputWidth: number,\n filterId: number, filterHeight: number, filterWidth: number, padTop: number,\n padRight: number, padBottom: number, padLeft: number, isSamePad: number,\n dilationHeight: number, dilationWidth: number, strideHeight: number,\n strideWidth: number, inputChannels: number, outputChannels: number,\n outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmConv2d = backend.wasm.cwrap(Conv2D, null /* void */, [\n 'number', // xId\n 'number', // batchSize\n 'number', // inputHeight\n 'number', // inputWidth\n 'number', // filterId\n 'number', // filterHeight\n 'number', // filterWidth\n 'number', // padTop\n 'number', // padRight\n 'number', // padBottom\n 'number', // padLeft\n 'number', // isSamePad\n 'number', // dilationHeight\n 'number', // dilationWidth\n 'number', // strideHeight\n 'number', // strideWidth\n 'number', // inputChannels\n 'number', // outputChannels\n 'number', // outId\n]);\n}\n\nfunction conv2d(\n args: {inputs: Conv2DInputs, backend: BackendWasm, attrs: Conv2DAttrs}) {\n const {inputs, attrs, backend} = args;\n\n const {x, filter} = inputs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n const filterId = backend.dataIdMap.get(filter.dataId).id;\n\n const {strides, dilations, pad, dimRoundingMode, dataFormat} = attrs;\n const $dataFormat = backend_util.convertConv2DDataFormat(dataFormat);\n const convInfo = backend_util.computeConv2DInfo(\n (x as Tensor4D).shape, (filter as Tensor4D).shape, strides, dilations,\n pad, dimRoundingMode, false, $dataFormat);\n\n const filterHeight = convInfo.filterHeight;\n const filterWidth = convInfo.filterWidth;\n const padTop = convInfo.padInfo.top;\n const padRight = convInfo.padInfo.right;\n const padBottom = convInfo.padInfo.bottom;\n const padLeft = convInfo.padInfo.left;\n const dilationHeight = convInfo.dilationHeight;\n const dilationWidth =

convInfo.dilationWidth;\n const strideHeight = convInfo.strideHeight;\n const strideWidth = convInfo.strideWidth;\n const inputChannels = convInfo.inChannels;\n const outputChannels = convInfo.outChannels;\n const isSamePad = convInfo.padInfo.type === 'SAME' ? 1 : 0;\n\n if (convInfo.dataFormat !== 'channelsLast') {\n   throw new Error(\n   `wasm backend Conv2D does not support dataFormat:` +\n   `${convInfo.dataFormat}'. Please
 use 'channelsLast'.`);\n }\n\n const out = backend.makeOutput(convInfo.outShape, 'float32');\n const outId = backend.dataIdMap.get(out.dataId).id;\n wasmConv2d(\n   xId, x.shape[0], x.shape[1], x.shape[2], filterId, filterHeight,\n   filterWidth, padTop, padRight, padBottom, padLeft, isSamePad,\n   dilationHeight, dilationWidth, strideHeight, strideWidth, inputChannels,\n   outputChannels, outId);\n return out;\n}\n\nexport const conv2DConfig: KernelConfig = {\n kernelName: Conv2D,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: conv2d as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under
 the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n */\n\nimport {backend_util, Conv2DBackpropInput, Conv2DBackpropInputAttrs, Conv2DBackpropInputInputs, KernelConfig, KernelFunc, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmConv2DBackpropInput: (\n   dyId: number, filterId: number, batchSize: number, filterHeight: number,\n   filterWidth: number, inHeight: number, inWidth: number, inChannels: number,\n   outHeight: number, outWidth: number, outChannels: number,\n   strideHeight: number, strideWidth: number, topPad: number, leftPad: number,\n   fltS0: number, fltS1: number, fltS2: number, xBatchStride: number,\n   xRowStride: number, xColStride: number,
 xChannelStride: number,\n   yBatchStride: number, yRowStride: number, yColStride: number,\n   yChannelStride: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n wasmConv2DBackpropInput = backend.wasm.cwrap(Conv2DBackpropInput, null, [\n   'number', // dyId\n   'number', // filterId\n   'number', // batchSize\n   'number', // filterHeight\n   'number', // filterWidth\n   'number', // inHeight\n   'number', // inWidth\n   'number', // inChannels\n   'number', // outHeight\n   'number', // outWidth\n   'number', // outChannels\n   'number', // strideHeight\n   'number', // strideWidth\n   'number', // topPad\n   'number', // leftPad\n   'number', // fltS0\n   'number', // fltS1\n   'number', // fltS2\n   'number', // xBatchStride\n   'number', // xRowStride\n   'number', // xColStride\n   'number', // xChannelStride\n   'number', // yBatchStride\n   'number', // yRowStride\n   'number', // yColStride\n
 'number', // yChannelStride\n   'number', // outId\n]);\n}\n\nfunction conv2DBackpropInput(args: {\n backend: BackendWasm,\n inputs: Conv2DBackpropInputInputs,\n attrs: Conv2DBackpropInputAttrs\n}): TensorInfo {\n const {backend, inputs, attrs} = args;\n const {dy, filter} = inputs;\n const {strides, pad, dataFormat, dimRoundingMode, inputShape} = attrs;\n\n const dilations = 1;\n\n const $dataFormat = backend_util.convertConv2DDataFormat(dataFormat);\n const convInfo = backend_util.computeConv2DInfo(\n   inputShape, filter.shape as [number, number, number, number], strides,\n   dilations, pad, dimRoundingMode, false /* depthwise */, $dataFormat);\n const {\n   batchSize,\n   filterHeight,\n   filterWidth,\n   inChannels,\n   inHeight,\n   inWidth,\n   outChannels,\n   outHeight,\n   outWidth,\n   strideHeight,\n   strideWidth\n } = convInfo;\n\n const topPad = filterHeight - 1 - convInfo.padInfo.top;\n const leftPad = filterWidth - 1 - convInfo.padInfo.left;\n\n
  const isChannelsLast = convInfo.dataFormat === 'channelsLast';\n const dxStrides = util.computeStrides(convInfo.inShape);\n const dyStrides = util.computeStrides(dy.shape);\n const [fltS0, fltS1, fltS2] = util.computeStrides(filter.shape);\n const xBatchStride = dxStrides[0];\n const xRowStride =

isChannelsLast ? dxStrides[1] : dxStrides[2];\n const xColStride = isChannelsLast ? dxStrides[2] : 1;\n const xChannelStride = isChannelsLast ? 1 : dxStrides[1];\n const yBatchStride = dyStrides[0];\n const yRowStride = isChannelsLast ? dyStrides[1] : dyStrides[2];\n const yColStride = isChannelsLast ? dyStrides[2] : 1;\n const yChannelStride = isChannelsLast ? 1 : dyStrides[1];\n\n const out = backend.makeOutput(convInfo.inShape, 'float32');\n const outId = backend.dataIdMap.get(out.dataId).id;\n const dyId = backend.dataIdMap.get(dy.dataId).id;\n const filterId = backend.dataIdMap.get(filter.dataId).id;\n\n wasmConv2DBackpropInput(\n   dyId, filterId, batchSize,
 filterHeight, filterWidth, inHeight, inWidth,\n   inChannels, outHeight, outWidth, outChannels, strideHeight, strideWidth,\n   topPad, leftPad, fltS0, fltS1, fltS2, xBatchStride, xRowStride,\n   xColStride, xChannelStride, yBatchStride, yRowStride, yColStride,\n   yChannelStride, outId);\n return out;\n}\n\nexport const conv2DBackpropInputConfig: KernelConfig = {\n kernelName: Conv2DBackpropInput,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: conv2DBackpropInput as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES
 OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n
*/\n\nimport {Cos, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\n\nexport const cosConfig: KernelConfig = createUnaryKernelConfig(Cos);\n","/**\n * @license\n * Copyright 2021 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the
 specific language governing permissions and\n * limitations under the License.\n *
==\n
*/\nimport {Cosh, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\n\nexport const coshConfig: KernelConfig = createUnaryKernelConfig(Cosh);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
 ==\n
*/\n\nimport {CropAndResize, CropAndResizeAttrs, CropAndResizeInputs, KernelConfig, KernelFunc, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {cast} from './Cast';\n\n// Must match enum in CropAndResize.cc\nenum InterpolationMethod {\n bilinear = 0,\n nearest = 1\n}\n\nlet wasmCropAndResize: (\n   imagesId: number, boxesId: number, boxIndId: number, numBoxes: number,\n   imagesShape: Uint8Array, cropHeight: number, cropWidth: number,\n   method: number, extrapolationValue: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n wasmCropAndResize = backend.wasm.cwrap(CropAndResize, null /*void*/, [\n   'number', // imagesId\n   'number', // boxesId\n   'number', // boxIndId\n   'number', // numBoxes\n   'array',   // images shape\n   'number', // cropHeight\n   'number', // cropWidth\n   'number', // method\n

'number', // extrapolation value\n 'number' // out id\n]);\n}\n\nfunction cropAndResize(args: {\n backend: BackendWasm,\n inputs: CropAndResizeInputs,\n attrs: CropAndResizeAttrs\n}): TensorInfo {\n const {backend, inputs, attrs} = args;\n const {method, extrapolationValue, cropSize} = attrs;\n const {image, boxes, boxInd} = inputs;\n\n const numBoxes = boxes.shape[0];\n\n const [cropHeight, cropWidth] = cropSize as [number, number];\n const outShape = [numBoxes, cropHeight, cropWidth, image.shape[3]];\n\n let imagesData = backend.dataIdMap.get(image.dataId);\n let castedData;\n if (image.dtype !== 'float32') {\n castedData = cast({backend, inputs: {x: image}, attrs: {dtype: 'float32'}});\n imagesData = backend.dataIdMap.get(castedData.dataId);\n }\n\n const imagesId = imagesData.id;\n const boxesId = backend.dataIdMap.get(boxes.dataId).id;\n const boxIndId = backend.dataIdMap.get(boxInd.dataId).id;\n\n const out = backend.makeOutput(outShape, 'float32');\n
const outId = backend.dataIdMap.get(out.dataId).id;\n\n const imagesShapeBytes = new Uint8Array(new Int32Array(image.shape).buffer);\n\n wasmCropAndResize(\n imagesId, boxesId, boxIndId, numBoxes, imagesShapeBytes, cropHeight,\n cropWidth,\n InterpolationMethod[method as {} as keyof typeof InterpolationMethod],\n extrapolationValue, outId);\n\n if (castedData != null) {\n backend.disposeData(castedData.dataId);\n }\n\n return out;\n}\n\nexport const cropAndResizeConfig: KernelConfig = {\n kernelName: CropAndResize,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: cropAndResize as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable
law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n */\n\nimport {backend_util, KernelConfig, KernelFunc, Cumsum, CumsumAttrs, CumsumInputs, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {CppDType} from './types';\n\nimport {transpose} from './Transpose';\n\nlet wasmCumsum: (xId: number, exclusive: number, reverse: number,\n finalDim: number, outId: number, dtype: CppDType) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmCumsum = backend.wasm.cwrap(Cumsum, null /* void */, [\n 'number', // x_id\n 'number', // exclusive\n 'number', // reverse\n 'number', // final_dim\n
'number', // out_id\n 'number' // dtype\n]);\n}\n\nexport function cumsum(\n args: {inputs: CumsumInputs, backend: BackendWasm, attrs: CumsumAttrs}):\nTensorInfo {\n const {inputs, backend, attrs} = args;\n const {x} = inputs;\n const {axis, exclusive, reverse} = attrs;\n const xRank = x.shape.length;\n\n util.assert(x.dtype === 'float32' || x.dtype === 'int32',\n () => `cumsum does not support ${x.dtype} tensors in the WASM backend`);\n // permute required axis to inner most axis\n const permutation = backend_util.getAxesPermutation([axis], xRank);\n let permutedX = x;\n if (permutation !== null) {\n permutedX = transpose({inputs: {x}, attrs: {perm: permutation}, backend});\n }\n const permutedAxis = backend_util.getInnerMostAxes(1, xRank)[0];\n backend_util.assertAxesAreInnerMostDims('cumsum', [permutedAxis], xRank);\n\n const permutedOut = backend.makeOutput(permutedX.shape, permutedX.dtype);\n const finalDim = permutedX.shape[permutedAxis];\n const permutedXId
= backend.dataIdMap.get(permutedX.dataId).id;\n const permutedOutId = backend.dataIdMap.get(permutedOut.dataId).id;\n wasmCumsum(permutedXId, exclusive ? 1 : 0, reverse ? 1 : 0, finalDim,\n permutedOutId, CppDType[x.dtype]);\n\n // transpose data back if permuted\n let out = permutedOut;\n if (permutation !== null) {\n const undoPermutation = backend_util.getUndoAxesPermutation(permutation);\n out = transpose(\n {inputs: {x: permutedOut}, attrs: {perm: undoPermutation}, backend});\n backend.disposeData(permutedX.dataId);\n backend.disposeData(permutedOut.dataId);\n }\n return out;\n}\n\nexport const cumsumConfig: KernelConfig = {\n kernelName: Cumsum,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: cumsum as {} as

KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {DepthToSpace, DepthToSpaceAttrs, DepthToSpaceInputs, KernelConfig, KernelFunc, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmDepthToSpace: (\n xId: number, blockSize: number, channelsLast: number, xStrides: Uint8Array,\n xStridesLength: number, outputShape: Uint8Array, outputStrides: Uint8Array,\n outSize: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n wasmDepthToSpace = backend.wasm.cwrap(DepthToSpace, null /*void*/, [\n 'number', // xId\n 'number', // blockSize\n 'number', // channelsLast\n 'array', // xStrides\n 'number', // xStridesLength\n 'array', // outputShape\n 'array', // outputStrides\n 'number', // outSize\n 'number', // outId\n]);\n}\n\nexport function depthToSpace(args: {\n backend: BackendWasm,\n inputs: DepthToSpaceInputs,\n attrs: DepthToSpaceAttrs\n}): TensorInfo {\n const {backend, inputs, attrs} = args;\n const {x} = inputs;\n const {blockSize, dataFormat} = attrs;\n\n const batchSize = x.shape[0];\n const inputHeight = (dataFormat === 'NHWC') ? x.shape[1] : x.shape[2];\n const inputWidth = (dataFormat === 'NHWC') ? x.shape[2] : x.shape[3];\n const inputDepth = (dataFormat === 'NHWC') ? x.shape[3] : x.shape[1];\n\n const outputHeight = inputHeight * blockSize;\n const outputWidth = inputWidth * blockSize;\n const outputDepth = inputDepth / (blockSize * blockSize);\n\n const outputShape = (dataFormat === 'NHWC') ?\n [batchSize, outputHeight, outputWidth, outputDepth] :\n [batchSize, outputDepth, outputHeight, outputWidth];\n\n const out = backend.makeOutput(outputShape, 'float32');\n\n const xData = backend.dataIdMap.get(x.dataId);\n const xId = xData.id;\n const xStridesBytes =\n new Uint8Array(new Int32Array(util.computeStrides(x.shape)).buffer);\n\n const outputShapeBytes = new Uint8Array(new Int32Array(outputShape).buffer);\n const outStridesBytes =\n new Uint8Array(new Int32Array(util.computeStrides(outputShape)).buffer);\n\n const outId = backend.dataIdMap.get(out.dataId).id;\n const channelsLast = dataFormat === 'NHWC' ? 1 : 0;\n wasmDepthToSpace(\n xId, blockSize, channelsLast, xStridesBytes, x.shape.length - 1,\n outputShapeBytes, outStridesBytes, outputShape.length, outId);\n\n return out;\n}\n\nexport const depthToSpaceConfig: KernelConfig = {\n kernelName: DepthToSpace,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: depthToSpace as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {backend_util, DepthwiseConv2dNative, DepthwiseConv2dNativeAttrs, DepthwiseConv2dNativeInputs, KernelConfig, KernelFunc, Tensor4D} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmDepthwiseConv2d: (\n xId: number, batchSize: number, inputHeight: number, inputWidth: number,\n filterId: number, filterHeight: number, filterWidth: number, padTop: number,\n padRight: number, padBottom: number, padLeft: number, isSamePad: number,\n dilationHeight: number, dilationWidth: number, strideHeight: number,\n strideWidth: number, inputChannels: number, outputChannels: number,\n outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmDepthwiseConv2d =\n

backend.wasm.cwrap(DepthwiseConv2dNative, null /* void */, [\n 'number', // xId\n 'number', // batchSize\n 'number', // inputHeight\n 'number', // inputWidth\n 'number', // filterId\n 'number', // filterHeight\n 'number', // filterWidth\n 'number', // padTop\n 'number', // padRight\n 'number', // padBottom\n 'number', // padLeft\n 'number', // isSamePad\n 'number', // dilationHeight\n 'number', // dilationWidth\n 'number', // strideHeight\n 'number', // strideWidth\n 'number', // inputChannels\n 'number', // outputChannels\n 'number', // outId\n]);\n}\n\nfunction depthwiseConv2d(args: {\n inputs: DepthwiseConv2dNativeInputs,\n backend: BackendWasm,\n attrs: DepthwiseConv2dNativeAttrs\n}) {\n const {inputs, attrs, backend} = args;\n\n const {x, filter} = inputs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n const filterId = backend.dataIdMap.get(filter.dataId).id;\n\n const {strides, dilations, pad, dimRoundingMode} = attrs;\n\n const $dilations = dilations == null ? [1, 1] : dilations;\n\n const convInfo = backend_util.computeConv2DInfo(\n (x as Tensor4D).shape, (filter as Tensor4D).shape, strides,\n ($dilations as number | [number, number]), pad, dimRoundingMode,\n true /* depthwise */);\n\n const filterHeight = convInfo.filterHeight;\n const filterWidth = convInfo.filterWidth;\n const padTop = convInfo.padInfo.top;\n const padRight = convInfo.padInfo.right;\n const padBottom = convInfo.padInfo.bottom;\n const padLeft = convInfo.padInfo.left;\n const dilationHeight = convInfo.dilationHeight;\n const dilationWidth = convInfo.dilationWidth;\n const strideHeight = convInfo.strideHeight;\n const strideWidth = convInfo.strideWidth;\n const inputChannels = convInfo.inChannels;\n const outputChannels = convInfo.outChannels;\n const isSamePad = convInfo.padInfo.type === 'SAME' ? 1 : 0;\n\n if (convInfo.dataFormat !== 'channelsLast') {\n throw new Error(\n `wasm backend DepthwiseConv2dNative does not support dataFormat:'` +\n `${convInfo.dataFormat}'. Please use 'channelsLast'.`);\n }\n\n const out = backend.makeOutput(convInfo.outShape, 'float32');\n const outId = backend.dataIdMap.get(out.dataId).id;\n wasmDepthwiseConv2d(\n xId, x.shape[0], x.shape[1], x.shape[2], filterId, filterHeight,\n filterWidth, padTop, padRight, padBottom, padLeft, isSamePad,\n dilationHeight, dilationWidth, strideHeight, strideWidth, inputChannels,\n outputChannels, outId);\n return out;\n}\n\nexport const depthwiseConv2dNativeConfig: KernelConfig = {\n kernelName: DepthwiseConv2dNative,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: depthwiseConv2d as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2021 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\nimport {Elu, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\n\nexport const eluConfig: KernelConfig = createUnaryKernelConfig(Elu);\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\nimport {Equal, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from './binary_kernel';\n\nconst supportsFullBroadcast = false;\nexport const equalConfig: KernelConfig =\n createBinaryKernelConfig(Equal, supportsFullBroadcast, 'bool');\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not

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 KernelConfig, KernelFunc, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\nimport {reshape} from './Reshape';\n\nexport function expandDims(args: {\n inputs: ExpandDimsInputs,\n attrs: ExpandDimsAttrs,\n backend: BackendWasm\n}) {\n const {inputs, attrs, backend} = args;\n const {input} = inputs;\n const {dim} = attrs;\n\n const inputRank = input.shape.length;\n const newShape = input.shape.slice();\n let $dim = dim;\n if (dim < 0) {\n   // Negative value is counted from the tail of rank.\n   util.assert(\n   -(inputRank + 1) <= dim,\n   () => `Axis must be in the interval [${- (inputRank + 1)}, ${\n  inputRank}]`);\n $dim = inputRank + dim + 1;\n }\n newShape.splice($dim, 0, 1);\n\n return reshape({inputs: {x: input}, backend, attrs: {shape: newShape}});\n}\n\nexport const expandDimsConfig: KernelConfig = {\n kernelName: ExpandDims,\n backendName: 'wasm',\n kernelFunc: expandDims as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ===\n */\n\nimport {KernelConfig, KernelFunc} from '@tensorflow/tfjs-core';\nimport {Fill, FillAttrs} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nexport function fill(args: {attrs: FillAttrs, backend: BackendWasm}) {\n const {attrs: {shape,
 value, dtype}, backend} = args;\n const out = backend.makeOutput(shape, dtype);\n const outVals = backend.typedArrayFromHeap(out);\n outVals.fill(value as number);\n return out;\n}\n\nexport const fillConfig: KernelConfig = {\n kernelName: Fill,\n backendName: 'wasm',\n kernelFunc: fill as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ===\n */\n\nimport {FlipLeftRight, FlipLeftRightInputs, KernelConfig, KernelFunc, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmFlipLeftRight: (\n   xId: number, batch:

number, imageHeight: number, imageWidth: number,\n   numChannels: number, outId: number) =>
void;\n\nfunction setup(backend: BackendWasm) {\n wasmFlipLeftRight = backend.wasm.cwrap(FlipLeftRight,
null /* void */, [\n   'number', // xId\n   'number', // batch\n   'number', // imageHeight\n   'number', //
imageWidth\n   'number', // numChannels\n   'number', // outId\n]);\n}\n\nexport function flipLeftRight(\n
args: {inputs: FlipLeftRightInputs, backend: BackendWasm}): TensorInfo {\n const {inputs, backend} = args;\n
const {image} = inputs;\n\n const out = backend.makeOutput(image.shape, image.dtype);\n const imageId =
backend.dataIdMap.get(image.dataId).id;\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n
  const [batch, imageHeight, imageWidth, numChannels] = image.shape;\n\n wasmFlipLeftRight(\n   imageId,
batch, imageHeight, imageWidth, numChannels, outId);\n return out;\n}\n\nexport const flipLeftRightConfig:
KernelConfig = {\n kernelName: FlipLeftRight,\n backendName: 'wasm',\n kernelFunc: flipLeftRight as {} as
KernelFunc,\n setupFunc: setup\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n
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OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language
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 License.\n *
==\n
*/\nimport {Floor, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from
'./unary_kernel';\nexport const floorConfig: KernelConfig = createUnaryKernelConfig(Floor);\n","/**\n *
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WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for
the specific language governing permissions and\n * limitations under the License.\n *
==\n
 */\n\nimport {FloorDiv, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from
'./binary_kernel';\n\nconst supportsFullBroadcast = false;\nexport const floorDivConfig: KernelConfig =\n
createBinaryKernelConfig(FloorDiv, supportsFullBroadcast);\n","/**\n * @license\n * Copyright 2019 Google
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OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language
governing permissions and\n * limitations under the License.\n *
==\n
 */\n\nimport {FusedBatchNorm, FusedBatchNormAttrs, FusedBatchNormInputs, KernelConfig, KernelFunc,
TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet
wasmBatchNorm: (\n   xId: number, meanId: number, varianceId: number, offsetId: number,\n   scaleId: number,
varianceEpsilon: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n
wasmBatchNorm = backend.wasm.cwrap(\n   FusedBatchNorm, null /* void */,\n   ['number', 'number',
'number', 'number', 'number', 'number', 'number']);\n}\n\nfunction fusedBatchNorm(args: {\n backend:
BackendWasm,\n inputs: FusedBatchNormInputs,\n attrs: FusedBatchNormAttrs\n}): TensorInfo {\n const
{backend, inputs, attrs} = args;\n const {varianceEpsilon} = attrs;\n const {x, mean, variance, offset, scale} =
inputs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n const meanId =
backend.dataIdMap.get(mean.dataId).id;\n const varianceId = backend.dataIdMap.get(variance.dataId).id;\n

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  const offsetId = offset != null ? backend.dataIdMap.get(offset.dataId).id : 0;\n  const scaleId = scale != null ? backend.dataIdMap.get(scale.dataId).id : 0;\n\n  const out = backend.makeOutput(x.shape, x.dtype);\n  // Short-circuit zero-sized tensors.\n  if (util.sizeFromShape(x.shape) === 0) {\n    return out;\n  }\n\n  const outId = backend.dataIdMap.get(out.dataId).id;\n\n  wasmBatchNorm(\n      xId, meanId, varianceId, offsetId, scaleId, varianceEpsilon, outId);\n  return out;\n}\n\nexport const fusedBatchNormConfig: KernelConfig = {\n  kernelName: FusedBatchNorm,\n  backendName: 'wasm',\n  setupFunc: setup,\n  kernelFunc: fusedBatchNorm as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n =============================================================================\n */\n\nimport {backend_util, FusedConv2D, FusedConv2DAttrs, FusedConv2DInputs, KernelConfig, KernelFunc, Tensor4D} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {FusableActivation} from './types';\n\nlet wasmFusedConv2d:\n    (xId: number, batchSize: number, inputHeight: number, inputWidth: number,\n     filterId: number, filterHeight: number, filterWidth: number,\n     biasId: number, padTop: number, padRight: number, padBottom: number,\n     padLeft: number, isSamePad: number, dilationHeight: number,\n     dilationWidth:
     number, strideHeight: number, strideWidth: number,\n     inputChannels: number, outputChannels: number, activation: number,\n     preluActivationWeightsId: number, leakyreluAlpha: number, outId: number) =>\n    void;\n\nfunction setup(backend: BackendWasm) {\n  wasmFusedConv2d = backend.wasm.cwrap(FusedConv2D, null /* void */, [\n    'number',  // xId\n    'number',  // batchSize\n    'number',  // inputHeight\n    'number',  // inputWidth\n    'number',  // filterId\n    'number',  // filterHeight\n    'number',  // filterWidth\n    'number',  // biasId\n    'number',  // padTop\n    'number',  // padRight\n    'number',  // padBottom\n    'number',  // padLeft\n    'number',  // isSamePad\n    'number',  // dilationHeight\n    'number',  // dilationWidth\n    'number',  // strideHeight\n    'number',  // strideWidth\n    'number',  // inputChannels\n    'number',  // outputChannels\n    'number',  // activation\n    'number',  // preluActivationWeightsId\n    'number',  // leakyreluAlpha\n
    'number',  // outId\n  ]);\n}\n\nfunction fusedConv2d(args: {\n  inputs: FusedConv2DInputs,\n  backend: BackendWasm,\n  attrs: FusedConv2DAttrs\n}) {\n  const {inputs, attrs, backend} = args;\n  const {x, filter, bias, preluActivationWeights} = inputs;\n  const {\n    strides,\n    pad,\n    dilations,\n    dataFormat,\n    dimRoundingMode,\n    activation,\n    leakyreluAlpha\n  } = attrs;\n\n  const convInfo = backend_util.computeConv2DInfo(\n      (x as Tensor4D).shape, (filter as Tensor4D).shape, strides, dilations,\n      pad, dimRoundingMode);\n\n  const fusedActivation =\n      FusableActivation[activation as {} as keyof typeof FusableActivation];\n  if (fusedActivation == null) {\n    throw new Error(\n        `${activation} activation not yet supported for FusedConv2D ` +\n        `in the wasm backend.`);\n  }\n\n  const xId = backend.dataIdMap.get(x.dataId).id;\n  const filterId = backend.dataIdMap.get(filter.dataId).id;\n\n  const outputChannels = convInfo.outChannels;\n\n
  let biasId = 0;\n  if (bias != null) {\n    const biasData = backend.dataIdMap.get(bias.dataId);\n    if (biasData.shape.length !== 1) {\n      throw new Error(\n          `FusedConv2D only supports rank-1 bias but got ` +\n          `rank ${biasData.shape.length}.`);\n    }\n    if (biasData.shape[0] !== outputChannels) {\n      throw new Error(\n          `FusedConv2D bias shape (${biasData.shape}) does not ` +\n          `match the number of output channels (${outputChannels})`);\n    }\n    biasId = biasData.id;\n  }\n\n  const filterHeight = convInfo.filterHeight;\n  const filterWidth = convInfo.filterWidth;\n  const padTop = convInfo.padInfo.top;\n  const padRight = convInfo.padInfo.right;\n  const padBottom = convInfo.padInfo.bottom;\n  const padLeft = convInfo.padInfo.left;\n  const dilationHeight = convInfo.dilationHeight;\n  const dilationWidth = convInfo.dilationWidth;\n  const strideHeight = convInfo.strideHeight;\n  const strideWidth =
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convInfo.strideWidth;\n
  const inputChannels = convInfo.inChannels;\n  const isSamePad = convInfo.padInfo.type === 'SAME' ? 1 : 0;\n
const batchSize = convInfo.batchSize;\n  const inHeight = convInfo.inHeight;\n  const inWidth =
convInfo.inWidth;\n\n  if (dataFormat !== 'NHWC') {\n    throw new Error(\n        `wasm backend FusedConv2D
does not support dataFormat:` +\n        `${dataFormat}'. Please use 'NHWC'.`);\n  }\n\n  const out =
backend.makeOutput(convInfo.outShape, 'float32');\n  const outId = backend.dataIdMap.get(out.dataId).id;\n  const
preluActivationWeightsId = preluActivationWeights == null ?\n      0 :\n
backend.dataIdMap.get(preluActivationWeights.dataId).id;\n\n  wasmFusedConv2d(\n      xId, batchSize, inHeight,
inWidth, filterId, filterHeight, filterWidth,\n      biasId, padTop, padRight, padBottom, padLeft, isSamePad,
dilationHeight,\n      dilationWidth, strideHeight, strideWidth, inputChannels, outputChannels,\n      fusedActivation,
preluActivationWeightsId, leakyreluAlpha ||
 0, outId);\n\n  return out;\n}\n\nexport const fusedConv2DConfig: KernelConfig = {\n  kernelName:
FusedConv2D,\n  backendName: 'wasm',\n  setupFunc: setup,\n  kernelFunc: fusedConv2d as {} as
KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the
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on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or
implied.\n * See the License for the specific language governing permissions and\n * limitations under the
License.\n *
==========================================================================\n
*/\n\nimport {backend_util, FusedDepthwiseConv2D, FusedDepthwiseConv2DAttrs,
 FusedDepthwiseConv2DInputs, KernelConfig, KernelFunc, Tensor4D} from '@tensorflow/tfjs-core';\n\nimport
{BackendWasm} from '../backend_wasm';\n\nimport {FusableActivation} from './types';\n\nlet
wasmFusedDepthwiseConv2d:\n    (xId: number, batchSize: number, inputHeight: number, inputWidth: number,\n
filterId: number, filterHeight: number, filterWidth: number,\n     biasId: number, padTop: number, padRight:
number, padBottom: number,\n     padLeft: number, isSamePad: number, dilationHeight: number,\n
dilationWidth: number, strideHeight: number, strideWidth: number,\n     inputChannels: number, outputChannels:
number, activation: number,\n     preluActivationWeightsId: number, leakyreluAlpha: number, outId: number) =>\n
    void;\n\nfunction setup(backend: BackendWasm) {\n  wasmFusedDepthwiseConv2d =\n
backend.wasm.cwrap(FusedDepthwiseConv2D, null /* void */, [\n        'number',  // xId\n        'number',  //
batchSize\n        'number',  // inputHeight\n
  'number',  // inputWidth\n        'number',  // filterId\n        'number',  // filterHeight\n        'number',  // filterWidth\n
   'number',  // biasId\n        'number',  // padTop\n        'number',  // padRight\n        'number',  // padBottom\n
'number',  // padLeft\n        'number',  // isSamePad\n        'number',  // dilationHeight\n        'number',  //
dilationWidth\n        'number',  // strideHeight\n        'number',  // strideWidth\n        'number',  // inputChannels\n
'number',  // outputChannels\n        'number',  // activation\n        'number',  // preluActivationWeightsId\n
'number',  // leakyreluAlpha\n        'number',  // outId\n      ]);\n}\n\nfunction fusedDepthwiseConv2d(args: {\n
inputs: FusedDepthwiseConv2DInputs,\n  backend: BackendWasm,\n  attrs: FusedDepthwiseConv2DAttrs\n}) {\n
const {inputs, attrs, backend} = args;\n  const {x, filter, bias, preluActivationWeights} = inputs;\n  const {\n
strides,\n    pad,\n    dilations,\n
   dataFormat,\n    dimRoundingMode,\n    activation,\n    leakyreluAlpha\n  } = attrs;\n\n  const convInfo =
backend_util.computeConv2DInfo(\n      (x as Tensor4D).shape, (filter as Tensor4D).shape, strides, dilations,\n
pad, dimRoundingMode, true /* depthwise */);\n\n  const fusedActivation =\n      FusableActivation[activation as {}
as keyof typeof FusableActivation];\n  if (fusedActivation == null) {\n    throw new Error(\n        `${activation}
activation not yet supported for FusedDepthwiseConv2D ` +\n        `in the wasm backend.`);\n  }\n\n  const xId =
backend.dataIdMap.get(x.dataId).id;\n  const filterId = backend.dataIdMap.get(filter.dataId).id;\n\n  const
outputChannels = convInfo.outChannels;\n\n  let biasId = 0;\n  if (bias != null) {\n    const biasData =
```

backend.dataIdMap.get(bias.dataId);\n if (biasData.shape.length !== 1) {\n   throw new Error(\n `FusedDepthwiseConv2D only supports rank-1 bias but got ` +\n   `rank ${biasData.shape.length}.`);\n }\n if (biasData.shape[0] !== outputChannels) {\n   throw new Error(\n   `FusedDepthwiseConv2D bias shape (${biasData.shape}) does not ` +\n   `match the number of output channels (${outputChannels})`);\n }\n biasId = biasData.id;\n }\n\n const filterHeight = convInfo.filterHeight;\n const filterWidth = convInfo.filterWidth;\n const padTop = convInfo.padInfo.top;\n const padRight = convInfo.padInfo.right;\n const padBottom = convInfo.padInfo.bottom;\n const padLeft = convInfo.padInfo.left;\n const dilationHeight = convInfo.dilationHeight;\n const dilationWidth = convInfo.dilationWidth;\n const strideHeight = convInfo.strideHeight;\n const strideWidth = convInfo.strideWidth;\n const inputChannels = convInfo.inChannels;\n const isSamePad = convInfo.padInfo.type === 'SAME' ? 1 : 0;\n const batchSize = convInfo.batchSize;\n const inHeight = convInfo.inHeight;\n const inWidth = convInfo.inWidth;\n\n if (dataFormat !== 'NHWC') {\n throw\n new Error(\n `wasm backend FusedDepthwiseConv2D does not support dataFormat:` +\n `${dataFormat}'. Please use 'NHWC'.`);\n }\n\n const out = backend.makeOutput(convInfo.outShape, 'float32');\n const outId = backend.dataIdMap.get(out.dataId).id;\n const preluActivationWeightsId = preluActivationWeights == null ?\n 0 :\n backend.dataIdMap.get(preluActivationWeights.dataId).id;\n\n wasmFusedDepthwiseConv2d(\n xId, batchSize, inHeight, inWidth, filterId, filterHeight, filterWidth,\n biasId, padTop, padRight, padBottom, padLeft, isSamePad, dilationHeight,\n dilationWidth, strideHeight, strideWidth, inputChannels, outputChannels,\n fusedActivation, preluActivationWeightsId, leakyreluAlpha || 0, outId);\n\n return out;\n}\n\nexport const fusedDepthwiseConv2DConfig: KernelConfig = {\n kernelName: FusedDepthwiseConv2D,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: fusedDepthwiseConv2d as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==\n */\n\nimport {gather_util, GatherNd, GatherNdInputs, KernelConfig, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {CppDType} from './types';\n\nlet wasmGatherNd: (\n xId: number, dtype: CppDType, indicesId: number, numSlices: number,\n sliceRank: number, sliceSize: number, strides: Uint8Array, outId: number) =>\n void;\n\nfunction setup(backend: BackendWasm): void {\n wasmGatherNd = backend.wasm.cwrap(GatherNd, null /*void*/, [\n 'number', // xId\n 'number', // dtype\n 'number', // indicesId\n 'number', // numSlices\n 'number', // sliceRank\n 'number', // sliceSize\n 'array', // strides\n 'number' // outId\n]);\n}\n\nfunction gatherNd(args: {backend: BackendWasm, inputs: GatherNdInputs}):\n TensorInfo {\n const {backend, inputs} = args;\n const {params, indices} = inputs;\n\n const [resultShape, numSlices, sliceSize, strides] =\n gather_util.prepareAndValidate(params, indices);\n\n const out = backend.makeOutput(resultShape, params.dtype);\n if (numSlices === 0) {\n return out;\n }\n\n const indicesShape = indices.shape;\n const sliceRank = indicesShape[indicesShape.length - 1];\n\n const xData = backend.dataIdMap.get(params.dataId);\n const xId = xData.id;\n\n const indicesData = backend.dataIdMap.get(indices.dataId);\n const indicesId = indicesData.id;\n\n const stridesBytes = new Uint8Array(new Int32Array(strides).buffer);\n\n const outId = backend.dataIdMap.get(out.dataId).id;\n wasmGatherNd(\n xId, CppDType[params.dtype], indicesId, numSlices, sliceRank, sliceSize,\n stridesBytes, outId);\n\n return out;\n}\n\nexport const gatherNdConfig: KernelConfig = {\n kernelName: GatherNd,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: gatherNd\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the

License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES
OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {backend_util, GatherV2, GatherV2Attrs, GatherV2Inputs, KernelConfig, KernelFunc, Tensor, TensorInfo, TypedArray, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {reshape} from './Reshape';\nimport {CppDType} from './types';\n\nlet wasmGather: (\n xId: number, dtype: CppDType, xStrides: Uint8Array, stridesSize: number,\n indicesId: number, batchSize: number, outStrides: Uint8Array,\n outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n wasmGather = backend.wasm.cwrap('Gather', null /*void*/, [\n 'number', // xId\n 'number', // dtype\n 'array', // xStrides\n 'number', // stridesSize\n 'number', // indicesId\n 'number', // batchSize\n
'array', // outStrides\n 'number' // outId\n]);\n}\n\nfunction gatherV2(\n args: {backend: BackendWasm, inputs: GatherV2Inputs, attrs: GatherV2Attrs}):\n TensorInfo {\n const {backend, inputs, attrs} = args;\n const {x, indices} = inputs;\n const {axis, batchDims} = attrs;\n\n // Throw error when any index is out of bound.\n const parsedAxis = util.parseAxisParam(axis, x.shape)[0];\n const indicesVals = backend.readSync(indices.dataId) as TypedArray;\n const axisDim = x.shape[parsedAxis];\n for (let i = 0; i < indicesVals.length; ++i) {\n const index = indicesVals[i];\n util.assert(\n index <= axisDim - 1 && index >= 0,\n () =>\n `GatherV2: the index value ${index} is not in [0, ${axisDim - 1}]`);\n }\n\n const shapeInfo = backend_util.segment_util.collectGatherOpShapeInfo(\n x as Tensor, indices as Tensor, parsedAxis, batchDims);\n\n const flattenX = reshape({\n inputs: {x},\n attrs: {\n shape: [\n shapeInfo.batchSize, shapeInfo.outerSize, shapeInfo.dimSize,\n shapeInfo.sliceSize\n]\n },\n backend\n });\n const indicesSize = util.sizeFromShape(indices.shape);\n const flattenIndex = reshape({\n inputs: {x: indices},\n attrs: {shape: [shapeInfo.batchSize, indicesSize / shapeInfo.batchSize]},\n backend\n });\n const flattenOutputShape = [\n shapeInfo.batchSize, shapeInfo.outerSize, indicesSize / shapeInfo.batchSize,\n shapeInfo.sliceSize\n];\n\n const out = backend.makeOutput(flattenOutputShape, x.dtype);\n if (util.sizeFromShape(x.shape) === 0) {\n return out;\n }\n const stridesSize = flattenX.shape.length - 1;\n\n const xData = backend.dataIdMap.get(flattenX.dataId);\n const xId = xData.id;\n\n const indicesData = backend.dataIdMap.get(flattenIndex.dataId);\n const indicesId = indicesData.id;\n\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n const xStridesBytes = new Uint8Array(\n new Int32Array(util.computeStrides(flattenX.shape)).buffer);\n
const outStridesBytes = new Uint8Array(\n new Int32Array(util.computeStrides(flattenOutputShape)).buffer);\n\n wasmGather(\n xId, CppDType[x.dtype], xStridesBytes, stridesSize, indicesId,\n shapeInfo.batchSize, outStridesBytes, outId);\n\n backend.disposeData(flattenX.dataId);\n backend.disposeData(flattenIndex.dataId);\n\n // reshape\n out.shape = shapeInfo.outputShape;\n return out;\n}\n\nexport const gatherV2Config: KernelConfig = {\n kernelName: GatherV2,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: gatherV2 as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed
under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\nimport {Greater, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from './binary_kernel';\n\nconst supportsFullBroadcast = false;\nexport const greaterConfig: KernelConfig =\n

createBinaryKernelConfig(Greater, supportsFullBroadcast, 'bool');\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n
 * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n
*/\nimport {GreaterEqual, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from './binary_kernel';\n\nconst supportsFullBroadcast = false;\nexport const greaterEqualConfig: KernelConfig =\n createBinaryKernelConfig(GreaterEqual, supportsFullBroadcast, 'bool');\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in
 writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n
/\n\nimport {KernelConfig, KernelFunc, LeakyRelu, LeakyReluAttrs, LeakyReluInputs, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {CppDType} from './types';\n\nlet wasmFunc: (\n xId: number, dtype: number, leakyreluAlpha: number, outId: number) => void;\n\nfunction setupFunc(backend: BackendWasm): void {\n wasmFunc = backend.wasm.cwrap(LeakyRelu, null / void */, [\n 'number', // x_id\n 'number', // dtype\n 'number', // leakyrelu_alpha\n 'number', // out_id\n]);\n}\n\nexport function leakyRelu(\n args:\n {inputs: LeakyReluInputs, attrs: LeakyReluAttrs,
 backend: BackendWasm}):\n TensorInfo {\n const {inputs: {x}, attrs: {alpha}, backend} = args;\n\n const xId = backend.dataIdMap.get(x.dataId).id;\n // According to TF API, LeakyRelu returns float32 when input is either float32\n // or int32.\n const out = backend.makeOutput(x.shape, 'float32');\n\n if (util.sizeFromShape(x.shape) !== 0) {\n const outId = backend.dataIdMap.get(out.dataId).id;\n wasmFunc(xId, CppDType[x.dtype], alpha, outId);\n }\n\n return out;\n}\n\nexport const leakyReluConfig: KernelConfig = {\n kernelName: LeakyRelu,\n backendName: 'wasm',\n setupFunc,\n kernelFunc: leakyRelu as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable
 law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n
*/\nimport {KernelConfig, Less} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from './binary_kernel';\nconst supportsFullBroadcast = false;\nexport const lessConfig: KernelConfig =\n createBinaryKernelConfig(Less, supportsFullBroadcast, 'bool');\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law
 or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
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*/\n\nimport {KernelConfig, LessEqual} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from './binary_kernel';\nconst supportsFullBroadcast = false;\nexport const lessEqualConfig: KernelConfig =\n createBinaryKernelConfig(LessEqual, supportsFullBroadcast, 'bool');\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable
 law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n*/\nimport {KernelConfig, Log} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\nexport const logConfig: KernelConfig = createUnaryKernelConfig(Log);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed
 on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n*/\nimport {KernelConfig, LogicalAnd} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from './binary_kernel';\nconst supportsFullBroadcast = false;\nexport const logicalAndConfig: KernelConfig =\n createBinaryKernelConfig(LogicalAnd, supportsFullBroadcast, 'bool');\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License
 is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n*/\n\nimport {backend_util, KernelConfig, KernelFunc, Max, MaxAttrs, MaxInputs, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {permuteAxesAndTranspose} from './kernel_utils';\nimport {CppDType} from './types';\n\nlet wasmMax: (xId: number, dtype: number, reduceSize: number, outId: number) =>\n   void;\n\nfunction setup(backend: BackendWasm): void {\n wasmMax = backend.wasm.cwrap(Max, null /*void*/, [\n   'number', // x_id\n   'number', // dtype\n   'number', // reduce_size\n   'number', // out_id\n]);\n}\n\nfunction max(args: {backend: BackendWasm, inputs: MaxInputs, attrs: MaxAttrs}):\n   TensorInfo {\n const
 {backend, inputs, attrs} = args;\n const {reductionIndices: axis, keepDims} = attrs;\n const {x} = inputs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n let inputId = xId;\n let input = x;\n\n const {transposed, axes, originalAxes, inputWasTransposed} =\n   permuteAxesAndTranspose(x, axis, backend);\n\n if (inputWasTransposed) {\n   const transposedId = backend.dataIdMap.get(transposed.dataId).id;\n   input = transposed;\n   inputId = transposedId;\n }\n\n const inputRank = input.shape.length;\n backend_util.assertAxesAreInnerMostDims('max', axes, inputRank);\n const [outShape, reduceShape] =\n   backend_util.computeOutAndReduceShapes(input.shape, axes);\n const reduceSize =
 util.sizeFromShape(reduceShape);\n\n const out = backend.makeOutput(outShape, x.dtype);\n if (util.sizeFromShape(input.shape) !== 0) {\n   const outId = backend.dataIdMap.get(out.dataId).id;\n   wasmMax(inputId, CppDType[x.dtype], reduceSize, outId);\n }\n\n if (inputWasTransposed)

{\n // dispose of the transposed tensor.\n backend.disposeData(transposed.dataId);\n }\n\n if (keepDims) {\n // reshape\n const newShape = backend_util.expandShapeToKeepDim(out.shape, originalAxes);\n out.shape = newShape;\n }\n\n return out;\n}\n\nexport const maxConfig: KernelConfig = {\n kernelName: Max,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: max as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing
 permissions and\n * limitations under the License.\n *
==\n
*/\nimport {KernelConfig, Maximum} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from './binary_kernel';\nconst supportsFullBroadcast = false;\nexport const maximumConfig: KernelConfig =\n createBinaryKernelConfig(Maximum, supportsFullBroadcast);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions
 and\n * limitations under the License.\n *
==\n
/\n\nimport {backend_util, KernelConfig, KernelFunc, MaxPool, MaxPoolAttrs, MaxPoolInputs, Tensor4D, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmMaxPool: (\n xId: number, batchSize: number, inputHeight: number, inputWidth: number,\n filterHeight: number, filterWidth: number, padTop: number, padRight: number,\n padBottom: number, padLeft: number, dilationHeight: number,\n dilationWidth: number, strideHeight: number, strideWidth: number,\n inputChannels: number, outputChannels: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmMaxPool = backend.wasm.cwrap(MaxPool, null / void */, [\n 'number', // xId\n 'number', // batchSize\n 'number', // inputHeight\n 'number', // inputWidth\n 'number', // filterHeight\n 'number', // filterWidth\n 'number', // padTop\n 'number', // padRight\n 'number', // padBottom\n 'number', // padLeft\n 'number', // dilationHeight\n 'number', // dilationWidth\n 'number', // strideHeight\n 'number', // strideWidth\n 'number', // inputChannels\n 'number', // outputChannels\n 'number', // outId\n]);\n}\n\nfunction maxPool(\n args: {inputs: MaxPoolInputs, backend: BackendWasm, attrs: MaxPoolAttrs}) {\n const {inputs, attrs, backend} = args;\n\n const x = inputs.x as Tensor4D;\n const xId = backend.dataIdMap.get(x.dataId).id;\n\n // TF API supports int32 input. CPU and WebGL backend also support int32\n // input. WASM backend doesn't support it because it uses xnnpack which only\n // supports float32.\n //\n // Add the following assert only for the WASM backend instead of at core op\n // level.\n //\n // TODO: add support for int32 input.\n util.assert(\n   x.dtype === 'float32',\n   () =>\n   `Error in MaxPool: only float32 input
 is supported. Got ${x.dtype}.`);\n\n const {filterSize, strides, pad, dimRoundingMode} = attrs;\n const convInfo = backend_util.computePool2DInfo(\n   x.shape, filterSize, strides, 1 /* dilations */, pad, dimRoundingMode);\n\n const filterHeight = convInfo.filterHeight;\n const filterWidth = convInfo.filterWidth;\n const padTop = convInfo.padInfo.top;\n const padRight = convInfo.padInfo.right;\n const padBottom = convInfo.padInfo.bottom;\n const padLeft = convInfo.padInfo.left;\n const dilationHeight = convInfo.dilationHeight;\n const dilationWidth = convInfo.dilationWidth;\n const strideHeight = convInfo.strideHeight;\n const strideWidth = convInfo.strideWidth;\n const inputChannels = convInfo.inChannels;\n const outputChannels = convInfo.outChannels;\n\n if (convInfo.dataFormat !== 'channelsLast') {\n throw new Error(\n   `wasm

backend does not support dataFormat:'` +\n `${convInfo.dataFormat}'. Please use 'channelsLast'.`);\n }\n\n const out =
backend.makeOutput(convInfo.outShape, 'float32');\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n wasmMaxPool(\n xId, x.shape[0], x.shape[1], x.shape[2], filterHeight, filterWidth,\n padTop, padRight, padBottom, padLeft, dilationHeight, dilationWidth,\n strideHeight, strideWidth, inputChannels, outputChannels, outId);\n return out;\n}\n\nexport const maxPoolConfig: KernelConfig = {\n kernelName: MaxPool,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: maxPool as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES
OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {backend_util, KernelConfig, KernelFunc, Mean, MeanAttrs, MeanInputs, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\nimport {cast} from './Cast';\n\nimport {permuteAxesAndTranspose} from './kernel_utils';\n\nlet wasmMean: (xId: number, reduceSize: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n wasmMean =\n backend.wasm.cwrap(Mean, null /*void*/, ['number, number, number']);\n}\n\nexport function mean(\n args: {backend: BackendWasm, inputs: MeanInputs, attrs: MeanAttrs}):\n TensorInfo {\n const {backend, inputs, attrs} = args;\n const {axis, keepDims} = attrs;\n const {x} = inputs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n
let inputId = xId;\n let input = x;\n\n const {transposed, axes, originalAxes, inputWasTransposed} =\n permuteAxesAndTranspose(x, axis, backend);\n\n let reductionAxes = axes;\n if (inputWasTransposed) {\n const transposedId = backend.dataIdMap.get(transposed.dataId).id;\n if (transposedId !== xId) {\n // transpose was not a no-op. We will need to dispose of this\n // once we are done.\n input = transposed;\n inputId = transposedId;\n reductionAxes = backend_util.getInnerMostAxes(\n reductionAxes.length, input.shape.length);\n }\n }\n\n backend_util.assertAxesAreInnerMostDims(\n 'mean', reductionAxes, input.shape.length);\n const [outShape, reduceShape] =\n backend_util.computeOutAndReduceShapes(input.shape, reductionAxes);\n const reduceSize = util.sizeFromShape(reduceShape);\n let castedInput = input;\n if (input.dtype !== 'float32') {\n castedInput =\n cast({backend, inputs: {x: input}, attrs: {dtype:
'float32'}});\n inputId = backend.dataIdMap.get(castedInput.dataId).id;\n }\n\n const out = backend.makeOutput(outShape, 'float32');\n if (util.sizeFromShape(input.shape) !== 0) {\n const outId = backend.dataIdMap.get(out.dataId).id;\n wasmMean(inputId, reduceSize, outId);\n }\n\n if (inputWasTransposed) {\n // dispose of the transposed tensor.\n backend.disposeData(transposed.dataId);\n }\n\n if (keepDims) {\n // reshape\n const newShape = backend_util.expandShapeToKeepDim(out.shape, originalAxes);\n out.shape = newShape;\n }\n\n if (input.dtype !== 'float32') {\n backend.disposeData(castedInput.dataId);\n }\n\n return out;\n}\n\nexport const meanConfig: KernelConfig = {\n kernelName: Mean,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: mean as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this
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```
==========\n
*/\n\nimport {backend_util, KernelConfig, KernelFunc, Min, MinAttrs, MinInputs, TensorInfo, util} from
'@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport
{permuteAxesAndTranspose} from './kernel_utils';\nimport {CppDType} from './types';\n\nlet wasmMin: (xId:
number, dtype: number, reduceSize: number, outId: number) =>\n    void;\n\nfunction setup(backend:
BackendWasm): void {\n  wasmMin = backend.wasm.cwrap(Min,
 null /*void*/, [\n    'number',  // x_id\n    'number',  // dtype\n    'number',  // reduce_size\n    'number',  // out_id\n
]);\n}\n\nfunction min(args: {backend: BackendWasm, inputs: MinInputs, attrs: MinAttrs}):\n    TensorInfo {\n
const {backend, inputs, attrs} = args;\n  const {axis, keepDims} = attrs;\n  const {x} = inputs;\n  const xId =
backend.dataIdMap.get(x.dataId).id;\n  let inputId = xId;\n  let input = x;\n\n  const {transposed, axes, originalAxes,
inputWasTransposed} =\n      permuteAxesAndTranspose(x, axis, backend);\n\n  if (inputWasTransposed) {\n
const transposedId = backend.dataIdMap.get(transposed.dataId).id;\n    if (transposedId !== xId) {\n      // transpose
was not a no-op. We will need to dispose of this\n      // once we are done.\n      input = transposed;\n      inputId =
transposedId;\n    }\n  }\n\n  const inputRank = input.shape.length;\n\n
backend_util.assertAxesAreInnerMostDims('min', axes, inputRank);\n  const [outShape, reduceShape] =\n
    backend_util.computeOutAndReduceShapes(input.shape, axes);\n  const reduceSize =
util.sizeFromShape(reduceShape);\n\n  const out = backend.makeOutput(outShape, input.dtype);\n  if
(util.sizeFromShape(input.shape) !== 0) {\n    const outId = backend.dataIdMap.get(out.dataId).id;\n
wasmMin(inputId, CppDType[x.dtype], reduceSize, outId);\n  }\n\n  if (inputWasTransposed) {\n    // dispose of the
transposed tensor.\n    backend.disposeData(transposed.dataId);\n  }\n\n  if (keepDims) {\n    // reshape\n    const
newShape = backend_util.expandShapeToKeepDim(out.shape, originalAxes);\n    out.shape = newShape;\n  }\n\n
return out;\n}\n\nexport const minConfig: KernelConfig = {\n  kernelName: Min,\n  backendName: 'wasm',\n
setupFunc: setup,\n  kernelFunc: min as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google
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\"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n
* See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n
*/\nimport {KernelConfig, Minimum} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from
'./binary_kernel';\nconst supportsFullBroadcast = false;\nexport const minimumConfig: KernelConfig =\n
createBinaryKernelConfig(Minimum, supportsFullBroadcast);\n","/**\n * @license\n * Copyright 2021 Google
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* See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n
*/\n\nimport {KernelConfig, KernelFunc, MirrorPad, MirrorPadAttrs, MirrorPadInputs} from '@tensorflow/tfjs-
core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {CppDType} from './types';\n\n// Must match
enum in MirrorPad.cc\nenum MirrorPaddingMode {\n  reflect = 0,\n  symmetric = 1\n}\n\nlet wasmMirrorPad: (\n
xId: number, xShapeBytes: Uint8Array, xShapeLength: number, xDtype: number,\n    prePaddingsBytes:
Uint8Array, postPaddingsBytes: Uint8Array, mode: number,\n
 outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n  wasmMirrorPad =
backend.wasm.cwrap(MirrorPad, null /* void */, [\n    'number',  // xId\n    'array',   // x.shape\n    'number',  //
x.shape.length\n    'number',  // x.dtype\n    'array',   // pre-paddings\n    'array',   // post-paddings\n    'number',  //
```

mode\n   'number', // outId\n]);\n}\n\nfunction mirrorPad(args: {\n inputs: MirrorPadInputs,\n backend: BackendWasm,\n attrs: MirrorPadAttrs\n}) {\n const {inputs: {x}, backend, attrs: {paddings, mode}} = args;\n\n const outShape = paddings.map(\n   (p, i) => p[0] /* beforePad */ + x.shape[i] + p[1] /* afterPad */);\n const xId = backend.dataIdMap.get(x.dataId).id;\n const out = backend.makeOutput(outShape, x.dtype);\n const outId = backend.dataIdMap.get(out.dataId).id;\n const xShapeBytes = new Uint8Array(new Int32Array(x.shape).buffer);\n\n const prePaddingsFlat = paddings.map(padTuple => padTuple[0]);\n const postPaddingsFlat = paddings.map(padTuple
 => padTuple[1]);\n const prePaddingsBytes =\n   new Uint8Array(new Int32Array(prePaddingsFlat).buffer);\n const postPaddingsBytes =\n   new Uint8Array(new Int32Array(postPaddingsFlat).buffer);\n\n wasmMirrorPad(\n   xId, xShapeBytes, x.shape.length, CppDType[x.dtype], prePaddingsBytes,\n   postPaddingsBytes, MirrorPaddingMode[mode], outId);\n return out;\n}\n\nexport const mirrorPadConfig: KernelConfig = {\n kernelName: MirrorPad,\n backendName: 'wasm',\n kernelFunc: mirrorPad as {} as KernelFunc,\n setupFunc: setup\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n *
http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\"
 BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {KernelConfig, Multiply} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from './binary_kernel';\n\nconst supportsFullBroadcast = true;\nexport const multiplyConfig: KernelConfig =\n createBinaryKernelConfig(Multiply, supportsFullBroadcast);\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n *
http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\"
 BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\nimport {KernelConfig, Neg} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\nexport const negConfig: KernelConfig = createUnaryKernelConfig(Neg);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n
 * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {BackendWasm} from '../backend_wasm';\n\n// Analogous to `struct Result` in `non_max_suppression_impl.h`.\ninterface Result {\n pSelectedIndices: number;\n selectedSize: number;\n pSelectedScores: number;\n pValidOutputs: number;\n}\n/**\n * Parse the result of the c++ method, which has the shape equivalent to\n * `Result`.\n */\nexport function parseResultStruct(\n   backend: BackendWasm, resOffset: number): Result {\n const result = new Int32Array(backend.wasm.HEAPU8.buffer, resOffset, 4);\n const pSelectedIndices = result[0];\n const selectedSize = result[1];\n const pSelectedScores = result[2];\n const pValidOutputs = result[3];\n // Since the result was allocated on the heap, we have to delete it.\n backend.wasm._free(resOffset);\n return {pSelectedIndices, selectedSize,

pSelectedScores, pValidOutputs};\n}\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {KernelConfig, KernelFunc, NonMaxSuppressionV3, NonMaxSuppressionV3Attrs, NonMaxSuppressionV3Inputs, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {parseResultStruct} from './NonMaxSuppression_util';\n\nlet wasmFunc: (\n boxesId: number, scoresId: number, maxOutputSize: number,\n iouThreshold: number, scoreThreshold: number) => number;\n\nfunction setup(backend: BackendWasm): void {\n wasmFunc = backend.wasm.cwrap(\n NonMaxSuppressionV3,\n 'number', // Result*\n [\n 'number', // boxesId\n 'number', // scoresId\n 'number', // maxOutputSize\n 'number', // iouThreshold\n 'number', // scoreThreshold\n]);\n}\n\nfunction kernelFunc(args: {\n backend: BackendWasm,\n inputs: NonMaxSuppressionV3Inputs,\n attrs: NonMaxSuppressionV3Attrs\n}): TensorInfo {\n const {backend, inputs, attrs} = args;\n const {iouThreshold, maxOutputSize, scoreThreshold} = attrs;\n const {boxes, scores} = inputs;\n\n const boxesId = backend.dataIdMap.get(boxes.dataId).id;\n const scoresId = backend.dataIdMap.get(scores.dataId).id;\n\n const resOffset =\n wasmFunc(boxesId, scoresId, maxOutputSize, iouThreshold,\n scoreThreshold);\n\n const {pSelectedIndices, selectedSize, pSelectedScores, pValidOutputs} =\n parseResultStruct(backend, resOffset);\n\n // Since we are not using scores for V3, we have to delete it from the heap.\n backend.wasm._free(pSelectedScores);\n backend.wasm._free(pValidOutputs);\n\n const selectedIndicesTensor =\n backend.makeOutput([selectedSize], 'int32', pSelectedIndices);\n\n return selectedIndicesTensor;\n}\n\nexport const nonMaxSuppressionV3Config: KernelConfig = {\n kernelName: NonMaxSuppressionV3,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: kernelFunc as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {KernelConfig, KernelFunc, NonMaxSuppressionV4, NonMaxSuppressionV4Attrs, NonMaxSuppressionV4Inputs, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {parseResultStruct} from './NonMaxSuppression_util';\n\nlet wasmFunc: (\n boxesId: number, scoresId: number, maxOutputSize: number,\n iouThreshold: number, scoreThreshold: number,\n padToMaxOutputSize: boolean) => number;\n\nfunction setup(backend: BackendWasm): void {\n wasmFunc = backend.wasm.cwrap(\n NonMaxSuppressionV4,\n 'number', // Result*\n [\n 'number', // boxesId\n 'number', // scoresId\n 'number', // maxOutputSize\n 'number', // iouThreshold\n 'number', // scoreThreshold\n 'bool', // padToMaxOutputSize\n]);\n}\n\nfunction nonMaxSuppressionV4(args: {\n backend: BackendWasm,\n inputs: NonMaxSuppressionV4Inputs,\n attrs: NonMaxSuppressionV4Attrs\n}): TensorInfo[] {\n const {backend, inputs, attrs} = args;\n const {iouThreshold, maxOutputSize, scoreThreshold, padToMaxOutputSize} =\n attrs;\n const {boxes, scores} = inputs;\n\n const boxesId = backend.dataIdMap.get(boxes.dataId).id;\n const scoresId = backend.dataIdMap.get(scores.dataId).id;\n\n const

resOffset = wasmFunc(\n boxesId, scoresId, maxOutputSize, iouThreshold, scoreThreshold,\n padToMaxOutputSize);\n\n const {pSelectedIndices, selectedSize, pSelectedScores, pValidOutputs} =\n parseResultStruct(backend, resOffset);\n\n // Since we are not using scores for V4, we have to delete it from the heap.\n backend.wasm._free(pSelectedScores);\n\n
const selectedIndicesTensor =\n backend.makeOutput([selectedSize], 'int32', pSelectedIndices);\n\n const validOutputsTensor = backend.makeOutput([], 'int32', pValidOutputs);\n\n return [selectedIndicesTensor, validOutputsTensor];\n}\n\nexport const nonMaxSuppressionV4Config: KernelConfig = {\n kernelName: NonMaxSuppressionV4,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: nonMaxSuppressionV4 as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See
the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {KernelConfig, KernelFunc, NonMaxSuppressionV5, NonMaxSuppressionV5Attrs, NonMaxSuppressionV5Inputs, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {parseResultStruct} from './NonMaxSuppression_util';\n\nlet wasmFunc:\n (boxesId: number, scoresId: number, maxOutputSize: number,\n iouThreshold: number, scoreThreshold: number, softNmsSigma: number) =>\n number;\n\nfunction setup(backend: BackendWasm): void {\n wasmFunc = backend.wasm.cwrap(\n NonMaxSuppressionV5,\n 'number', // Result*\n [\n 'number', // boxesId\n 'number', // scoresId\n 'number', // maxOutputSize\n 'number', // iouThreshold\n 'number', // scoreThreshold\n 'number', // softNmsSigma\n]);\n}\n\nfunction
kernelFunc(args: {\n backend: BackendWasm,\n inputs: NonMaxSuppressionV5Inputs,\n attrs: NonMaxSuppressionV5Attrs\n}): TensorInfo[] {\n const {backend, inputs, attrs} = args;\n const {iouThreshold, maxOutputSize, scoreThreshold, softNmsSigma} = attrs;\n const {boxes, scores} = inputs;\n\n const boxesId = backend.dataIdMap.get(boxes.dataId).id;\n const scoresId = backend.dataIdMap.get(scores.dataId).id;\n\n const resOffset = wasmFunc(\n boxesId, scoresId, maxOutputSize, iouThreshold, scoreThreshold,\n softNmsSigma);\n\n const {pSelectedIndices, selectedSize, pSelectedScores, pValidOutputs} =\n parseResultStruct(backend, resOffset);\n\n // Since we are not using validOutputs for V5, we have to delete it from the\n // heap.\n backend.wasm._free(pValidOutputs);\n\n const selectedIndicesTensor =\n backend.makeOutput([selectedSize], 'int32', pSelectedIndices);\n const selectedScoresTensor =\n backend.makeOutput([selectedSize], 'float32', pSelectedScores);\n\n
return [selectedIndicesTensor, selectedScoresTensor];\n}\n\nexport const nonMaxSuppressionV5Config: KernelConfig = {\n kernelName: NonMaxSuppressionV5,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: kernelFunc as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\nimport
{KernelConfig, NotEqual} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from './binary_kernel';\nconst supportsFullBroadcast = false;\nexport const notEqualConfig: KernelConfig =\n createBinaryKernelConfig(NotEqual, supportsFullBroadcast, 'bool');\n","/**\n * @license\n * Copyright 2020

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==========\n
*/\n\nimport
{KernelConfig, KernelFunc, OneHot, OneHotAttrs, OneHotInputs} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmOneHot: (\n indicesId: number, depth: number, onValue: number, offValue: number,\n outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmOneHot = backend.wasm.cwrap(OneHot, null /* void */, [\n 'number', // indices_id\n 'number', // depth,\n 'number', // onValue\n 'number', // offValue\n 'number' // out_id\n]);\n}\n\nfunction oneHot(\n args: {inputs: OneHotInputs, attrs: OneHotAttrs, backend: BackendWasm}) {\n const {inputs, backend, attrs} = args;\n const {indices} = inputs;\n const {depth, onValue, offValue} = attrs;\n\n const out = backend.makeOutput([...indices.shape, depth], 'int32');\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n const indicesData = backend.dataIdMap.get(indices.dataId);\n const indicesId = indicesData.id;\n\n wasmOneHot(indicesId, depth,
onValue, offValue, outId);\n\n return out;\n}\n\nexport const oneHotConfig: KernelConfig = {\n kernelName: OneHot,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: oneHot as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n
*/\n\nimport {KernelConfig, KernelFunc, OnesLike, OnesLikeInputs} from
'@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nfunction onesLike(args: {inputs: OnesLikeInputs, backend: BackendWasm}) {\n const {inputs: {x}, backend} = args;\n const out = backend.makeOutput(x.shape, x.dtype);\n const outVals = backend.typedArrayFromHeap(out);\n outVals.fill(1);\n return out;\n}\n\nexport const onesLikeConfig: KernelConfig = {\n kernelName: OnesLike,\n backendName: 'wasm',\n kernelFunc: onesLike as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express
or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n
*/\n\nimport {KernelConfig, KernelFunc, Pack, PackAttrs, PackInputs, TensorInfo, util} from '@tensorflow/tfjs-core';\nimport {BackendWasm} from '../backend_wasm';\n\nimport {concat} from './Concat';\nimport {expandDims} from './ExpandDims';\n\nexport function pack(\n args: {inputs: PackInputs, backend: BackendWasm, attrs: PackAttrs}):\n TensorInfo {\n const {inputs, backend, attrs} = args;\n const {axis} = attrs;\n\n if (inputs.length === 1) {\n return expandDims(\n {inputs: {input: inputs[0]}, backend, attrs: {dim: axis}});\n }\n\n const shape = inputs[0].shape;\n const dtype = inputs[0].dtype;\n\n inputs.forEach(t => {\n util.assertShapesMatch(\n shape, t.shape,\n 'All tensors passed to stack must have matching shapes');\n

util.assert(\n
dtype === t.dtype,\n () => 'All tensors passed to stack must have matching dtypes');\n });\n\n const intermediateTensorInfos: TensorInfo[] = [];\n const expandedTensors = inputs.map(t => {\n const expandedT =\n expandDims({inputs: {input: t}, backend, attrs: {dim: axis}});\n intermediateTensorInfos.push(expandedT);\n return expandedT;\n });\n\n const result = concat({inputs: expandedTensors, backend, attrs: {axis}});\n\n intermediateTensorInfos.forEach(t => backend.disposeData(t.dataId));\n\n return result;\n}\n\nexport const packConfig: KernelConfig = {\n kernelName: Pack,\n backendName: 'wasm',\n kernelFunc: pack as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {KernelConfig, KernelFunc, PadV2, PadV2Attrs, PadV2Inputs, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {fill} from './Fill';\n\nimport {CppDType} from './types';\n\nlet wasmPadV2: (\n xId: number, xShapeBytes: Uint8Array, xShapeLength: number, xDtype: number,\n prePaddingsBytes: Uint8Array, postPaddingsBytes: Uint8Array,\n constantValue: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmPadV2 = backend.wasm.cwrap(PadV2, null /* void */, [\n 'number', // xId\n 'array', // x.shape\n 'number', // x.shape.length\n 'number', // x.dtype\n 'array', // pre-paddings\n 'array', // post-paddings\n 'number', // constantValue\n 'number', // outId\n]);\n}\n\nfunction pad(\n args: {inputs: PadV2Inputs, backend: BackendWasm, attrs: PadV2Attrs}) {\n const {inputs: {x}, backend, attrs: {paddings, constantValue}} = args;\n\n const outShape = paddings.map(\n (p, i) => p[0] /* beforePad */ + x.shape[i] + p[1] /* afterPad */);\n\n if (util.sizeFromShape(x.shape) === 0) {\n // Short-circuit the computation, since x doesn't have value, only\n // the shape is used to compute output shape to pad.\n return fill({\n backend,\n attrs: {shape: outShape, value: constantValue, dtype: x.dtype}\n });\n }\n\n const xId = backend.dataIdMap.get(x.dataId).id;\n const out = backend.makeOutput(outShape, x.dtype);\n const outTensorData = backend.dataIdMap.get(out.dataId);\n const outId = outTensorData.id;\n\n const xShapeBytes =\n new Uint8Array(new Int32Array(x.shape).buffer);\n\n const prePaddingsFlat = paddings.map(padTuple => padTuple[0]);\n const postPaddingsFlat = paddings.map(padTuple => padTuple[1]);\n const prePaddingsBytes =\n new Uint8Array(new Int32Array(prePaddingsFlat).buffer);\n const postPaddingsBytes =\n new Uint8Array(new Int32Array(postPaddingsFlat).buffer);\n\n wasmPadV2(\n xId, xShapeBytes, x.shape.length, CppDType[x.dtype], prePaddingsBytes,\n postPaddingsBytes, constantValue, outId);\n return out;\n}\n\nexport const padV2Config: KernelConfig = {\n kernelName: PadV2,\n backendName: 'wasm',\n kernelFunc: pad as {} as KernelFunc,\n setupFunc: setup\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {KernelConfig, Pow} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from './binary_kernel';\n\nconst supportsFullBroadcast = false;\n\nexport const powConfig: KernelConfig =\n createBinaryKernelConfig(Pow, supportsFullBroadcast);\n","/**\n * @license\n * Copyright 2019 Google LLC. All

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applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {KernelConfig, KernelFunc, Prelu, PreluInputs} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {cast} from './Cast';\n\nlet wasmPrelu: (xId: number, weightsId: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmPrelu = backend.wasm.cwrap(Prelu, null /* void */, [\n 'number', // x_id\n 'number', // weights_id\n 'number' // out_id\n]);\n}\n\nfunction prelu(args: {inputs: PreluInputs, backend: BackendWasm}) {\n const {inputs, backend} = args;\n const {x, alpha} = inputs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n
const weightsId = backend.dataIdMap.get(alpha.dataId).id;\n\n let inputId = xId;\n const input = x;\n let castedInput = input;\n if (input.dtype !== 'float32') {\n castedInput = cast({backend, inputs: {x}, attrs: {dtype: 'float32'}});\n inputId = backend.dataIdMap.get(castedInput.dataId).id;\n }\n\n const out = backend.makeOutput(x.shape, 'float32');\n const outId = backend.dataIdMap.get(out.dataId).id;\n wasmPrelu(inputId, weightsId, outId);\n\n if (input.dtype !== 'float32') {\n backend.disposeData(castedInput.dataId);\n }\n return out;\n}\n\nexport const preluConfig: KernelConfig = {\n kernelName: Prelu,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: prelu as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n
*\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {backend_util, KernelConfig, KernelFunc, Prod, ProdAttrs, ProdInputs, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {permuteAxesAndTranspose} from './kernel_utils';\n\nimport {CppDType} from './types';\n\nlet wasmProd: (\n xId: number, reduceSize: number,\n dtype: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n wasmProd = backend.wasm.cwrap(Prod, null /*void*/, [\n 'number',\n 'number',\n 'number',\n 'number'\n
]);\n}\n\nfunction prod(args: {\n backend: BackendWasm,\n inputs: ProdInputs,\n attrs: ProdAttrs\n}): TensorInfo {\n const {backend, inputs, attrs} = args;\n const {axis, keepDims} = attrs;\n const {x} = inputs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n let inputId = xId;\n let input = x;\n\n const {transposed, axes, originalAxes, inputWasTransposed} =\n permuteAxesAndTranspose(x, axis, backend);\n\n let reductionAxes = axes;\n if (inputWasTransposed) {\n const transposedId = backend.dataIdMap.get(transposed.dataId).id;\n if (transposedId !== xId) {\n // transpose was not a no-op. We will need to dispose of this\n // once we are done.\n input = transposed;\n inputId = transposedId;\n reductionAxes = backend_util.getInnerMostAxes(\n reductionAxes.length, input.shape.length);\n }\n }\n\n backend_util.assertAxesAreInnerMostDims(\n 'prod', reductionAxes, input.shape.length);\n const [outShape, reduceShape]
=\n backend_util.computeOutAndReduceShapes(input.shape, reductionAxes);\n const reduceSize = util.sizeFromShape(reduceShape);\n\n const out = backend.makeOutput(outShape, input.dtype);\n if (util.sizeFromShape(input.shape) !== 0) {\n const outId = backend.dataIdMap.get(out.dataId).id;\n wasmProd(inputId, reduceSize, CppDType[out.dtype], outId);\n }\n\n if (inputWasTransposed) {\n // dispose of

the transposed tensor.\n backend.disposeData(transposed.dataId);\n }\n\n if (keepDims) {\n // reshape\n const newShape = backend_util.expandShapeToKeepDim(out.shape, originalAxes);\n out.shape = newShape;\n }\n\n return out;\n}\n\nexport const prodConfig: KernelConfig = {\n kernelName: Prod,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: prod as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in
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OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language
governing permissions and\n * limitations under the License.\n *
==========\n
*/\n\nimport {KernelConfig, KernelFunc, Range, RangeAttrs, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport
{BackendWasm} from '../backend_wasm';\nimport {rangeImplCPU} from '../kernel_utils/shared';\n\nexport const
range =\n (args: {backend: BackendWasm, attrs: RangeAttrs}): TensorInfo => {\n const {backend, attrs} =
args;\n const {start, stop, step, dtype} = attrs;\n const values = rangeImplCPU(start, stop, step, dtype);\n\n
const
out = backend.makeOutput([values.length], dtype);\n const outVals = backend.typedArrayFromHeap(out);\n
outVals.set(values);\n return out;\n };\n\nexport const rangeConfig: KernelConfig = {\n kernelName: Range,\n
backendName: 'wasm',\n kernelFunc: range as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019
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OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language
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==========\n
*/\n\nimport {KernelConfig, RealDiv} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from
'./binary_kernel';\n\nconst supportsFullBroadcast = true;\nexport const realDivConfig: KernelConfig =\n
createBinaryKernelConfig(RealDiv, supportsFullBroadcast);\n","/**\n * @license\n * Copyright 2019 Google LLC.
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OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language
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==========\n
*/\nimport {KernelConfig, Relu} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from
'./unary_kernel';\nexport const reluConfig: KernelConfig = createUnaryKernelConfig(Relu);\n","/**\n * @license\n
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the specific language governing permissions and\n * limitations under the License.\n *
==========\n
*/\nimport {KernelConfig, Relu6} from '@tensorflow/tfjs-core';\n\nimport

{createUnaryKernelConfig} from './unary_kernel';\nexport const relu6Config: KernelConfig = createUnaryKernelConfig(Relu6);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {KernelConfig, KernelFunc, ResizeBilinear, ResizeBilinearAttrs, ResizeBilinearInputs, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {cast} from './Cast';\n\nlet wasmResizeBilinear: (\n xId: number, batch: number, oldHeight: number, oldWidth: number,\n numChannels: number, newHeight: number, newWidth: number,\n alignCorners: number, halfPixelCenters: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n wasmResizeBilinear = backend.wasm.cwrap(ResizeBilinear, null /*void*/, [\n 'number', // xId\n 'number', // batch\n 'number', // oldHeight\n 'number', // oldWidth\n 'number', // numChannels\n 'number', // newHeight\n 'number', // newWidth\n 'number', // alignCorners\n 'number', // halfPixelCenters\n 'number' // outId\n]);\n}\n\nfunction resizeBilinear(args: {\n backend: BackendWasm,\n inputs: ResizeBilinearInputs,\n attrs: ResizeBilinearAttrs\n}): TensorInfo {\n const {backend, inputs, attrs} = args;\n\n const {images} = inputs;\n const {alignCorners, halfPixelCenters, size} = attrs;\n const [newHeight, newWidth] = size;\n\n const [batch, oldHeight, oldWidth, numChannels] = images.shape;\n const outShape = [batch, newHeight, newWidth, numChannels];\n\n let xData = backend.dataIdMap.get(images.dataId);\n let castedData;\n if (xData.dtype !== 'float32') {\n castedData =\n cast({backend, inputs: {x: images}, attrs: {dtype: 'float32'}});\n xData = backend.dataIdMap.get(castedData.dataId);\n }\n const xId = xData.id;\n\n const out = backend.makeOutput(outShape, 'float32');\n if (util.sizeFromShape(images.shape) === 0) {\n return out;\n }\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n wasmResizeBilinear(\n xId, batch, oldHeight, oldWidth, numChannels, newHeight, newWidth,\n alignCorners ? 1 : 0, halfPixelCenters ? 1 : 0, outId);\n\n if (castedData != null) {\n backend.disposeData(castedData.dataId);\n }\n\n return out;\n}\n\nexport const resizeBilinearConfig: KernelConfig = {\n kernelName: ResizeBilinear,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: resizeBilinear as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {KernelConfig, KernelFunc, Reverse, ReverseAttrs, ReverseInputs, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {identity} from './Identity';\nimport {reshape} from './Reshape';\n\nlet wasmReverse: (\n xId: number, axes: Uint8Array, axesLength: number, outShape: Uint8Array,\n outShapeLength: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmReverse = backend.wasm.cwrap(Reverse, null, [\n 'number', // x_id\n 'array', // axes\n 'number', // axes_length\n 'array', // out_shape\n 'number', // out_shape_length\n 'number' // out_id\n]);\n}\n\nexport function reverse(\n args: {inputs: ReverseInputs, backend: BackendWasm, attrs: ReverseAttrs}):\n TensorInfo {\n const {inputs, backend, attrs} = args;\n const {x} = inputs;\n const {dims} = attrs;\n\n const axes = util.parseAxisParam(dims, x.shape);\n\n if (x.shape.length === 0) {\n return identity({inputs: {x}, backend});\n }\n\n const out = backend.makeOutput(x.shape, x.dtype);\n

const xId = backend.dataIdMap.get(x.dataId).id;\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n const axesBytes = new Uint8Array(new Int32Array(axes).buffer);\n const outShapeBytes = new Uint8Array(new Int32Array(x.shape).buffer);\n\n wasmReverse(\n   xId, axesBytes, axes.length, outShapeBytes, x.shape.length, outId);\n\n const reshaped =\n   reshape({inputs: {x: out}, attrs: {shape: x.shape}, backend});\n\n backend.disposeData(out.dataId);\n return reshaped;\n}\n\nexport const reverseConfig: KernelConfig = {\n kernelName: Reverse,\n backendName: 'wasm',\n kernelFunc: reverse as {} as KernelFunc,\n setupFunc: setup\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {KernelConfig, KernelFunc, RotateWithOffset, RotateWithOffsetAttrs, RotateWithOffsetInputs, TensorInfo} from '@tensorflow/tfjs-core';\nimport {backend_util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmRotate: (\n   xId: number, batch: number, imageHeight: number, imageWidth: number,\n   numChannels: number, radians: number, centerX: number, centerY: number,\n fillBytes: Uint8Array, fillLength: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmRotate = backend.wasm.cwrap(RotateWithOffset, null /* void */, [\n   'number', // xId\n   'number', // batch\n   'number', // imageHeight\n   'number', // imageWidth\n   'number', // numChannels\n   'number', // radians\n   'number', // centerX\n   'number', // centerY\n   'array',   // fillBytes\n   'number', // fillLength\n   'number', // outId\n]);\n}\n\nexport function rotateWithOffset(args: {\n inputs: RotateWithOffsetInputs,\n backend: BackendWasm,\n attrs: RotateWithOffsetAttrs\n}): TensorInfo {\n const {inputs, backend, attrs} = args;\n const {image} = inputs;\n const {radians, fillValue, center} = attrs;\n\n const out = backend.makeOutput(image.shape, image.dtype);\n const imageId = backend.dataIdMap.get(image.dataId).id;\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n const [batch, imageHeight, imageWidth, numChannels] = image.shape;\n\n const [centerX, centerY] =\n backend_util.getImageCenter(center, imageHeight, imageWidth);\n\n const fillIsBlack = fillValue === 0;\n const fullOpacityValue = 255;\n\n const fillValues = typeof fillValue === 'number' ?\n   [fillValue, fillValue, fillValue, fillIsBlack ? 0 : fullOpacityValue] :\n   [...fillValue, fullOpacityValue];\n const fillBytes = new Uint8Array(new Int32Array(fillValues).buffer);\n\n wasmRotate(\n   imageId, batch, imageHeight, imageWidth, numChannels, radians, centerX,\n   centerY, fillBytes, fillValues.length, outId);\n return out;\n}\n\nexport const rotateWithOffsetConfig: KernelConfig = {\n kernelName: RotateWithOffset,\n backendName: 'wasm',\n kernelFunc: rotateWithOffset as {} as KernelFunc,\n setupFunc: setup\n};\n","/**\n * @license\n * Copyright 2021 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS
 OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\nimport {KernelConfig, Round} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\n\nexport const roundConfig: KernelConfig = createUnaryKernelConfig(Round);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable

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==========\n
*/\nimport {KernelConfig, Rsqrt} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\nexport const rsqrtConfig: KernelConfig = createUnaryKernelConfig(Rsqrt);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n
*/\n\nimport {KernelConfig, KernelFunc, scatter_util, ScatterNd, ScatterNdAttrs, ScatterNdInputs, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {CppDType} from './types';\n\nlet wasmScatterNd: (\n indicesId: number, updatesId: number, dtype: CppDType, sliceRank: number,\n numUpdates: number, sliceSize: number, strides: Uint8Array,\n outputSize: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n wasmScatterNd = backend.wasm.cwrap(ScatterNd, null /*void*/, [\n   'number', // indicesId\n   'number', // updatesId\n   'number', // dtype\n   'number', // sliceRank\n   'number', // numUpdates\n   'number', // sliceSize\n   'array',   // strides\n   'number', // outputSize\n   'number'   // outId\n]);\n}\n\nfunction scatterNd(\n args:\n   {backend: BackendWasm, inputs: ScatterNdInputs, attrs:
ScatterNdAttrs}):\n TensorInfo {\n const {backend, inputs, attrs} = args;\n const {indices, updates} = inputs;\n const {shape} = attrs;\n\n const out = backend.makeOutput(shape, updates.dtype);\n if (util.sizeFromShape(shape) === 0) {\n   return out;\n }\n\n const {sliceRank, numUpdates, sliceSize, strides, outputSize} =\n scatter_util.calculateShapes(updates, indices, shape);\n\n const indicesData = backend.dataIdMap.get(indices.dataId);\n const indicesId = indicesData.id;\n\n const updatesData = backend.dataIdMap.get(updates.dataId);\n const updatesId = updatesData.id;\n\n const stridesBytes = new Uint8Array(new Int32Array(strides).buffer);\n\n const outId = backend.dataIdMap.get(out.dataId).id;\n wasmScatterNd(\n   indicesId, updatesId, CppDType[updates.dtype], sliceRank, numUpdates,\n   sliceSize, stridesBytes, outputSize, outId);\n\n return out;\n}\n\nexport const scatterNdConfig: KernelConfig = {\n kernelName: ScatterNd,\n backendName: 'wasm',\n
setupFunc: setup,\n kernelFunc: scatterNd as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n
*/\n\nimport {KernelConfig, KernelFunc, Select, SelectInputs, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmSelect: (\n conditionId: number, tId: number, eId:
number, offset: number,\n outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmSelect = backend.wasm.cwrap('SelectV2', null, [\n   'number', // conditionId\n   'number', // tId\n   'number', // eId\n   'number', // offset\n   'number', // outId\n]);\n}\n\nfunction select(args: {inputs: SelectInputs, backend: BackendWasm}) {\n const {inputs, backend} = args;\n const {condition, t, e} = inputs;\n\n const conditionId = backend.dataIdMap.get(condition.dataId).id;\n const tId = backend.dataIdMap.get(t.dataId).id;\n const eId =

backend.dataIdMap.get(e.dataId).id;\n const out = backend.makeOutput(t.shape, t.dtype);\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n const cRank = condition.shape.length;\n const tRank = t.shape.length;\n\n const offset = cRank === 0 || cRank > 1 || tRank === 1 ?\n   1 :\n util.sizeFromShape(t.shape.slice(1));\n\n wasmSelect(conditionId, tId, eId, offset, outId);\n return out;\n}\n\nexport const selectConfig:
KernelConfig = {\n kernelName: Select,\n backendName: 'wasm',\n kernelFunc: select as {} as KernelFunc,\n setupFunc: setup\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {KernelConfig, KernelFunc, Sigmoid, SigmoidInputs, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm}
from '../backend_wasm';\n\nlet wasmFunc: (xId: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n wasmFunc = backend.wasm.cwrap(Sigmoid, null /* void */, ['number', 'number']);\n}\n\nfunction sigmoid(args: {backend: BackendWasm, inputs: SigmoidInputs}):\n   TensorInfo {\n const {backend, inputs: {x}} = args;\n const xId = backend.dataIdMap.get(x.dataId).id;\n const out = backend.makeOutput(x.shape, x.dtype);\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n // Short-circuit zero-sized tensors.\n if (util.sizeFromShape(out.shape) === 0) {\n   return out;\n }\n\n wasmFunc(xId, outId);\n return out;\n}\n\nexport const sigmoidConfig: KernelConfig = {\n kernelName: 'Sigmoid',\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: sigmoid as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except
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==========\n */\nimport {KernelConfig, Sin} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\nexport const sinConfig: KernelConfig = createUnaryKernelConfig(Sin);\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n *
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==========\n */\n\nimport {KernelConfig, KernelFunc, Softmax, SoftmaxAttrs, SoftmaxInputs, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmFunc: (xId: number, outId: number, channels: number, batch: number) =>\n   void;\n\nfunction setup(backend: BackendWasm): void {\n wasmFunc = backend.wasm.cwrap(Softmax, null /* void */, [\n   'number', // xId\n   'number', // outId\n 'number', // channels\n   'number'   // batch\n]);\n}\n\nfunction softmax(\n   args: {backend: BackendWasm,

inputs: SoftmaxInputs, attrs: SoftmaxAttrs}):\n TensorInfo {\n const {backend, inputs: {logits}, attrs: {dim}} = args;\n const xId = backend.dataIdMap.get(logits.dataId).id;\n const out = backend.makeOutput(logits.shape, logits.dtype);\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n const channels = logits.shape[dim];\n const batch = util.sizeFromShape(logits.shape) / channels;\n\n // Short-circuit zero-sized tensors.\n if (util.sizeFromShape(out.shape) === 0) {\n   return out;\n }\n\n wasmFunc(xId, outId, channels, batch);\n return out;\n}\n\nexport const softmaxConfig: KernelConfig = {\n kernelName: Softmax,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: softmax as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2021 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ===\n */\n\nimport {backend_util, KernelConfig, KernelFunc, ReshapeAttrs, ReshapeInputs, SpaceToBatchND, SpaceToBatchNDAttrs, SpaceToBatchNDInputs, TensorInfo, TransposeAttrs, TransposeInputs, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {padV2Config} from './PadV2';\nimport {reshape} from './Reshape';\nimport {transpose} from './Transpose';\n\nfunction spaceToBatchND(args: {\n inputs: SpaceToBatchNDInputs,\n backend: BackendWasm,\n attrs: SpaceToBatchNDAttrs\n}) {\n const {inputs, backend,\n attrs} = args;\n const {x} = inputs;\n const {blockShape, paddings} = attrs;\n\n const prod = util.sizeFromShape(blockShape);\n\n const completePaddings: Array<[number, number]> = [[0, 0]];\n completePaddings.push(...(paddings as Array<[number, number]>));\n\n for (let i = 1 + blockShape.length; i < x.shape.length; ++i) {\n   completePaddings.push([0, 0]);\n }\n\n const paddedX = padV2Config.kernelFunc({\n inputs: {x},\n   backend,\n   attrs: {paddings: completePaddings, constantValue: 0}\n }) as TensorInfo;\n\n const reshapedPaddedShape =\n   backend_util.getReshaped(paddedX.shape, blockShape, prod, false);\n\n const permutedReshapedPaddedPermutation = backend_util.getPermuted(\n   reshapedPaddedShape.length, blockShape.length, false);\n\n const flattenShape =\n   backend_util.getReshapedPermuted(paddedX.shape, blockShape, prod, false);\n\n const reshapeInputs: ReshapeInputs = {x: paddedX};\n const reshapeAttrs: ReshapeAttrs = {shape: reshapedPaddedShape};\n\n const paddedXReshaped =\n   reshape({inputs: reshapeInputs, backend, attrs: reshapeAttrs});\n\n const transposeInputs: TransposeInputs = {x: paddedXReshaped};\n const transposeAttrs:\n   TransposeAttrs = {perm: permutedReshapedPaddedPermutation};\n const paddedXT =\n   transpose({inputs: transposeInputs, backend, attrs: transposeAttrs});\n\n const resultReshapeInputs: ReshapeInputs = {x: paddedXT};\n const resultReshapeAttrs: ReshapeAttrs = {shape: flattenShape};\n const result = reshape(\n   {inputs: resultReshapeInputs, backend, attrs: resultReshapeAttrs});\n\n backend.disposeData(paddedX.dataId);\n backend.disposeData(paddedXReshaped.dataId);\n backend.disposeData(paddedXT.dataId);\n\n return result;\n}\n\nexport const spaceToBatchNDConfig: KernelConfig = {\n kernelName: SpaceToBatchND,\n backendName: 'wasm',\n kernelFunc: spaceToBatchND as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under\n the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ===\n */\n\nimport {KernelConfig, KernelFunc, SplitV, SplitVAttrs, SplitVInputs, util} from '@tensorflow/tfjs-

core';\nimport {backend_util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {slice} from './Slice';\n\nexport function splitV(\n args: {inputs: SplitVInputs, attrs: SplitVAttrs, backend: BackendWasm}) {\n const {inputs,
 attrs, backend} = args;\n const {x} = inputs;\n const {numOrSizeSplits, axis} = attrs;\n\n const $axis = util.parseAxisParam(axis, x.shape)[0];\n\n const splitSizes = backend_util.prepareSplitSize(x, numOrSizeSplits, $axis);\n const begin = new Array(x.shape.length).fill(0);\n const size = x.shape.slice();\n return splitSizes.map(s => {\n   const xSliceSize = [...size];\n   xSliceSize[$axis] = s;\n   const xSlice =\n   slice({inputs: {x}, attrs: {begin, size: xSliceSize}, backend});\n   begin[$axis] += s;\n   return xSlice;\n });\n}\n\nexport const splitVConfig: KernelConfig = {\n kernelName: SplitV,\n backendName: 'wasm',\n kernelFunc: splitV as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n
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==\n
*/\n\nimport {KernelConfig, Sqrt} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\nexport const sqrtConfig: KernelConfig = createUnaryKernelConfig(Sqrt);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n
 * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n
*/\nimport {KernelConfig, Square} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\nexport const squareConfig: KernelConfig = createUnaryKernelConfig(Square);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT
 WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n
*/\nimport {KernelConfig, SquaredDifference} from '@tensorflow/tfjs-core';\nimport {createBinaryKernelConfig} from './binary_kernel';\nconst supportsFullBroadcast = true;\nexport const squaredDifferenceConfig: KernelConfig =\n   createBinaryKernelConfig(SquaredDifference, supportsFullBroadcast);\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS
 IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n
*/\n\nimport {KernelConfig, KernelFunc, Step, StepAttrs, StepInputs, TensorInfo} from '@tensorflow/tfjs-

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core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {CppDType} from './types';\n\nlet wasmStep:
(xId: number, alpha: number, dtype: number, outId: number) =>\n    void;\n\nfunction setup(backend:
BackendWasm): void {\n  wasmStep = backend.wasm.cwrap(Step, null /*void*/, [\n    'number',  // x_id\n
'number',  // alpha\n    'number',  // dtype\n    'number',  // out_id\n  ]);\n}\n\nfunction step(\n    args: {backend:
BackendWasm, inputs: StepInputs, attrs: StepAttrs}):\n    TensorInfo {\n  const {backend, inputs, attrs} = args;\n
const {alpha} = attrs;\n  const {x} = inputs;\n  const xId =
 backend.dataIdMap.get(x.dataId).id;\n\n  const out = backend.makeOutput(x.shape, x.dtype);\n  const outId =
backend.dataIdMap.get(out.dataId).id;\n  wasmStep(xId, alpha, CppDType[x.dtype], outId);\n  return
out;\n}\n\nexport const stepConfig: KernelConfig = {\n  kernelName: Step,\n  backendName: 'wasm',\n  setupFunc:
setup,\n  kernelFunc: step as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2021 Google LLC. All
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OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language
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 License.\n *
==========================================================================\n
*/\n\nimport {KernelConfig, KernelFunc, slice_util, StridedSlice, StridedSliceAttrs, StridedSliceInputs, TensorInfo,
util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\nimport {reshape} from
'./Reshape';\nimport {slice} from './Slice';\n\nlet wasmStridedSlice: (\n    xId: number, xStridesBytes: Uint8Array,
xRank: number,\n    beginBytes: Uint8Array, endBytes: Uint8Array, stridesBytes: Uint8Array,\n    outShapeBytes:
Uint8Array, outStridesBytes: Uint8Array,\n    outShapeLength: number, outId: number) => void;\n\nfunction
setup(backend: BackendWasm): void {\n  wasmStridedSlice = backend.wasm.cwrap(StridedSlice, null /*void*/, [\n
 'number',  // xId\n    'array',   // xStrides\n    'number',  // xRank\n    'array',   // beginBytes\n    'array',   // endBytes\n
'array',   // stridesBytes\n    'array',   // outShapeBytes\n    'array',   // outStridesBytes\n    'number',
  // outShapeLength\n    'number',  // outId\n  ]);\n}\n\nexport function stridedSlice(args: {\n  backend:
BackendWasm,\n  inputs: StridedSliceInputs,\n  attrs: StridedSliceAttrs\n}): TensorInfo {\n  const {backend, inputs,
attrs} = args;\n  const {x} = inputs;\n\n  const {\n    begin,\n    end,\n    strides,\n    beginMask,\n    endMask,\n
ellipsisMask,\n    newAxisMask,\n    shrinkAxisMask\n  } = attrs;\n\n  const {\n    finalShapeSparse,\n
finalShape,\n    isIdentity,\n    sliceDim0,\n    isSimpleSlice,\n    begin: $begin,\n    end: $end,\n    strides: $strides\n
  } =\n      slice_util.sliceInfo(\n          x.shape, begin, end, strides, beginMask, endMask, ellipsisMask,\n
newAxisMask, shrinkAxisMask);\n\n  let result;\n\n  if (isIdentity) {\n    // Optimization #1, slice is a no-op plus
reshape\n    result = reshape({inputs: {x}, backend, attrs: {shape: finalShape}});\n  } else if (sliceDim0 ||
isSimpleSlice) {\n    // Optimization #2, slice is memory contiguous
 (only occurs in dim 0)\n    util.assert(\n        x.shape.length >= 1,\n        () => `Input must have rank at least 1, got:
${x.shape.length}`);\n\n    const size = slice_util.computeOutShape($begin, $end, $strides);\n    // To tolerate
begin[0] > end[0] (a 0-output slice), we min(begin, end).\n    const sliced = slice({inputs: {x}, backend, attrs:
{begin: $begin, size}});\n    result =\n        reshape({inputs: {x: sliced}, backend, attrs: {shape: finalShape}});\n
backend.disposeData(sliced.dataId);\n  } else {\n    const out = backend.makeOutput(finalShapeSparse,
'float32');\n\n    const xId = backend.dataIdMap.get(x.dataId).id;\n    const xStridesBytes =\n        new
Uint8Array(new Int32Array(util.computeStrides(x.shape)).buffer);\n    const beginBytes = new Uint8Array(new
Int32Array($begin).buffer);\n    const endBytes = new Uint8Array(new Int32Array($end).buffer);\n    const
stridesBytes = new Uint8Array(new Int32Array($strides).buffer);\n\n    const outputShapeBytes =\n
    new Uint8Array(new Int32Array(finalShapeSparse).buffer);\n    const outStridesBytes = new Uint8Array(\n
new Int32Array(util.computeStrides(finalShapeSparse)).buffer);\n    const outId =
backend.dataIdMap.get(out.dataId).id;\n\n    wasmStridedSlice(\n        xId, xStridesBytes, x.shape.length,
beginBytes, endBytes, stridesBytes,\n        outputShapeBytes, outStridesBytes, finalShapeSparse.length, outId);\n\n
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result = reshape({inputs: {x: out}, backend, attrs: {shape: finalShape}});\n\n backend.disposeData(out.dataId);\n }\n\n return result;\n}\n\nexport const stridedSliceConfig: KernelConfig = {\n kernelName: StridedSlice,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: stridedSlice as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License

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==========\n */\nimport {KernelConfig, Sub} from '@tensorflow/tfjs-core';\nimport {createBinaryKernelConfig} from './binary_kernel';\nconst supportsFullBroadcast = true;\nexport const subConfig: KernelConfig =\n createBinaryKernelConfig(Sub, supportsFullBroadcast);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n

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==========\n */\n\nimport {backend_util, KernelConfig, KernelFunc, Sum, SumAttrs, SumInputs, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {permuteAxesAndTranspose} from './kernel_utils';\nimport {CppDType} from './types';\n\nlet wasmSum: (xId: number, reduceSize: number, dtype: number, outId: number) =>\n void;\n\nfunction setup(backend: BackendWasm): void {\n wasmSum = backend.wasm.cwrap(Sum, null /*void*/, [\n   'number', // input_id\n 'number', // reduce_size\n   'number', // dtype\n

    'number', // out_id\n]);\n}\n\nfunction sum(args: {backend: BackendWasm, inputs: SumInputs, attrs: SumAttrs}):\n   TensorInfo {\n const {backend, inputs, attrs} = args;\n const {axis, keepDims} = attrs;\n const {x} = inputs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n let inputId = xId;\n let input = x;\n\n const {transposed, axes, originalAxes, inputWasTransposed} =\n   permuteAxesAndTranspose(x, axis, backend);\n\n let reductionAxes = axes;\n if (inputWasTransposed) {\n   const transposedId =\n backend.dataIdMap.get(transposed.dataId).id;\n   if (transposedId !== xId) {\n   // transpose was not a no-op. We will need to dispose of this\n   // once we are done.\n   input = transposed;\n   inputId = transposedId;\n reductionAxes = backend_util.getInnerMostAxes(\n   reductionAxes.length, input.shape.length);\n   }\n }\n\n backend_util.assertAxesAreInnerMostDims(\n   'sum', reductionAxes, input.shape.length);\n const [outShape, reduceShape]

 =\n   backend_util.computeOutAndReduceShapes(input.shape, reductionAxes);\n const reduceSize = util.sizeFromShape(reduceShape);\n\n const out = backend.makeOutput(outShape, input.dtype);\n if (util.sizeFromShape(input.shape) !== 0) {\n   const outId = backend.dataIdMap.get(out.dataId).id;\n wasmSum(inputId, reduceSize, CppDType[out.dtype], outId);\n }\n\n if (inputWasTransposed) {\n   // dispose of the transposed tensor.\n   backend.disposeData(transposed.dataId);\n }\n\n if (keepDims) {\n   // reshape\n   const newShape = backend_util.expandShapeToKeepDim(out.shape, originalAxes);\n   out.shape = newShape;\n }\n\n return out;\n}\n\nexport const sumConfig: KernelConfig = {\n kernelName: Sum,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: sum as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2021 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except

in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==========\n */\nimport {KernelConfig, Tan} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\nexport const tanConfig: KernelConfig = createUnaryKernelConfig(Tan);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==========\n */\nimport {KernelConfig, Tanh} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\nexport const tanhConfig: KernelConfig = createUnaryKernelConfig(Tanh);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==========\n */\n\nimport {KernelConfig, KernelFunc, Tile, TileAttrs, TileInputs} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {CppDType} from './types';\n\nlet wasmTile: (\n   xId: number, xShape: Uint8Array, xShapeSize: number, newShape: Uint8Array,\n   newShapeSize: number, dtype: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmTile = backend.wasm.cwrap(Tile, null /* void */, [\n   'number', // x_id\n   'array',   // x_shape\n   'number', // x_shape.length\n   'array',   // new_shape\n   'number', // new_shape.length\n   'number'   // out_id\n]);\n}\n\nfunction tile(\n   args: {inputs: TileInputs, backend: BackendWasm, attrs: TileAttrs}) {\n const {inputs, backend, attrs} = args;\n const {x} = inputs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n const {reps} = attrs;\n\n const newShape: number[] = new Array(x.shape.length);\n for (let i = 0; i < newShape.length; i++) {\n   newShape[i] = x.shape[i] * reps[i];\n }\n const xShapeBytes = new Uint8Array(new Int32Array(x.shape).buffer);\n const newShapeBytes = new Uint8Array(new Int32Array(newShape).buffer);\n\n const out = backend.makeOutput(newShape, x.dtype);\n const outId = backend.dataIdMap.get(out.dataId).id;\n wasmTile(\n   xId, xShapeBytes, x.shape.length, newShapeBytes, newShape.length,\n   CppDType[out.dtype], outId);\n return out;\n}\n\nexport const tileConfig: KernelConfig = {\n kernelName: Tile,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: tile as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==========\n */\n\nimport {KernelConfig, KernelFunc, TensorInfo, TopK, TopKAttrs, TopKInputs} from '@tensorflow/tfjs-

core';\n\nimport {BackendWasm} from '../backend_wasm';\nimport {CppDType} from './types';\n\nlet wasmTopK: (\n xId: number, xShapeBytes: Uint8Array, xShapeLength: number,\n xDtype: CppDType, k: number, sorted: boolean, outValuesId:
number,\n outIndicesId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmTopK = backend.wasm.cwrap(TopK, null /* void */, [\n 'number', // xId\n 'array', // x.shape\n 'number', // x.shape.length\n 'number', // x.dtype\n 'number', // k\n 'bool', // sorted\n 'number', // outValuesId\n 'number', // outIndicesId\n]);\n}\n\nexport const topk:\n (args: {inputs: TopKInputs, backend: BackendWasm, attrs: TopKAttrs}) =>\n TensorInfo[] | TensorInfo = ({inputs, backend, attrs}) => {\n const {x} = inputs;\n const {k, sorted} = attrs;\n\n const xId = backend.dataIdMap.get(x.dataId).id;\n const xShapeBytes = new Uint8Array(new Int32Array(x.shape).buffer);\n const outputShape = x.shape.slice();\n outputShape[outputShape.length - 1] = k;\n const outValues = backend.makeOutput(outputShape, x.dtype);\n const outValuesId = backend.dataIdMap.get(outValues.dataId).id;\n
const outIndices = backend.makeOutput(outputShape, 'int32');\n const outIndicesId = backend.dataIdMap.get(outIndices.dataId).id;\n\n wasmTopK(\n xId, xShapeBytes, x.shape.length, CppDType[x.dtype], k, sorted,\n outValuesId, outIndicesId);\n\n return [outValues, outIndices];\n};\n\nexport const topKConfig: KernelConfig = {\n kernelName: TopK,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: topk as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2021 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS
OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n */\n\nimport {KernelConfig, KernelFunc, TensorInfo, Transform, TransformAttrs, TransformInputs, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmTransform: (\n imageId: number, transformsId: number, isBatchTransform: boolean,\n batch: number, outHeight: number, outWidth: number, numChannels: number,\n imageWidth: number, imageHeight: number, strides: Uint8Array,\n stridesLength: number, interpolationModeId: number, fillModeId: number,\n fillValue: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n wasmTransform = backend.wasm.cwrap(Transform, null /*void*/, [\n 'number', // imageId\n 'number', // transformsId\n 'bool', // isBatchTransform\n 'number', // batch\n 'number', // outHeight\n 'number', // outWidth\n 'number', // numChannels\n 'number', // imageWidth\n 'number', // imageHeight\n 'array', // strides\n 'number', // stridesLength\n 'number', // interpolationModeId\n 'number', // fillModeId\n 'number', // fillValue\n 'number' // outId\n]);\n}\n\nfunction transform(\n args:\n {backend: BackendWasm, inputs: TransformInputs, attrs: TransformAttrs}):\n TensorInfo {\n const {backend, inputs, attrs} = args;\n const {image, transforms} = inputs;\n const {interpolation, fillMode, fillValue, outputShape} = attrs;\n\n const [batch, imageHeight, imageWidth, numChannels] = image.shape;\n const [outHeight, outWidth] =\n outputShape != null ? outputShape : [imageHeight, imageWidth];\n const outShape =\n [batch, outHeight, outWidth,\n numChannels] as [number, number, number, number];\n const strides =\n new Uint8Array(new Int32Array(util.computeStrides(image.shape)).buffer);\n\n
const out = backend.makeOutput(outShape, image.dtype);\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n const imageData = backend.dataIdMap.get(image.dataId);\n const imageId = imageData.id;\n\n const transformsData = backend.dataIdMap.get(transforms.dataId);\n const transformsId = transformsData.id;\n\n const interpolationModeId = interpolation === 'nearest' ? 1 : 2;\n let fillModeId;\n switch (fillMode) {\n case 'constant':\n fillModeId = 1;\n break;\n case 'reflect':\n fillModeId = 2;\n break;\n case 'wrap':\n fillModeId = 3;\n break;\n case 'nearest':\n fillModeId =

4;\n break;\n default:\n fillModeId = 1;\n break;\n }\n\n wasmTransform(\n imageId, transformsId, (transforms.shape[0] > 1), batch, outHeight,\n outWidth, numChannels, imageWidth, imageHeight, strides,\n image.shape.length - 1, interpolationModeId, fillModeId, fillValue,\n outId);\n\n
return out;\n}\n\nexport const transformConfig: KernelConfig = {\n kernelName: Transform,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: transform as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {KernelConfig, KernelFunc, TensorInfo, Unpack, UnpackAttrs, UnpackInputs}
from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {slice} from './Slice';\n\nfunction unpack(\n args: {inputs: UnpackInputs, backend: BackendWasm, attrs: UnpackAttrs}):\n TensorInfo[] {\n const {inputs, backend, attrs} = args;\n const {value} = inputs;\n let {axis} = attrs;\n\n if (axis < 0) {\n axis += value.shape.length;\n }\n\n const numOutputs = value.shape[axis];\n const rank = value.shape.length;\n const outShape: number[] = new Array(rank - 1);\n let outIndex = 0;\n for (let i = 0; i < rank; i++) {\n if (i !== axis) {\n outShape[outIndex++] = value.shape[i];\n }\n }\n const outs: TensorInfo[] = new Array(numOutputs);\n const begin = new Array(rank).fill(0);\n const size = value.shape.slice();\n size[axis] = 1;\n for (let i = 0; i < outs.length; i++) {\n begin[axis] = i;\n outs[i] = slice({inputs: {x: value}, attrs: {begin, size}, backend});\n }\n return outs.map(({dataId, dtype}) => ({dataId, dtype,
shape: outShape}));\n}\n\nexport const unpackConfig: KernelConfig = {\n kernelName: Unpack,\n backendName: 'wasm',\n kernelFunc: unpack as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {KernelConfig, KernelFunc, ZerosLike, ZerosLikeInputs} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm}
from '../backend_wasm';\n\nfunction zerosLike(args: {inputs: ZerosLikeInputs, backend: BackendWasm}) {\n const {inputs: {x}, backend} = args;\n const out = backend.makeOutput(x.shape, x.dtype);\n const outVals = backend.typedArrayFromHeap(out);\n outVals.fill(0);\n return out;\n}\n\nexport const zerosLikeConfig: KernelConfig = {\n kernelName: ZerosLike,\n backendName: 'wasm',\n kernelFunc: zerosLike as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for
the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n//
We explicitly import the modular kernels so they get registered in the\n// global registry when we compile the library. A modular build would replace\n// the contents of this file and import only the kernels that are needed.\nimport {KernelConfig, registerKernel} from '@tensorflow/tfjs-core';\n\nimport {fusedMatMulConfig}

from './kernels/_FusedMatMul';\nimport {absConfig} from './kernels/Abs';\nimport {addConfig} from './kernels/Add';\nimport {addNConfig} from './kernels/AddN';\nimport {allConfig} from './kernels/All';\nimport {anyConfig} from './kernels/Any';\nimport {argMaxConfig} from './kernels/ArgMax';\nimport {avgPoolConfig} from './kernels/AvgPool';\nimport {batchMatMulConfig} from './kernels/BatchMatMul';\nimport {batchToSpaceNDConfig} from './kernels/BatchToSpaceND';\nimport {castConfig} from './kernels/Cast';\nimport {ceilConfig} from './kernels/Ceil';\nimport {clipByValueConfig} from './kernels/ClipByValue';\nimport {concatConfig} from './kernels/Concat';\nimport {conv2DConfig} from './kernels/Conv2D';\nimport {conv2DBackpropInputConfig} from './kernels/Conv2DBackpropInput';\nimport {cosConfig} from './kernels/Cos';\nimport {coshConfig} from './kernels/Cosh';\nimport {cropAndResizeConfig} from './kernels/CropAndResize';\nimport {cumsumConfig} from './kernels/Cumsum';\nimport {depthToSpaceConfig} from './kernels/DepthToSpace';\nimport {depthwiseConv2dNativeConfig} from './kernels/DepthwiseConv2dNative';\nimport {eluConfig} from './kernels/Elu';\nimport {equalConfig} from './kernels/Equal';\nimport {expConfig} from './kernels/Exp';\nimport {expandDimsConfig} from './kernels/ExpandDims';\nimport {fillConfig} from './kernels/Fill';\nimport {flipLeftRightConfig} from './kernels/FlipLeftRight';\nimport {floorConfig} from './kernels/Floor';\nimport {floorDivConfig} from './kernels/FloorDiv';\nimport {fusedBatchNormConfig} from './kernels/FusedBatchNorm';\nimport {fusedConv2DConfig} from './kernels/FusedConv2D';\nimport {fusedDepthwiseConv2DConfig} from './kernels/FusedDepthwiseConv2D';\nimport {gatherNdConfig} from './kernels/GatherNd';\nimport {gatherV2Config} from './kernels/GatherV2';\nimport {greaterConfig} from './kernels/Greater';\nimport {greaterEqualConfig} from './kernels/GreaterEqual';\nimport {identityConfig} from './kernels/Identity';\nimport {leakyReluConfig} from './kernels/LeakyRelu';\nimport {lessConfig} from './kernels/Less';\nimport {lessEqualConfig} from './kernels/LessEqual';\nimport {logConfig} from './kernels/Log';\nimport {logicalAndConfig} from './kernels/LogicalAnd';\nimport {maxConfig} from './kernels/Max';\nimport {maximumConfig} from './kernels/Maximum';\nimport {maxPoolConfig} from './kernels/MaxPool';\nimport {meanConfig} from './kernels/Mean';\nimport {minConfig} from './kernels/Min';\nimport {minimumConfig} from './kernels/Minimum';\nimport {mirrorPadConfig} from './kernels/MirrorPad';\nimport {multiplyConfig} from './kernels/Multiply';\nimport {negConfig} from './kernels/Neg';\nimport {nonMaxSuppressionV3Config} from './kernels/NonMaxSuppressionV3';\nimport {nonMaxSuppressionV4Config} from './kernels/NonMaxSuppressionV4';\nimport {nonMaxSuppressionV5Config} from './kernels/NonMaxSuppressionV5';\nimport {notEqualConfig} from './kernels/NotEqual';\nimport {oneHotConfig} from './kernels/OneHot';\nimport {onesLikeConfig} from './kernels/OnesLike';\nimport {packConfig} from './kernels/Pack';\nimport {padV2Config} from './kernels/PadV2';\nimport {powConfig} from './kernels/Pow';\nimport {preluConfig} from './kernels/Prelu';\nimport {prodConfig} from './kernels/Prod';\nimport {rangeConfig} from './kernels/Range';\nimport {realDivConfig} from './kernels/RealDiv';\nimport {reluConfig} from './kernels/Relu';\nimport {relu6Config} from './kernels/Relu6';\nimport {reshapeConfig} from './kernels/Reshape';\nimport {resizeBilinearConfig} from './kernels/ResizeBilinear';\nimport {reverseConfig} from './kernels/Reverse';\nimport {rotateWithOffsetConfig} from './kernels/RotateWithOffset';\nimport {roundConfig} from './kernels/Round';\nimport {rsqrtConfig} from './kernels/Rsqrt';\nimport {scatterNdConfig} from './kernels/ScatterNd';\nimport {selectConfig} from './kernels/Select';\nimport {sigmoidConfig} from './kernels/Sigmoid';\nimport {sinConfig} from './kernels/Sin';\nimport {sliceConfig} from './kernels/Slice';\nimport {softmaxConfig} from './kernels/Softmax';\nimport {spaceToBatchNDConfig} from './kernels/SpaceToBatchND';\nimport {splitVConfig} from './kernels/SplitV';\nimport {sqrtConfig} from './kernels/Sqrt';\nimport {squareConfig} from './kernels/Square';\nimport {squaredDifferenceConfig} from './kernels/SquaredDifference';\nimport {stepConfig} from './kernels/Step';\nimport {stridedSliceConfig} from './kernels/StridedSlice';\nimport {subConfig} from './kernels/Sub';\nimport {sumConfig} from

'./kernels/Sum';\nimport {tanConfig} from './kernels/Tan';\nimport {tanhConfig} from './kernels/Tanh';\nimport {tileConfig} from './kernels/Tile';\nimport {topKConfig} from './kernels/TopK';\nimport {transformConfig} from './kernels/Transform';\nimport {transposeConfig} from './kernels/Transpose';\nimport {unpackConfig} from './kernels/Unpack';\nimport {zerosLikeConfig} from './kernels/ZerosLike';\n\n// List all kernel configs here\nconst kernelConfigs: KernelConfig[] = [\n absConfig,\n addConfig,\n addNConfig,\n allConfig,\n anyConfig,\n argMaxConfig,\n avgPoolConfig,\n batchMatMulConfig,\n batchToSpaceNDConfig,\n castConfig,\n ceilConfig,\n clipByValueConfig,\n concatConfig,\n conv2DConfig,\n conv2DBackpropInputConfig,\n cosConfig,\n coshConfig,\n cropAndResizeConfig,\n cumsumConfig,\n depthToSpaceConfig,\n depthwiseConv2dNativeConfig,\n eluConfig,\n equalConfig,\n expConfig,\n expandDimsConfig,\n fillConfig,\n flipLeftRightConfig,\n floorConfig,\n floorDivConfig,\n fusedMatMulConfig,\n fusedBatchNormConfig,\n fusedConv2DConfig,\n fusedDepthwiseConv2DConfig,\n gatherNdConfig,\n gatherV2Config,\n greaterConfig,\n greaterEqualConfig,\n identityConfig,\n leakyReluConfig,\n lessConfig,\n lessEqualConfig,\n logConfig,\n logicalAndConfig,\n maxConfig,\n maximumConfig,\n maxPoolConfig,\n meanConfig,\n minConfig,\n minimumConfig,\n mirrorPadConfig,\n multiplyConfig,\n negConfig,\n nonMaxSuppressionV3Config,\n nonMaxSuppressionV4Config,\n nonMaxSuppressionV5Config,\n notEqualConfig,\n oneHotConfig,\n onesLikeConfig,\n packConfig,\n padV2Config,\n powConfig,\n preluConfig,\n prodConfig,\n rangeConfig,\n realDivConfig,\n reluConfig,\n relu6Config,\n reshapeConfig,\n resizeBilinearConfig,\n reverseConfig,\n rotateWithOffsetConfig,\n rsqrtConfig,\n roundConfig,\n scatterNdConfig,\n selectConfig,\n sigmoidConfig,\n sinConfig,\n sliceConfig,\n softmaxConfig,\n spaceToBatchNDConfig,\n splitVConfig,\n sqrtConfig,\n squareConfig,\n squaredDifferenceConfig,\n stepConfig,\n stridedSliceConfig,\n subConfig,\n sumConfig,\n tanConfig,\n tanhConfig,\n tileConfig,\n topKConfig,\n transformConfig,\n transposeConfig,\n unpackConfig,\n zerosLikeConfig\n];\n\nfor (const kernelConfig of kernelConfigs) {\n registerKernel(kernelConfig);\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {env} from '@tensorflow/tfjs-core';\n\nconst ENV = env();\n\n/**\n * True if SIMD is supported.\n */\n// From: https://github.com/GoogleChromeLabs/wasm-feature-detect\nENV.registerFlag(\n // This typed array passed in to WebAssembly.validate is WebAssembly binary\n // code. In this case it is a small program that contains SIMD\n // instructions.\n 'WASM_HAS_SIMD_SUPPORT', async () => WebAssembly.validate(new Uint8Array([\n 0, 97, 115, 109, 1, 0, 0, 0, 1, 4, 1, 96, 0, 0, 3,\n 2, 1, 0, 10, 9, 1, 7, 0, 65, 0, 253, 15, 26, 11\n])));\n\n/**\n * True if threads are supported.\n */\n// From: https://github.com/GoogleChromeLabs/wasm-feature-detect\nENV.registerFlag('WASM_HAS_MULTITHREAD_SUPPORT', async () => {\n // TODO(annxingyuan): Enable node support once this is resolved:\n // https://github.com/tensorflow/tfjs/issues/3830\n if (ENV.get('IS_NODE')) {\n return false;\n }\n\n try {\n // Test for transferability of SABs (needed for Firefox)\n // https://groups.google.com/forum/#!msg/mozilla.dev.platform/IHkBZlHETpA/dwsMNchWEQAJ\n new MessageChannel().port1.postMessage(new SharedArrayBuffer(1));\n // This typed array is a WebAssembly program containing threaded\n // instructions.\n return WebAssembly.validate(new Uint8Array([\n 0, 97, 115, 109, 1, 0, 0, 0, 1, 4, 1, 96, 0, 0, 3, 2, 1, 0, 5,\n 4, 1, 3, 1, 1, 10, 11, 1, 9, 0, 65, 0, 254, 16, 2, 0, 26, 11\n]));\n } catch (e) {\n return false;\n }\n});\n","\nvar WasmBackendModuleThreadedSimd = (function() {\n var _scriptDir = typeof document !== 'undefined' && document.currentScript ? document.currentScript.src : undefined;\n if (typeof __filename !== 'undefined') _scriptDir = _scriptDir || __filename;\n return

(\nfunction(WasmBackendModuleThreadedSimd) {\n WasmBackendModuleThreadedSimd = WasmBackendModuleThreadedSimd || {};\n\nfunction GROWABLE_HEAP_I8(){if(wasmMemory.buffer!=buffer){updateGlobalBufferAndViews(wasmMemory.buffer)}return HEAP8}function GROWABLE_HEAP_U8(){if(wasmMemory.buffer!=buffer){updateGlobalBufferAndViews(wasmMemory.buffer)}return HEAPU8}function GROWABLE_HEAP_I32(){if(wasmMemory.buffer!=buffer){updateGlobalBufferAndViews(wasmMemory.buffer)}return HEAP32}function GROWABLE_HEAP_U32(){if(wasmMemory.buffer!=buffer){updateGlobalBufferAndViews(wasmMemory.buffer)}return HEAPU32}function GROWABLE_HEAP_F64(){if(wasmMemory.buffer!=buffer){updateGlobalBufferAndViews(wasmMemory.buffer)}return HEAPF64}var Module=typeof WasmBackendModuleThreadedSimd!==\"undefined\"?WasmBackendModuleThreadedSimd:{};var readyPromiseResolve,readyPromiseReject;Module[\"ready\"]=new Promise(function(resolve,reject){readyPromiseResolve=resolve;readyPromiseReject=reject});var moduleOverrides={};var key;for(key in Module){if(Module.hasOwnProperty(key)){moduleOverrides[key]=Module[key]}}var arguments_=[];var thisProgram=\"./this.program\";var quit_=function(status,toThrow){throw toThrow};var ENVIRONMENT_IS_WEB=false;var ENVIRONMENT_IS_WORKER=false;var ENVIRONMENT_IS_NODE=false;var ENVIRONMENT_IS_SHELL=false;ENVIRONMENT_IS_WEB=typeof window===\"object\";ENVIRONMENT_IS_WORKER=typeof importScripts===\"function\";ENVIRONMENT_IS_NODE=typeof process===\"object\"&&typeof process.versions===\"object\"&&typeof process.versions.node===\"string\";ENVIRONMENT_IS_SHELL=!ENVIRONMENT_IS_WEB&&!ENVIRONMENT_IS_NODE&&!ENVIRONMENT_IS_WORKER;var ENVIRONMENT_IS_PTHREAD=Module[\"ENVIRONMENT_IS_PTHREAD\"]||false;if(ENVIRONMENT_IS_PTHREAD){buffer=Module[\"buffer\"]}var scriptDirectory=\"\";function locateFile(path){if(Module[\"locateFile\"]){return Module[\"locateFile\"](path,scriptDirectory)}return scriptDirectory+path}var read_,readAsync,readBinary,setWindowTitle;var nodeFS;var nodePath;if(ENVIRONMENT_IS_NODE){if(ENVIRONMENT_IS_WORKER){scriptDirectory=require(\"path\").dirname(scriptDirectory)+\"/\"}else{scriptDirectory=__dirname+\"/\"}read_=function shell_read(filename,binary){if(!nodeFS)nodeFS=require(\"fs\");if(!nodePath)nodePath=require(\"path\");filename=nodePath[\"normalize\"](filename);return nodeFS[\"readFileSync\"](filename,binary?null:\"utf8\")};readBinary=function readBinary(filename){var ret=read_(filename,true);if(!ret.buffer){ret=new Uint8Array(ret)}assert(ret.buffer);return ret};if(process[\"argv\"].length>1){thisProgram=process[\"argv\"][1].replace(/\\\\/g,\"/\")}arguments_=process[\"argv\"].slice(2);process[\"on\"](\"uncaughtException\",function(ex){if(!(ex instanceof ExitStatus)){throw ex}});process[\"on\"](\"unhandledRejection\",abort);quit_=function(status){process[\"exit\"](status)};Module[\"inspect\"]=function(){return\"[Emscripten Module object]\"};var nodeWorkerThreads;try{nodeWorkerThreads=require(\"worker_threads\")}catch(e){console.error('The \"worker_threads\" module is not supported in this node.js build - perhaps a newer version is needed?');throw e}global.Worker=nodeWorkerThreads.Worker}else if(ENVIRONMENT_IS_SHELL){if(typeof read!=\"undefined\"){read_=function shell_read(f){return read(f)}}readBinary=function readBinary(f){var data;if(typeof readbuffer===\"function\"){return new Uint8Array(readbuffer(f))}data=read(f,\"binary\");assert(typeof data===\"object\");return data};if(typeof scriptArgs!=\"undefined\"){arguments_=scriptArgs}else if(typeof arguments!=\"undefined\"){arguments_=arguments}if(typeof

quit===\"function\"){quit_=function(status){quit(status)}}if(typeof print!==\"undefined\"){if(typeof console===\"undefined\")console={};console.log=print;console.warn=console.error=typeof printErr!==\"undefined\"?printErr:print}}else if(ENVIRONMENT_IS_WEB||ENVIRONMENT_IS_WORKER){if(ENVIRONMENT_IS_WORKER){scriptDirectory=self.location.href}else if(typeof document!==\"undefined\"&&document.currentScript){scriptDirectory=document.currentScript.src}if(typeof _scriptDir !== \"undefined\" && _scriptDir){scriptDirectory=_scriptDir}if(scriptDirectory.indexOf(\"blob:\")!==0){scriptDirectory=scriptDirectory.substr(0,scriptDirectory.lastIndexOf(\"/\")+1)}else{scriptDirectory=\"\"}if(ENVIRONMENT_IS_NODE){read_=function shell_read(filename,binary){if(!nodeFS)nodeFS=require(\"fs\");if(!nodePath)nodePath=require(\"path\");filename=nodePath[\"normalize\"](filename);return nodeFS[\"readFileSync\"](filename,binary?null:\"utf8\")};readBinary=function readBinary(filename){var ret=read_(filename,true);if(!ret.buffer){ret=new Uint8Array(ret)}assert(ret.buffer);return ret}}else{read_=function(url){var xhr=new XMLHttpRequest;xhr.open(\"GET\",url,false);xhr.send(null);return xhr.responseText};if(ENVIRONMENT_IS_WORKER){readBinary=function(url){var xhr=new XMLHttpRequest;xhr.open(\"GET\",url,false);xhr.responseType=\"arraybuffer\";xhr.send(null);return new Uint8Array(xhr.response)}}readAsync=function(url,onload,onerror){var xhr=new XMLHttpRequest;xhr.open(\"GET\",url,true);xhr.responseType=\"arraybuffer\";xhr.onload=function(){if(xhr.status==200||xhr.status==0&&xhr.response){onload(xhr.response);return}onerror()};xhr.onerror=onerror;xhr.send(null)}}setWindowTitle=function(title){document.title=title}}else{}if(ENVIRONMENT_IS_NODE){if(typeof performance===\"undefined\"){global.performance=require(\"perf_hooks\").performance}}var out=Module[\"print\"]||console.log.bind(console);var err=Module[\"printErr\"]||console.warn.bind(console);for(key in moduleOverrides){if(moduleOverrides.hasOwnProperty(key)){Module[key]=moduleOverrides[key]}}moduleOverrides=null;if(Module[\"arguments\"])arguments_=Module[\"arguments\"];if(Module[\"thisProgram\"])thisProgram=Module[\"thisProgram\"];if(Module[\"quit\"])quit_=Module[\"quit\"];function warnOnce(text){if(!warnOnce.shown)warnOnce.shown={};if(!warnOnce.shown[text]){warnOnce.shown[text]=1;err(text)}}var Atomics_load=Atomics.load;var Atomics_store=Atomics.store;var Atomics_compareExchange=Atomics.compareExchange;var wasmBinary;if(Module[\"wasmBinary\"])wasmBinary=Module[\"wasmBinary\"];var noExitRuntime=Module[\"noExitRuntime\"]||true;if(typeof WebAssembly!==\"object\"){abort(\"no native wasm support detected\")}var wasmMemory;var wasmModule;var ABORT=false;var EXITSTATUS;function assert(condition,text){if(!condition){abort(\"Assertion failed: \"+text)}}function getCFunc(ident){var func=Module[\"_\"+ident];assert(func,\"Cannot call unknown function \"+ident+\", make sure it is exported\");return func}function ccall(ident,returnType,argTypes,args,opts){var toC={\"string\":function(str){var ret=0;if(str!==null&&str!==undefined&&str!==0){var len=(str.length<<2)+1;ret=stackAlloc(len);stringToUTF8(str,ret,len)}return ret},\"array\":function(arr){var ret=stackAlloc(arr.length);writeArrayToMemory(arr,ret);return ret}};function convertReturnValue(ret){if(returnType===\"string\")return UTF8ToString(ret);if(returnType===\"boolean\")return Boolean(ret);return ret}var func=getCFunc(ident);var cArgs=[];var stack=0;if(args){for(var i=0;i<args.length;i++){var converter=toC[argTypes[i]];if(converter){if(stack===0)stack=stackSave();cArgs[i]=converter(args[i])}else{cArgs[i]=args[i]}}}var ret=func.apply(null,cArgs);ret=convertReturnValue(ret);if(stack!==0)stackRestore(stack);return ret}function cwrap(ident,returnType,argTypes,opts){argTypes=argTypes||[];var numericArgs=argTypes.every(function(type){return type===\"number\"});var numericRet=returnType!==\"string\";if(numericRet&&numericArgs&&!opts){return getCFunc(ident)}return

function(){return ccall(ident,returnType,argTypes,arguments,opts)}}function UTF8ArrayToString(heap,idx,maxBytesToRead){var endIdx=idx+maxBytesToRead;var str=\"\";while(!(idx>=endIdx)){var u0=heap[idx++];if(!u0)return str;if(!(u0&128)){str+=String.fromCharCode(u0);continue}var u1=heap[idx++]&63;if((u0&224)==192){str+=String.fromCharCode((u0&31)<<6|u1);continue}var u2=heap[idx++]&63;if((u0&240)==224){u0=(u0&15)<<12|u1<<6|u2}else{u0=(u0&7)<<18|u1<<12|u2<<6|heap[idx++]&63}if(u0<65536){str+=String.fromCharCode(u0)}else{var ch=u0-65536;str+=String.fromCharCode(55296|ch>>10,56320|ch&1023)}}return str}function UTF8ToString(ptr,maxBytesToRead){return ptr?UTF8ArrayToString(GROWABLE_HEAP_U8(),ptr,maxBytesToRead):\"\"}function stringToUTF8Array(str,heap,outIdx,maxBytesToWrite){if(!(maxBytesToWrite>0))return 0;var startIdx=outIdx;var endIdx=outIdx+maxBytesToWrite-1;for(var i=0;i<str.length;++i){var u=str.charCodeAt(i);if(u>=55296&&u<=57343){var u1=str.charCodeAt(++i);u=65536+((u&1023)<<10)|u1&1023}if(u<=127){if(outIdx>=endIdx)break;heap[outIdx++]=u}else if(u<=2047){if(outIdx+1>=endIdx)break;heap[outIdx++]=192|u>>6;heap[outIdx++]=128|u&63}else if(u<=65535){if(outIdx+2>=endIdx)break;heap[outIdx++]=224|u>>12;heap[outIdx++]=128|u>>6&63;heap[outIdx++]=128|u&63}else{if(outIdx+3>=endIdx)break;heap[outIdx++]=240|u>>18;heap[outIdx++]=128|u>>12&63;heap[outIdx++]=128|u>>6&63;heap[outIdx++]=128|u&63}}heap[outIdx]=0;return outIdx-startIdx}function stringToUTF8(str,outPtr,maxBytesToWrite){return stringToUTF8Array(str,GROWABLE_HEAP_U8(),outPtr,maxBytesToWrite)}function lengthBytesUTF8(str){var len=0;for(var i=0;i<str.length;++i){var u=str.charCodeAt(i);if(u>=55296&&u<=57343)u=65536+((u&1023)<<10)|str.charCodeAt(++i)&1023;if(u<=127)++len;else if(u<=2047)len+=2;else if(u<=65535)len+=3;else len+=4}return len}function writeArrayToMemory(array,buffer){GROWABLE_HEAP_I8().set(array,buffer)}function alignUp(x,multiple){if(x%multiple>0){x+=multiple-x%multiple}return x}var buffer,HEAP8,HEAPU8,HEAP16,HEAPU16,HEAP32,HEAPU32,HEAPF32,HEAPF64;function updateGlobalBufferAndViews(buf){buffer=buf;Module[\"HEAP8\"]=HEAP8=new Int8Array(buf);Module[\"HEAP16\"]=HEAP16=new Int16Array(buf);Module[\"HEAP32\"]=HEAP32=new Int32Array(buf);Module[\"HEAPU8\"]=HEAPU8=new Uint8Array(buf);Module[\"HEAPU16\"]=HEAPU16=new Uint16Array(buf);Module[\"HEAPU32\"]=HEAPU32=new Uint32Array(buf);Module[\"HEAPF32\"]=HEAPF32=new Float32Array(buf);Module[\"HEAPF64\"]=HEAPF64=new Float64Array(buf)}var INITIAL_MEMORY=Module[\"INITIAL_MEMORY\"]||16777216;if(ENVIRONMENT_IS_PTHREAD){wasmMemory=Module[\"wasmMemory\"];buffer=Module[\"buffer\"]}else{if(Module[\"wasmMemory\"]){wasmMemory=Module[\"wasmMemory\"]}else{wasmMemory=new WebAssembly.Memory({\"initial\":INITIAL_MEMORY/65536,\"maximum\":2147483648/65536,\"shared\":true});if(!(wasmMemory.buffer instanceof SharedArrayBuffer)){err(\"requested a shared WebAssembly.Memory but the returned buffer is not a SharedArrayBuffer, indicating that while the browser has SharedArrayBuffer it does not have WebAssembly threads support - you may need to set a flag\");if(ENVIRONMENT_IS_NODE){console.log(\"(on node you may need: --experimental-wasm-threads --experimental-wasm-bulk-memory and also use a recent version)\")}throw Error(\"bad memory\")}}}if(wasmMemory){buffer=wasmMemory.buffer}INITIAL_MEMORY=buffer.byteLength;updateGlobalBufferAndViews(buffer);var wasmTable;var __ATPRERUN__=[];var __ATINIT__=[];var __ATMAIN__=[];var __ATEXIT__=[];var __ATPOSTRUN__=[];var runtimeInitialized=false;var runtimeExited=false;if(!ENVIRONMENT_IS_PTHREAD)__ATINIT__.push({func:function(){___wasm_call_ctors()}});function preRun(){if(ENVIRONMENT_IS_PTHREAD)return;if(Module[\"preRun\"]){if(typeof Module[\"preRun\"]==\"function\")Module[\"preRun\"]=[Module[\"preRun\"]];while(Module[\"preRun\"].length){a

ddOnPreRun(Module[\"preRun\"].shift())}}callRuntimeCallbacks(__ATPRERUN__)}function initRuntime(){runtimeInitialized=true;if(ENVIRONMENT_IS_PTHREAD)return;callRuntimeCallbacks(__ATINIT__)}function preMain(){if(ENVIRONMENT_IS_PTHREAD)return;callRuntimeCallbacks(__ATMAIN__)}function exitRuntime(){if(ENVIRONMENT_IS_PTHREAD)return;runtimeExited=true}function postRun(){if(ENVIRONMENT_IS_PTHREAD)return;if(Module[\"postRun\"]){if(typeof Module[\"postRun\"]==\"function\")Module[\"postRun\"]=[Module[\"postRun\"]];while(Module[\"postRun\"].length){addOnPostRun(Module[\"postRun\"].shift())}}callRuntimeCallbacks(__ATPOSTRUN__)}function addOnPreRun(cb){__ATPRERUN__.unshift(cb)}function addOnPostRun(cb){__ATPOSTRUN__.unshift(cb)}var runDependencies=0;var runDependencyWatcher=null;var dependenciesFulfilled=null;function addRunDependency(id){assert(!ENVIRONMENT_IS_PTHREAD,\"addRunDependency cannot be used in a pthread worker\");runDependencies++;if(Module[\"monitorRunDependencies\"]){Module[\"monitorRunDependencies\"](runDependencies)}}function removeRunDependency(id){runDependencies--;if(Module[\"monitorRunDependencies\"]){Module[\"monitorRunDependencies\"](runDependencies)}if(runDependencies==0){if(runDependencyWatcher!==null){clearInterval(runDependencyWatcher);runDependencyWatcher=null}if(dependenciesFulfilled){var callback=dependenciesFulfilled;dependenciesFulfilled=null;callback()}}}Module[\"preloadedImages\"]={};Module[\"preloadedAudios\"]={};function abort(what){if(Module[\"onAbort\"]){Module[\"onAbort\"](what)}if(ENVIRONMENT_IS_PTHREAD)console.error(\"Pthread aborting at \"+(new Error).stack);what+=\"\";err(what);ABORT=true;EXITSTATUS=1;what=\"abort(\"+what+\"). Build with -s ASSERTIONS=1 for more info.\";var e=new WebAssembly.RuntimeError(what);readyPromiseReject(e);throw e}function hasPrefix(str,prefix){return String.prototype.startsWith?str.startsWith(prefix):str.indexOf(prefix)===0}var dataURIPrefix=\"data:application/octet-stream; base64,\";function isDataURI(filename){return hasPrefix(filename,dataURIPrefix)}var fileURIPrefix=\"file://\";function isFileURI(filename){return hasPrefix(filename,fileURIPrefix)}var wasmBinaryFile=\"tfjs-backend-wasm-threaded-simd.wasm\";if(!isDataURI(wasmBinaryFile)){wasmBinaryFile=locateFile(wasmBinaryFile)}function getBinary(file){try{if(file==wasmBinaryFile&&wasmBinary){return new Uint8Array(wasmBinary)}if(readBinary){return readBinary(file)}else{throw\"both async and sync fetching of the wasm failed\"}}catch(err){abort(err)}}function getBinaryPromise(){if(!wasmBinary&&(ENVIRONMENT_IS_WEB||ENVIRONMENT_IS_WORKER)){if(typeof fetch===\"function\"&&!isFileURI(wasmBinaryFile)){return fetch(wasmBinaryFile,{credentials:\"same-origin\"}).then(function(response){if(!response[\"ok\"]){throw\"failed to load wasm binary file at '\"+wasmBinaryFile+\"'\"}return response[\"arrayBuffer\"]()}).catch(function(){return getBinary(wasmBinaryFile)})}else{if(readAsync){return new Promise(function(resolve,reject){readAsync(wasmBinaryFile,function(response){resolve(new Uint8Array(response))},reject)})}}}return Promise.resolve().then(function(){return getBinary(wasmBinaryFile)})}function createWasm(){var info={\"a\":asmLibraryArg};function receiveInstance(instance,module){var exports=instance.exports;Module[\"asm\"]=exports;wasmTable=Module[\"asm\"][\"I\"];wasmModule=module;if(!ENVIRONMENT_IS_PTHREAD){var numWorkersToLoad=PThread.unusedWorkers.length;PThread.unusedWorkers.forEach(function(w){PThread.loadWasmModuleToWorker(w,function(){if(!--numWorkersToLoad)removeRunDependency(\"wasm-instantiate\")})})}if(!ENVIRONMENT_IS_PTHREAD){addRunDependency(\"wasm-instantiate\")}function receiveInstantiatedSource(output){receiveInstance(output[\"instance\"],output[\"module\"])}function instantiateArrayBuffer(receiver){return getBinaryPromise().then(function(binary){return

WebAssembly.instantiate(binary,info)}).then(receiver,function(reason){err(\"failed to asynchronously prepare wasm: \"+reason);abort(reason)})}function instantiateAsync(){if(!wasmBinary&&typeof WebAssembly.instantiateStreaming===\"function\"&&!isDataURI(wasmBinaryFile)&&!isFileURI(wasmBinaryFile)&&typeof fetch===\"function\"){return fetch(wasmBinaryFile,{credentials:\"same-origin\"}).then(function(response){var result=WebAssembly.instantiateStreaming(response,info);return result.then(receiveInstantiatedSource,function(reason){err(\"wasm streaming compile failed: \"+reason);err(\"falling back to ArrayBuffer instantiation\");return instantiateArrayBuffer(receiveInstantiatedSource)})})}else{return instantiateArrayBuffer(receiveInstantiatedSource)}}if(Module[\"instantiateWasm\"]){try{var exports=Module[\"instantiateWasm\"](info,receiveInstance);return exports}catch(e){err(\"Module.instantiateWasm callback failed with error: \"+e);return false}}instantiateAsync().catch(readyPromiseReject);return{}}var ASM_CONSTS={10520:function(){throw\"Canceled!\"},10538:function($0,$1){setTimeout(function(){__emscripten_do_dispatch_to_thread($0,$1)},0)}};function initPthreadsJS(){PThread.initRuntime()}function callRuntimeCallbacks(callbacks){while(callbacks.length>0){var callback=callbacks.shift();if(typeof callback==\"function\"){callback(Module);continue}var func=callback.func;if(typeof func===\"number\"){if(callback.arg===undefined){wasmTable.get(func)()}else{wasmTable.get(func)(callback.arg)}}else{func(callback.arg===undefined?null:callback.arg)}}}var ERRNO_CODES={EPERM:63,ENOENT:44,ESRCH:71,EINTR:27,EIO:29,ENXIO:60,E2BIG:1,ENOEXEC:45,EBADF:8,ECHILD:12,EAGAIN:6,EWOULDBLOCK:6,ENOMEM:48,EACCES:2,EFAULT:21,ENOTBLK:105,EBUSY:10,EEXIST:20,EXDEV:75,ENODEV:43,ENOTDIR:54,EISDIR:31,EINVAL:28,ENFILE:41,EMFILE:33,ENOTTY:59,ETXTBSY:74,EFBIG:22,ENOSPC:51,ESPIPE:70,EROFS:69,EMLINK:34,EPIPE:64,EDOM:18,ERANGE:68,ENOMSG:49,EIDRM:24,ECHRNG:106,EL2NSYNC:156,EL3HLT:107,EL3RST:108,ELNRNG:109,EUNATCH:110,ENOCSI:111,EL2HLT:112,EDEADLK:16,ENOLCK:46,EBADE:113,EBADR:114,EXFULL:115,ENOANO:104,EBADRQC:103,EBADSLT:102,EDEADLOCK:16,EBFONT:101,ENOSTR:100,ENODATA:116,ETIME:117,ENOSR:118,ENONET:119,ENOPKG:120,EREMOTE:121,ENOLINK:47,EADV:122,ESRMNT:123,ECOMM:124,EPROTO:65,EMULTIHOP:36,EDOTDOT:125,EBADMSG:9,ENOTUNIQ:126,EBADFD:127,EREMCHG:128,ELIBACC:129,ELIBBAD:130,ELIBSCN:131,ELIBMAX:132,ELIBEXEC:133,ENOSYS:52,ENOTEMPTY:55,ENAMETOOLONG:37,ELOOP:32,EOPNOTSUPP:138,EPFNOSUPPORT:139,ECONNRESET:15,ENOBUFS:42,EAFNOSUPPORT:5,EPROTOTYPE:67,ENOTSOCK:57,ENOPROTOOPT:50,ESHUTDOWN:140,ECONNREFUSED:14,EADDRINUSE:3,ECONNABORTED:13,ENETUNREACH:40,ENETDOWN:38,ETIMEDOUT:73,EHOSTDOWN:142,EHOSTUNREACH:23,EINPROGRESS:26,EALREADY:7,EDESTADDRREQ:17,EMSGSIZE:35,EPROTONOSUPPORT:66,ESOCKTNOSUPPORT:137,EADDRNOTAVAIL:4,ENETRESET:39,EISCONN:30,ENOTCONN:53,ETOOMANYREFS:141,EUSERS:136,EDQUOT:19,ESTALE:72,ENOTSUP:138,ENOMEDIUM:148,EILSEQ:25,EOVERFLOW:61,ECANCELED:11,ENOTRECOVERABLE:56,EOWNERDEAD:62,ESTRPIPE:135};function _emscripten_futex_wake(addr,count){if(addr<=0||addr>GROWABLE_HEAP_I8().length||addr&3!=0||count<0)return-28;if(count==0)return 0;if(count>=2147483647)count=Infinity;var mainThreadWaitAddress=Atomics.load(GROWABLE_HEAP_I32(),__emscripten_main_thread_futex>>2);var mainThreadWoken=0;if(mainThreadWaitAddress==addr){var loadedAddr=Atomics.compareExchange(GROWABLE_HEAP_I32(),__emscripten_main_thread_futex>>2,mainThreadWaitAddress,0);if(loadedAddr==mainThreadWaitAddress){--count;mainThreadWoken=1;if(count<=0)return 1}}var ret=Atomics.notify(GROWABLE_HEAP_I32(),addr>>2,count);if(ret>=0)return ret+mainThreadWoken;throw\"Atomics.notify returned an unexpected value \"+ret}Module[\"_emscripten_futex_wake\"]=_emscripten_futex_wake;function killThread(pthread_ptr){if(ENVIRONMENT_IS_PTHREAD)throw\"Internal Error! killThread() can only ever be called from main application thread!\";if(!pthread_ptr)throw\"Internal Error! Null pthread_ptr in killThread!\";GROWABLE_HEAP_I32()[pthread_ptr+12>>2]=0;var pthread=PThread.pthreads[pthread_ptr];pthread.worker.terminate();PThread.freeThreadData(pthread);PThread.runningWorkers.splice(PThread.runningWorkers.indexOf(pthread.worker),1);pthread.worker.pthread=undefined}functio

n cancelThread(pthread_ptr){if(ENVIRONMENT_IS_PTHREAD)throw\"Internal Error! cancelThread() can only ever be called from main application thread!\";if(!pthread_ptr)throw\"Internal Error! Null pthread_ptr in cancelThread!\";var pthread=PThread.pthreads[pthread_ptr];pthread.worker.postMessage({\"cmd\":\"cancel\"})}function cleanupThread(pthread_ptr){if(ENVIRONMENT_IS_PTHREAD)throw\"Internal Error! cleanupThread() can only ever be called from main application thread!\";if(!pthread_ptr)throw\"Internal Error! Null pthread_ptr in cleanupThread!\";var pthread=PThread.pthreads[pthread_ptr];if(pthread){GROWABLE_HEAP_I32()[pthread_ptr+12>>2]=0;var worker=pthread.worker;PThread.returnWorkerToPool(worker)}}var PThread={unusedWorkers:[],runningWorkers:[],initMainThreadBlock:function(){var pthreadPoolSize=8;for(var i=0;i<pthreadPoolSize;++i){PThread.allocateUnusedWorker()}},initRuntime:function(){var tb=_malloc(228);for(var i=0;i<228/4;++i)GROWABLE_HEAP_U32()[tb/4+i]=0;GROWABLE_HEAP_I32()[tb+12>>2]=tb;var headPtr=tb+152;GROWABLE_HEAP_I32()[headPtr>>2]=headPtr;var tlsMemory=_malloc(512);for(var i=0;i<128;++i)GROWABLE_HEAP_U32()[tlsMemory/4+i]=0;Atomics.store(GROWABLE_HEAP_U32(),tb+100>>2,tlsMemory);Atomics.store(GROWABLE_HEAP_U32(),tb+40>>2,tb);__emscripten_thread_init(tb,!ENVIRONMENT_IS_WORKER,1);_emscripten_register_main_browser_thread_id(tb)},initWorker:function(){},pthreads:{},threadExitHandlers:[],setThreadStatus:function(){},runExitHandlers:function(){while(PThread.threadExitHandlers.length>0){PThread.threadExitHandlers.pop()()}if(ENVIRONMENT_IS_PTHREAD&&_pthread_self())___pthread_tsd_run_dtors()},runExitHandlersAndDeinitThread:function(tb,exitCode){Atomics.store(GROWABLE_HEAP_U32(),tb+56>>2,1);Atomics.store(GROWABLE_HEAP_U32(),tb+60>>2,0);PThread.runExitHandlers();Atomics.store(GROWABLE_HEAP_U32(),tb+4>>2,exitCode);Atomics.store(GROWABLE_HEAP_U32(),tb+0>>2,1);_emscripten_futex_wake(tb+0,2147483647);__emscripten_thread_init(0,0,0)},threadExit:function(exitCode){var tb=_pthread_self();if(tb){PThread.runExitHandlersAndDeinitThread(tb,exitCode);if(ENVIRONMENT_IS_PTHREAD){postMessage({\"cmd\":\"exit\"})}}},threadCancel:function(){PThread.runExitHandlersAndDeinitThread(_pthread_self(),-1);postMessage({\"cmd\":\"cancelDone\"})},terminateAllThreads:function(){for(var t in PThread.pthreads){var pthread=PThread.pthreads[t];if(pthread&&pthread.worker){PThread.returnWorkerToPool(pthread.worker)}}PThread.pthreads={};for(var i=0;i<PThread.unusedWorkers.length;++i){var worker=PThread.unusedWorkers[i];worker.terminate()}PThread.unusedWorkers=[];for(var i=0;i<PThread.runningWorkers.length;++i){var worker=PThread.runningWorkers[i];var pthread=worker.pthread;PThread.freeThreadData(pthread);worker.terminate()}PThread.runningWorkers=[]},freeThreadData:function(pthread){if(!pthread)return;if(pthread.threadInfoStruct){var tlsMemory=GROWABLE_HEAP_I32()[pthread.threadInfoStruct+100>>2];GROWABLE_HEAP_I32()[pthread.threadInfoStruct+100>>2]=0;_free(tlsMemory);_free(pthread.threadInfoStruct)}pthread.threadInfoStruct=0;if(pthread.allocatedOwnStack&&pthread.stackBase)_free(pthread.stackBase);pthread.stackBase=0;if(pthread.worker)pthread.worker.pthread=null},returnWorkerToPool:function(worker){PThread.runWithoutMainThreadQueuedCalls(function(){delete PThread.pthreads[worker.pthread.threadInfoStruct];PThread.unusedWorkers.push(worker);PThread.runningWorkers.splice(PThread.runningWorkers.indexOf(worker),1);PThread.freeThreadData(worker.pthread);worker.pthread=undefined})},runWithoutMainThreadQueuedCalls:function(func){GROWABLE_HEAP_I32()[__emscripten_allow_main_runtime_queued_calls>>2]=0;try{func()}finally{GROWABLE_HEAP_I32()[__emscripten_allow_main_runtime_queued_calls>>2]=1}},receiveObjectTransfer:function(data){},loadWasmModuleToWorker:function(worker,onFinishedLoading){worker.onmessage=function(e){var d=e[\"data\"];var cmd=d[\"cmd\"];if(worker.pthread)PThread.currentProxiedOperationCallerThread=worker.pthread.threadInfoStruct;if(d[\"targetThread\"]&&d[\"targetThread\"]!=_pthread_self()){var

thread=PThread.pthreads[d.targetThread];if(thread){thread.worker.postMessage(e.data,d[\"transferList\"])}else{console.error('Internal error! Worker sent a message \"'+cmd+'\" to target pthread '+d[\"targetThread\"]+\", but that thread no longer
exists!\")}PThread.currentProxiedOperationCallerThread=undefined;return}if(cmd===\"processQueuedMainThreadWork\"){_emscripten_main_thread_process_queued_calls()}else
if(cmd===\"spawnThread\"){spawnThread(e.data)}else
if(cmd===\"cleanupThread\"){cleanupThread(d[\"thread\"])}else
if(cmd===\"killThread\"){killThread(d[\"thread\"])}else
if(cmd===\"cancelThread\"){cancelThread(d[\"thread\"])}else
if(cmd===\"loaded\"){worker.loaded=true;if(onFinishedLoading)onFinishedLoading(worker);if(worker.runPthread){worker.runPthread();delete
worker.runPthread}}else if(cmd===\"print\"){out(\"Thread \"+d[\"threadId\"]+\": \"+d[\"text\"])}else
if(cmd===\"printErr\"){err(\"Thread \"+d[\"threadId\"]+\": \"+d[\"text\"])}else if(cmd===\"alert\"){alert(\"Thread \"+d[\"threadId\"]+\": \"+d[\"text\"])}else if(cmd===\"exit\"){var
detached=worker.pthread&&Atomics.load(GROWABLE_HEAP_U32(),worker.pthread.threadInfoStruct+64>>2);if(detached){PThread.returnWorkerToPool(worker)}}else
if(cmd===\"exitProcess\"){try{exit(d[\"returnCode\"])}catch(e){if(e instanceof ExitStatus)return;throw e}}else
if(cmd===\"cancelDone\"){PThread.returnWorkerToPool(worker)}else
if(cmd===\"objectTransfer\"){PThread.receiveObjectTransfer(e.data)}else
if(e.data.target===\"setimmediate\"){worker.postMessage(e.data)}else{err(\"worker sent an unknown command \"+cmd)}PThread.currentProxiedOperationCallerThread=undefined};worker.onerror=function(e){err(\"pthread sent an error! \"+e.filename+\":\"+e.lineno+\":
\"+e.message)};if(ENVIRONMENT_IS_NODE){worker.on(\"message\",function(data){worker.onmessage({data:data})});worker.on(\"error\",function(data){worker.onerror(data)});worker.on(\"exit\",function(data){})}worker.postMessage({\"cmd\":\"load\",\"urlOrBlob\":Module[\"mainScriptUrlOrBlob\"]||_scriptDir,\"wasmMemory\":wasmMemory,\"wasmModule\":wasmModule})},allocateUnusedWorker:function(){var
pthreadMainJs=locateFile(\"tfjs-backend-wasm-threaded-simd.worker.js\");PThread.unusedWorkers.push(new Worker(pthreadMainJs))},getNewWorker:function(){if(PThread.unusedWorkers.length==0){PThread.allocateUnusedWorker();PThread.loadWasmModuleToWorker(PThread.unusedWorkers[0])}if(PThread.unusedWorkers.length>0)return PThread.unusedWorkers.pop();else return null},busySpinWait:function(msecs){var
t=performance.now()+msecs;while(performance.now()<t){}}};function
establishStackSpace(stackTop,stackMax){_emscripten_stack_set_limits(stackTop,stackMax);stackRestore(stackTop)}Module[\"establishStackSpace\"]=establishStackSpace;function getNoExitRuntime(){return
noExitRuntime}Module[\"getNoExitRuntime\"]=getNoExitRuntime;function invokeEntryPoint(ptr,arg){return wasmTable.get(ptr)(arg)}Module[\"invokeEntryPoint\"]=invokeEntryPoint;function
___assert_fail(condition,filename,line,func){abort(\"Assertion failed: \"+UTF8ToString(condition)+\", at: \"+[filename?UTF8ToString(filename):\"unknown filename\",line,func?UTF8ToString(func):\"unknown function\"])}function ___call_main(argc,argv){var returnCode=_main(argc,argv)}var
_emscripten_get_now;if(ENVIRONMENT_IS_NODE){_emscripten_get_now=function(){var
t=process[\"hrtime\"]();return t[0]*1e3+t[1]/1e6}}else
if(ENVIRONMENT_IS_PTHREAD){_emscripten_get_now=function(){return performance.now()-Module[\"__performance_now_clock_drift\"]}}else if(typeof
dateNow!==\"undefined\"){_emscripten_get_now=dateNow}else _emscripten_get_now=function(){return performance.now()};function setErrNo(value){GROWABLE_HEAP_I32()[___errno_location()>>2]=value;return value}function _atexit(func,arg){if(ENVIRONMENT_IS_PTHREAD)return
_emscripten_proxy_to_main_thread_js(1,1,func,arg)}function
__emscripten_notify_thread_queue(targetThreadId,mainThreadId){if(targetThreadId==mainThreadId){postMessage({\"cmd\":\"processQueuedMainThreadWork\"})}else

if(ENVIRONMENT_IS_PTHREAD){postMessage({\"targetThread\":targetThreadId,\"cmd\":\"processThreadQueue\"})}else{var pthread=PThread.pthreads[targetThreadId];var worker=pthread&&pthread.worker;if(!worker){return}worker.postMessage({\"cmd\":\"processThreadQueue\"})}return 1}function _abort(){abort()}function _emscripten_asm_const_int(code,sigPtr,argbuf){var args=readAsmConstArgs(sigPtr,argbuf);return ASM_CONSTS[code].apply(null,args)}function _emscripten_conditional_set_current_thread_status(expectedStatus,newStatus){}function _emscripten_futex_wait(addr,val,timeout){if(addr<=0||addr>GROWABLE_HEAP_I8().length||addr&3!=0)return-28;if(!ENVIRONMENT_IS_WEB){var ret=Atomics.wait(GROWABLE_HEAP_I32(),addr>>2,val,timeout);if(ret===\"timed-out\")return-73;if(ret===\"not-equal\")return-6;if(ret===\"ok\")return 0;throw\"Atomics.wait returned an unexpected value \"+ret}else{if(Atomics.load(GROWABLE_HEAP_I32(),addr>>2)!=val){return-6}var tNow=performance.now();var tEnd=tNow+timeout;var lastAddr=Atomics.exchange(GROWABLE_HEAP_I32(),__emscripten_main_thread_futex>>2,addr);while(1){tNow=performance.now();if(tNow>tEnd){lastAddr=Atomics.exchange(GROWABLE_HEAP_I32(),__emscripten_main_thread_futex>>2,0);return-73}lastAddr=Atomics.exchange(GROWABLE_HEAP_I32(),__emscripten_main_thread_futex>>2,0);if(lastAddr==0){break}_emscripten_main_thread_process_queued_calls();if(Atomics.load(GROWABLE_HEAP_I32(),addr>>2)!=val){return-6}lastAddr=Atomics.exchange(GROWABLE_HEAP_I32(),__emscripten_main_thread_futex>>2,addr)}return 0}}function _emscripten_memcpy_big(dest,src,num){GROWABLE_HEAP_U8().copyWithin(dest,src,src+num)}function _emscripten_num_logical_cores(){if(ENVIRONMENT_IS_NODE)return require(\"os\").cpus().length;return navigator[\"hardwareConcurrency\"]}function _emscripten_proxy_to_main_thread_js(index,sync){var numCallArgs=arguments.length-2;var stack=stackSave();var serializedNumCallArgs=numCallArgs;var args=stackAlloc(serializedNumCallArgs*8);var b=args>>3;for(var i=0;i<numCallArgs;i++){var arg=arguments[2+i];GROWABLE_HEAP_F64()[b+i]=arg}var ret=_emscripten_run_in_main_runtime_thread_js(index,serializedNumCallArgs,args,sync);stackRestore(stack);return ret}var _emscripten_receive_on_main_thread_js_callArgs=[];var readAsmConstArgsArray=[];function readAsmConstArgs(sigPtr,buf){readAsmConstArgsArray.length=0;var ch;buf>>=2;while(ch=GROWABLE_HEAP_U8()[sigPtr++]){var double=ch<105;if(double&&buf&1)buf++;readAsmConstArgsArray.push(double?GROWABLE_HEAP_F64()[buf++>>1]:GROWABLE_HEAP_I32()[buf]);++buf}return readAsmConstArgsArray}function _emscripten_receive_on_main_thread_js(index,numCallArgs,args){_emscripten_receive_on_main_thread_js_callArgs.length=numCallArgs;var b=args>>3;for(var i=0;i<numCallArgs;i++){_emscripten_receive_on_main_thread_js_callArgs[i]=GROWABLE_HEAP_F64()[b+i]}var isEmAsmConst=index<0;var func=!isEmAsmConst?proxiedFunctionTable[index]:ASM_CONSTS[-index-1];return func.apply(null,_emscripten_receive_on_main_thread_js_callArgs)}function _emscripten_get_heap_size(){return GROWABLE_HEAP_U8().length}function emscripten_realloc_buffer(size){try{wasmMemory.grow(size-buffer.byteLength+65535>>>16);updateGlobalBufferAndViews(wasmMemory.buffer);return 1}catch(e){}}function _emscripten_resize_heap(requestedSize){var oldSize=_emscripten_get_heap_size();if(requestedSize<=oldSize){return false}var maxHeapSize=2147483648;if(requestedSize>maxHeapSize){return false}for(var cutDown=1;cutDown<=4;cutDown*=2){var overGrownHeapSize=oldSize*(1+.2/cutDown);overGrownHeapSize=Math.min(overGrownHeapSize,requestedSize+100663296);var

newSize=Math.min(maxHeapSize,alignUp(Math.max(requestedSize,overGrownHeapSize),65536));var replacement=emscripten_realloc_buffer(newSize);if(replacement){return true}}return false}var JSEvents={inEventHandler:0,removeAllEventListeners:function(){for(var i=JSEvents.eventHandlers.length-1;i>=0;--i){JSEvents._removeHandler(i)}JSEvents.eventHandlers=[];JSEvents.deferredCalls=[]},registerRemoveEventListeners:function(){if(!JSEvents.removeEventListenersRegistered){__ATEXIT__.push(JSEvents.removeAllEventListeners);JSEvents.removeEventListenersRegistered=true}},deferredCalls:[],deferCall:function(targetFunction,precedence,argsList){function arraysHaveEqualContent(arrA,arrB){if(arrA.length!=arrB.length)return false;for(var i in arrA){if(arrA[i]!=arrB[i])return false}return true}for(var i in JSEvents.deferredCalls){var call=JSEvents.deferredCalls[i];if(call.targetFunction==targetFunction&&arraysHaveEqualContent(call.argsList,argsList)){return}}JSEvents.deferredCalls.push({targetFunction:targetFunction,precedence:precedence,argsList:argsList});JSEvents.deferredCalls.sort(function(x,y){return x.precedence<y.precedence})},removeDeferredCalls:function(targetFunction){for(var i=0;i<JSEvents.deferredCalls.length;++i){if(JSEvents.deferredCalls[i].targetFunction==targetFunction){JSEvents.deferredCalls.splice(i,1);--i}}},canPerformEventHandlerRequests:function(){return JSEvents.inEventHandler&&JSEvents.currentEventHandler.allowsDeferredCalls},runDeferredCalls:function(){if(!JSEvents.canPerformEventHandlerRequests()){return}for(var i=0;i<JSEvents.deferredCalls.length;++i){var call=JSEvents.deferredCalls[i];JSEvents.deferredCalls.splice(i,1);--i;call.targetFunction.apply(null,call.argsList)}},eventHandlers:[],removeAllHandlersOnTarget:function(target,eventTypeString){for(var i=0;i<JSEvents.eventHandlers.length;++i){if(JSEvents.eventHandlers[i].target==target&&(!eventTypeString||eventTypeString==JSEvents.eventHandlers[i].eventTypeString)){JSEvents._removeHandler(i--)}}},_removeHandler:function(i){var h=JSEvents.eventHandlers[i];h.target.removeEventListener(h.eventTypeString,h.eventListenerFunc,h.useCapture);JSEvents.eventHandlers.splice(i,1)},registerOrRemoveHandler:function(eventHandler){var jsEventHandler=function jsEventHandler(event){++JSEvents.inEventHandler;JSEvents.currentEventHandler=eventHandler;JSEvents.runDeferredCalls();eventHandler.handlerFunc(event);JSEvents.runDeferredCalls();--JSEvents.inEventHandler};if(eventHandler.callbackfunc){eventHandler.eventListenerFunc=jsEventHandler;eventHandler.target.addEventListener(eventHandler.eventTypeString,jsEventHandler,eventHandler.useCapture);JSEvents.eventHandlers.push(eventHandler);JSEvents.registerRemoveEventListeners()}else{for(var i=0;i<JSEvents.eventHandlers.length;++i){if(JSEvents.eventHandlers[i].target==eventHandler.target&&JSEvents.eventHandlers[i].eventTypeString==eventHandler.eventTypeString){JSEvents._removeHandler(i--)}}}},queueEventHandlerOnThread_iiii:function(targetThread,eventHandlerFunc,eventTypeId,eventData,userData){var stackTop=stackSave();var varargs=stackAlloc(12);GROWABLE_HEAP_I32()[varargs>>2]=eventTypeId;GROWABLE_HEAP_I32()[varargs+4>>2]=eventData;GROWABLE_HEAP_I32()[varargs+8>>2]=userData;__emscripten_call_on_thread(0,targetThread,637534208,eventHandlerFunc,eventData,varargs);stackRestore(stackTop)},getTargetThreadForEventCallback:function(targetThread){switch(targetThread){case 1:return 0;case 2:return PThread.currentProxiedOperationCallerThread;default:return targetThread}},getNodeNameForTarget:function(target){if(!target)return\"\";if(target==window)return\"#window\";if(target==screen)return\"#screen\";return target&&target.nodeName?target.nodeName:\"\"},fullscreenEnabled:function(){return document.fullscreenEnabled||document.webkitFullscreenEnabled}};function stringToNewUTF8(jsString){var length=lengthBytesUTF8(jsString)+1;var cString=_malloc(length);stringToUTF8(jsString,cString,length);return cString}function _emscripten_set_offscreencanvas_size_on_target_thread_js(targetThread,targetCanvas,width,height){var stackTop=stackSave();var varargs=stackAlloc(12);var

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targetCanvasPtr=0;if(targetCanvas){targetCanvasPtr=stringToNewUTF8(targetCanvas)}GROWABLE_HEAP_I32(
)[varargs>>2]=targetCanvasPtr;GROWABLE_HEAP_I32()[varargs+4>>2]=width;GROWABLE_HEAP_I32()[var
args+8>>2]=height;__emscripten_call_on_thread(0,targetThread,657457152,0,targetCanvasPtr,varargs);stackRestor
e(stackTop)}function
_emscripten_set_offscreencanvas_size_on_target_thread(targetThread,targetCanvas,width,height){targetCanvas=tar
getCanvas?UTF8ToString(targetCanvas):\"\";_emscripten_set_offscreencanvas_size_on_target_thread_js(targetThr
ead,targetCanvas,width,height)}function maybeCStringToJsString(cString){return
cString>2?UTF8ToString(cString):cString}var specialHTMLTargets=[0,typeof
document!==\"undefined\"?document:0,typeof window!==\"undefined\"?window:0];function
findEventTarget(target){target=maybeCStringToJsString(target);var
domElement=specialHTMLTargets[target]||(typeof
document!==\"undefined\"?document.querySelector(target):undefined);return domElement}function
findCanvasEventTarget(target){return findEventTarget(target)}function
_emscripten_set_canvas_element_size_calling_thread(target,width,height){var
 canvas=findCanvasEventTarget(target);if(!canvas)return-
4;if(canvas.canvasSharedPtr){GROWABLE_HEAP_I32()[canvas.canvasSharedPtr>>2]=width;GROWABLE_HEA
P_I32()[canvas.canvasSharedPtr+4>>2]=height}if(canvas.offscreenCanvas||!canvas.controlTransferredOffscreen){if
(canvas.offscreenCanvas)canvas=canvas.offscreenCanvas;var
autoResizeViewport=false;if(canvas.GLctxObject&&canvas.GLctxObject.GLctx){var
prevViewport=canvas.GLctxObject.GLctx.getParameter(2978);autoResizeViewport=prevViewport[0]===0&&prev
Viewport[1]===0&&prevViewport[2]===canvas.width&&prevViewport[3]===canvas.height}canvas.width=width;
canvas.height=height;if(autoResizeViewport){canvas.GLctxObject.GLctx.viewport(0,0,width,height)}}else
if(canvas.canvasSharedPtr){var
targetThread=GROWABLE_HEAP_I32()[canvas.canvasSharedPtr+8>>2];_emscripten_set_offscreencanvas_size_o
n_target_thread(targetThread,target,width,height);return 1}else{return-4}return 0}function
_emscripten_set_canvas_element_size_main_thread(target,width,height){if(ENVIRONMENT_IS_PTHREAD)retur
n
 _emscripten_proxy_to_main_thread_js(2,1,target,width,height);return
_emscripten_set_canvas_element_size_calling_thread(target,width,height)}function
_emscripten_set_canvas_element_size(target,width,height){var
canvas=findCanvasEventTarget(target);if(canvas){return
_emscripten_set_canvas_element_size_calling_thread(target,width,height)}else{return
_emscripten_set_canvas_element_size_main_thread(target,width,height)}}function
_emscripten_set_current_thread_status(newStatus){}function
_emscripten_set_thread_name(threadId,name){}function __webgl_enable_ANGLE_instanced_arrays(ctx){var
ext=ctx.getExtension(\"ANGLE_instanced_arrays\");if(ext){ctx[\"vertexAttribDivisor\"]=function(index,divisor){ex
t[\"vertexAttribDivisorANGLE\"](index,divisor)};ctx[\"drawArraysInstanced\"]=function(mode,first,count,primcou
nt){ext[\"drawArraysInstancedANGLE\"](mode,first,count,primcount)};ctx[\"drawElementsInstanced\"]=function(
mode,count,type,indices,primcount){ext[\"drawElementsInstancedANGLE\"](mode,count,type,indices,primcount)};
return
 1}}function __webgl_enable_OES_vertex_array_object(ctx){var
ext=ctx.getExtension(\"OES_vertex_array_object\");if(ext){ctx[\"createVertexArray\"]=function(){return
ext[\"createVertexArrayOES\"]()};ctx[\"deleteVertexArray\"]=function(vao){ext[\"deleteVertexArrayOES\"](vao)};
ctx[\"bindVertexArray\"]=function(vao){ext[\"bindVertexArrayOES\"](vao)};ctx[\"isVertexArray\"]=function(vao)
{return ext[\"isVertexArrayOES\"](vao)};return 1}}function __webgl_enable_WEBGL_draw_buffers(ctx){var
ext=ctx.getExtension(\"WEBGL_draw_buffers\");if(ext){ctx[\"drawBuffers\"]=function(n,bufs){ext[\"drawBuffers
WEBGL\"](n,bufs)};return 1}}function
__webgl_enable_WEBGL_multi_draw(ctx){return!!(ctx.multiDrawWebgl=ctx.getExtension(\"WEBGL_multi_dra
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w\"))}var
GL={counter:1,buffers:[],programs:[],framebuffers:[],renderbuffers:[],textures:[],uniforms:[],shaders:[],vaos:[],cont
exts:{},offscreenCanvases:{},timerQueriesEXT:[],programInfos:{},stringCache:{},unpackAlignment:4,recordError:
function
recordError(errorCode){if(!GL.lastError){GL.lastError=errorCode}},getNewId:function(table){var
ret=GL.counter++;for(var i=table.length;i<ret;i++){table[i]=null}return
ret},getSource:function(shader,count,string,length){var source=\"\";for(var i=0;i<count;++i){var
len=length?GROWABLE_HEAP_I32()[length+i*4>>2]:-
1;source+=UTF8ToString(GROWABLE_HEAP_I32()[string+i*4>>2],len<0?undefined:len)}return
source},createContext:function(canvas,webGLContextAttributes){var
ctx=canvas.getContext(\"webgl\",webGLContextAttributes);if(!ctx)return 0;var
handle=GL.registerContext(ctx,webGLContextAttributes);return
handle},registerContext:function(ctx,webGLContextAttributes){var
handle=_malloc(8);GROWABLE_HEAP_I32()[handle+4>>2]=_pthread_self();var
context={handle:handle,attributes:webGLContextAttributes,version:webGLContextAttributes.majorVersion,GLctx:
ctx};if(ctx.canvas)ctx.canvas.GLctxObject=context;GL.contexts[handle]=context;if(typeof
webGLContextAttributes.enableExtensionsByDefault===\"undefined\"||webGLContextAttributes.enableExtensions
ByDefault){GL.initExtensions(context)}return
handle},makeContextCurrent:function(contextHandle){GL.currentContext=GL.contexts[contextHandle];Module.ctx
=GLctx=GL.currentContext&&GL.currentContext.GLctx;return!(contextHandle&&!GLctx)},getContext:function(c
ontextHandle){return
GL.contexts[contextHandle]},deleteContext:function(contextHandle){if(GL.currentContext===GL.contexts[context
Handle])GL.currentContext=null;if(typeof
JSEvents===\"object\")JSEvents.removeAllHandlersOnTarget(GL.contexts[contextHandle].GLctx.canvas);if(GL.co
ntexts[contextHandle]&&GL.contexts[contextHandle].GLctx.canvas)GL.contexts[contextHandle].GLctx.canvas.GL
ctxObject=undefined;_free(GL.contexts[contextHandle].handle);GL.contexts[contextHandle]=null},initExtensions:f
unction(context){if(!context)context=GL.currentContext;if(context.initExtensionsDone)return;context.initExtension
sDone=true;var
GLctx=context.GLctx;__webgl_enable_ANGLE_instanced_arrays(GLctx);__webgl_enable_OES_vertex_array_obj
ect(GLctx);__webgl_enable_WEBGL_draw_buffers(GLctx);GLctx.disjointTimerQueryExt=GLctx.getExtension(\"
EXT_disjoint_timer_query\");__webgl_enable_WEBGL_multi_draw(GLctx);var
exts=GLctx.getSupportedExtensions()||[];exts.forEach(function(ext){if(ext.indexOf(\"lose_context\")<0&&ext.inde
xOf(\"debug\")<0){GLctx.getExtension(ext)}})},populateUniformTable:function(program){var
p=GL.programs[program];var
ptable=GL.programInfos[program]={uniforms:{},maxUniformLength:0,maxAttributeLength:-
1,maxUniformBlockNameLength:-1};var utable=ptable.uniforms;var
numUniforms=GLctx.getProgramParameter(p,35718);for(var i=0;i<numUniforms;++i){var
u=GLctx.getActiveUniform(p,i);var
name=u.name;ptable.maxUniformLength=Math.max(ptable.maxUniformLength,name.length+1);if(name.slice(-
1)==\"]\"){name=name.slice(0,name.lastIndexOf(\"[\"))}var loc=GLctx.getUniformLocation(p,name);if(loc){var
id=GL.getNewId(GL.uniforms);utable[name]=[u.size,id];GL.uniforms[id]=loc;for(var
j=1;j<u.size;++j){var
n=name+\"[\"+j+\"]\";loc=GLctx.getUniformLocation(p,n);id=GL.getNewId(GL.uniforms);GL.uniforms[id]=loc}}
}};var __emscripten_webgl_power_preferences=[\"default\",\"low-power\",\"high-performance\"];function
_emscripten_webgl_do_create_context(target,attributes){var a=attributes>>2;var
powerPreference=GROWABLE_HEAP_I32()[a+(24>>2)];var
contextAttributes={\"alpha\":!!GROWABLE_HEAP_I32()[a+(0>>2)],\"depth\":!!GROWABLE_HEAP_I32()[a+(4
>>2)],\"stencil\":!!GROWABLE_HEAP_I32()[a+(8>>2)],\"antialias\":!!GROWABLE_HEAP_I32()[a+(12>>2)],\"p

remultipliedAlpha\":!!GROWABLE_HEAP_I32()[a+(16>>2)],\"preserveDrawingBuffer\":!!GROWABLE_HEAP_I32()[a+(20>>2)],\"powerPreference\":__emscripten_webgl_power_preferences[powerPreference],\"failIfMajorPerformanceCaveat\":!!GROWABLE_HEAP_I32()[a+(28>>2)],majorVersion:GROWABLE_HEAP_I32()[a+(32>>2)],minorVersion:GROWABLE_HEAP_I32()[a+(36>>2)],enableExtensionsByDefault:GROWABLE_HEAP_I32()[a+(40>>2)],explicitSwapControl:GROWABLE_HEAP_I32()[a+(44>>2)],proxyContextToMainThread:GROWABLE_HEAP_I32()[a+(48>>2)],renderViaOffscreenBackBuffer:GROWABLE_HEAP_I32()[a+(52>>2)]};var canvas=findCanvasEventTarget(target);if(!canvas){return 0}if(contextAttributes.explicitSwapControl){return 0}var contextHandle=GL.createContext(canvas,contextAttributes);return contextHandle}function _emscripten_webgl_create_context(a0,a1){return _emscripten_webgl_do_create_context(a0,a1)}var SYSCALLS={mappings:{},buffers:[null,[],[]],printChar:function(stream,curr){var buffer=SYSCALLS.buffers[stream];if(curr===0||curr===10){(stream===1?out:err)(UTF8ArrayToString(buffer,0));buffer.length=0}else{buffer.push(curr)}},varargs:undefined,get:function(){SYSCALLS.varargs+=4;var ret=GROWABLE_HEAP_I32()[SYSCALLS.varargs-4>>2];return ret},getStr:function(ptr){var ret=UTF8ToString(ptr);return ret},get64:function(low,high){return low}};function _fd_close(fd){if(ENVIRONMENT_IS_PTHREAD)return _emscripten_proxy_to_main_thread_js(3,1,fd);return 0}function _fd_seek(fd,offset_low,offset_high,whence,newOffset){if(ENVIRONMENT_IS_PTHREAD)return _emscripten_proxy_to_main_thread_js(4,1,fd,offset_low,offset_high,whence,newOffset)}function _fd_write(fd,iov,iovcnt,pnum){if(ENVIRONMENT_IS_PTHREAD)return _emscripten_proxy_to_main_thread_js(5,1,fd,iov,iovcnt,pnum);var num=0;for(var i=0;i<iovcnt;i++){var ptr=GROWABLE_HEAP_I32()[iov+i*8>>2];var len=GROWABLE_HEAP_I32()[iov+(i*8+4)>>2];for(var j=0;j<len;j++){SYSCALLS.printChar(fd,GROWABLE_HEAP_U8()[ptr+j])}num+=len}GROWABLE_HEAP_I32()[pnum>>2]=num;return 0}function _pthread_cleanup_pop(execute){var routine=PThread.threadExitHandlers.pop();if(execute)routine()}function _pthread_cleanup_push(routine,arg){PThread.threadExitHandlers.push(function(){wasmTable.get(routine)(arg)})}function spawnThread(threadParams){if(ENVIRONMENT_IS_PTHREAD)throw\"Internal Error! spawnThread() can only ever be called from main application thread!\";var worker=PThread.getNewWorker();if(worker.pthread!==undefined)throw\"Internal error!\";if(!threadParams.pthread_ptr)throw\"Internal error, no pthread ptr!\";PThread.runningWorkers.push(worker);var tlsMemory=_malloc(128*4);for(var i=0;i<128;++i){GROWABLE_HEAP_I32()[tlsMemory+i*4>>2]=0}var stackHigh=threadParams.stackBase+threadParams.stackSize;var pthread=PThread.pthreads[threadParams.pthread_ptr]={worker:worker,stackBase:threadParams.stackBase,stackSize:threadParams.stackSize,allocatedOwnStack:threadParams.allocatedOwnStack,threadInfoStruct:threadParams.pthread_ptr};var tis=pthread.threadInfoStruct>>2;Atomics.store(GROWABLE_HEAP_U32(),tis+(64>>2),threadParams.detached);Atomics.store(GROWABLE_HEAP_U32(),tis+(100>>2),tlsMemory);Atomics.store(GROWABLE_HEAP_U32(),tis+(40>>2),pthread.threadInfoStruct);Atomics.store(GROWABLE_HEAP_U32(),tis+(80>>2),threadParams.stackSize);Atomics.store(GROWABLE_HEAP_U32(),tis+(76>>2),stackHigh);Atomics.store(GROWABLE_HEAP_U32(),tis+(104>>2),threadParams.stackSize);Atomics.store(GROWABLE_HEAP_U32(),tis+(104+8>>2),stackHigh);Atomics.store(GROWABLE_HEAP_U32(),tis+(104+12>>2),threadParams.detached);var global_libc=_emscripten_get_global_libc();var global_locale=global_libc+40;Atomics.store(GROWABLE_HEAP_U32(),tis+(172>>2),global_locale);worker.pthread=pthread;var msg={\"cmd\":\"run\",\"start_routine\":threadParams.startRoutine,\"arg\":threadParams.arg,\"threadInfoStruct\":threadParams.pthread_ptr,\"stackBase\":threadParams.stackBase,\"stackSize\":threadParams.stackSize};worker.runPthread=function(){msg.time=performance.now();worker.postMessage(msg,threadParams.transferList)};if(worker.loaded){worker.runPthread();delete worker.runPthread}}function _pthread_create(pthread_ptr,attr,start_routine,arg){if(typeof SharedArrayBuffer===\"undefined\"){err(\"Current

environment does not support SharedArrayBuffer, pthreads are not available!\");return 6}if(!pthread_ptr){err(\"pthread_create called with a null thread pointer!\");return 28}var transferList=[];var error=0;if(ENVIRONMENT_IS_PTHREAD&&(transferList.length===0||error)){return _emscripten_sync_run_in_main_thread_4(687865856,pthread_ptr,attr,start_routine,arg)}if(error)return error;var stackSize=0;var stackBase=0;var detached=0;if(attr&&attr!=-1){stackSize=GROWABLE_HEAP_I32()[attr>>2];stackSize+=81920;stackBase=GROWABLE_HEAP_I32()[attr+8>>2];detached=GROWABLE_HEAP_I32()[attr+12>>2]!==0}else{stackSize=2097152}var allocatedOwnStack=stackBase==0;if(allocatedOwnStack){stackBase=_memalign(16,stackSize)}else{stackBase-=stackSize;assert(stackBase>0)}var threadInfoStruct=_malloc(228);for(var i=0;i<228>>2;++i)GROWABLE_HEAP_U32()[(threadInfoStruct>>2)+i]=0;GROWABLE_HEAP_I32()[pthread_ptr>>2]=threadInfoStruct;GROWABLE_HEAP_I32()[threadInfoStruct+12>>2]=threadInfoStruct;var headPtr=threadInfoStruct+152;GROWABLE_HEAP_I32()[headPtr>>2]=headPtr;var threadParams={stackBase:stackBase,stackSize:stackSize,allocatedOwnStack:allocatedOwnStack,detached:detached,startRoutine:start_routine,pthread_ptr:threadInfoStruct,arg:arg,transferList:transferList};if(ENVIRONMENT_IS_PTHREAD){threadParams.cmd=\"spawnThread\";postMessage(threadParams,transferList)}else{spawnThread(threadParams)}return 0}function __pthread_testcancel_js(){if(!ENVIRONMENT_IS_PTHREAD)return;var tb=_pthread_self();if(!tb)return;var cancelDisabled=Atomics.load(GROWABLE_HEAP_U32(),tb+56>>2);if(cancelDisabled)return;var canceled=Atomics.load(GROWABLE_HEAP_U32(),tb+0>>2);if(canceled==2)throw\"Canceled!\"}function _emscripten_check_blocking_allowed(){if(ENVIRONMENT_IS_NODE)return;if(ENVIRONMENT_IS_WORKER)return;warnOnce(\"Blocking on the main thread is very dangerous, see https://emscripten.org/docs/porting/pthreads.html#blocking-on-the-main-browser-thread\")}function __emscripten_do_pthread_join(thread,status,block){if(!thread){err(\"pthread_join attempted on a null thread pointer!\");return ERRNO_CODES.ESRCH}if(ENVIRONMENT_IS_PTHREAD&&_pthread_self()==thread){err(\"PThread \"+thread+\" is attempting to join to itself!\");return ERRNO_CODES.EDEADLK}else if(!ENVIRONMENT_IS_PTHREAD&&_emscripten_main_browser_thread_id()==thread){err(\"Main thread \"+thread+\" is attempting to join to itself!\");return ERRNO_CODES.EDEADLK}var self=GROWABLE_HEAP_I32()[thread+12>>2];if(self!==thread){err(\"pthread_join attempted on thread \"+thread+\", which does not point to a valid thread, or does not exist anymore!\");return ERRNO_CODES.ESRCH}var detached=Atomics.load(GROWABLE_HEAP_U32(),thread+64>>2);if(detached){err(\"Attempted to join thread \"+thread+\", which was already detached!\");return ERRNO_CODES.EINVAL}if(block){_emscripten_check_blocking_allowed()}for(;;){var threadStatus=Atomics.load(GROWABLE_HEAP_U32(),thread+0>>2);if(threadStatus==1){var threadExitCode=Atomics.load(GROWABLE_HEAP_U32(),thread+4>>2);if(status)GROWABLE_HEAP_I32()[status>>2]=threadExitCode;Atomics.store(GROWABLE_HEAP_U32(),thread+64>>2,1);if(!ENVIRONMENT_IS_PTHREAD)cleanupThread(thread);else postMessage({\"cmd\":\"cleanupThread\",\"thread\":thread});return 0}if(!block){return ERRNO_CODES.EBUSY}__pthread_testcancel_js();if(!ENVIRONMENT_IS_PTHREAD)_emscripten_main_thread_process_queued_calls();_emscripten_futex_wait(thread+0,threadStatus,ENVIRONMENT_IS_PTHREAD?100:1)}}function _pthread_join(thread,status){return __emscripten_do_pthread_join(thread,status,true)}function _sysconf(name){if(ENVIRONMENT_IS_PTHREAD)return _emscripten_proxy_to_main_thread_js(6,1,name);switch(name){case 30:return 16384;case 85:var maxHeapSize=2147483648;return maxHeapSize/16384;case 132:case 133:case 12:case 137:case 138:case 15:case 235:case 16:case 17:case 18:case 19:case 20:case 149:case 13:case 10:case 236:case 153:case 9:case 21:case 22:case

159:case 154:case 14:case 77:case 78:case 139:case 82:case 68:case 67:case 164:case 11:case 29:case 47:case 48:case 95:case 52:case 51:case 46:return 200809;case 27:case 246:case 127:case 128:case 23:case 24:case 160:case 161:case 181:case 182:case 242:case 183:case 184:case 243:case 244:case 245:case 165:case 178:case 179:case 49:case 50:case 168:case 169:case 175:case 170:case 171:case 172:case 97:case 76:case 32:case 173:case 35:case 80:case 81:case 79:return-1;case 176:case 177:case 7:case 155:case 8:case 157:case 125:case 126:case 92:case 93:case 129:case 130:case 131:case 94:case 91:return 1;case 74:case 60:case 69:case 70:case 4:return 1024;case 31:case 42:case 72:return 32;case 87:case 26:case 33:return 2147483647;case 34:case 1:return 47839;case 38:case 36:return 99;case 43:case 37:return 2048;case 0:return 2097152;case 3:return 65536;case 28:return 32768;case 44:return 32767;case 75:return 16384;case 39:return 1e3;case 89:return 700;case 71:return 256;case 40:return 255;case 2:return 100;case 180:return 64;case 25:return 20;case 5:return 16;case 6:return 6;case 73:return 4;case 84:{if(typeof navigator===\"object\")return navigator[\"hardwareConcurrency\"]||1;return 1}}setErrNo(28);return-1}if(!ENVIRONMENT_IS_PTHREAD)PThread.initMainThreadBlock();var GLctx;var proxiedFunctionTable=[null,_atexit,_emscripten_set_canvas_element_size_main_thread,_fd_close,_fd_seek,_fd_write,_sysconf];var asmLibraryArg={\"e\":___assert_fail,\"r\":___call_main,\"x\":__emscripten_notify_thread_queue,\"b\":_abort,\"y\":_emscripten_asm_const_int,\"j\":_emscripten_conditional_set_current_thread_status,\"d\":_emscripten_futex_wait,\"c\":_emscripten_futex_wake,\"f\":_emscripten_get_now,\"p\":_emscripten_memcpy_big,\"A\":_emscripten_num_logical_cores,\"u\":_emscripten_receive_on_main_thread_js,\"q\":_emscripten_resize_heap,\"v\":_emscripten_set_canvas_element_size,\"i\":_emscripten_set_current_thread_status,\"s\":_emscripten_set_thread_name,\"w\":_emscripten_webgl_create_context,\"l\":_fd_close,\"n\":_fd_seek,\"g\":_fd_write,\"o\":initPthreadsJS,\"a\":wasmMemory||Module[\"wasmMemory\"],\"z\":_pthread_cleanup_pop,\"k\":_pthread_cleanup_push,\"h\":_pthread_create,\"m\":_pthread_join,\"t\":_sysconf};var asm=createWasm();var ___wasm_call_ctors=Module[\"___wasm_call_ctors\"]=function(){return(___wasm_call_ctors=Module[\"___wasm_call_ctors\"]=Module[\"asm\"][\"B\"]).apply(null,arguments)};var _init=Module[\"_init\"]=function(){return(_init=Module[\"_init\"]=Module[\"asm\"][\"C\"]).apply(null,arguments)};var _init_with_threads_count=Module[\"_init_with_threads_count\"]=function(){return(_init_with_threads_count=Module[\"_init_with_threads_count\"]=Module[\"asm\"][\"D\"]).apply(null,arguments)};var _get_threads_count=Module[\"_get_threads_count\"]=function(){return(_get_threads_count=Module[\"_get_threads_count\"]=Module[\"asm\"][\"E\"]).apply(null,arguments)};var _register_tensor=Module[\"_register_tensor\"]=function(){return(_register_tensor=Module[\"_register_tensor\"]=Module[\"asm\"][\"F\"]).apply(null,arguments)};var _dispose_data=Module[\"_dispose_data\"]=function(){return(_dispose_data=Module[\"_dispose_data\"]=Module[\"asm\"][\"G\"]).apply(null,arguments)};var _dispose=Module[\"_dispose\"]=function(){return(_dispose=Module[\"_dispose\"]=Module[\"asm\"][\"H\"]).apply(null,arguments)};var _Abs=Module[\"_Abs\"]=function(){return(_Abs=Module[\"_Abs\"]=Module[\"asm\"][\"J\"]).apply(null,arguments)};var _Add=Module[\"_Add\"]=function(){return(_Add=Module[\"_Add\"]=Module[\"asm\"][\"K\"]).apply(null,arguments)};var _AddN=Module[\"_AddN\"]=function(){return(_AddN=Module[\"_AddN\"]=Module[\"asm\"][\"L\"]).apply(null,arguments)};var _All=Module[\"_All\"]=function(){return(_All=Module[\"_All\"]=Module[\"asm\"][\"M\"]).apply(null,arguments)};var _Any=Module[\"_Any\"]=function(){return(_Any=Module[\"_Any\"]=Module[\"asm\"][\"N\"]).apply(null,arguments)};var _ArgMax=Module[\"_ArgMax\"]=function(){return(_ArgMax=Module[\"_ArgMax\"]=Module[\"asm\"][\"O\"]).ap

ply(null,arguments)};var
_AvgPool=Module[\"_AvgPool\"]=function(){return(_AvgPool=Module[\"_AvgPool\"]=Module[\"asm\"][\"P\"]).apply(null,arguments)};var
_BatchMatMul=Module[\"_BatchMatMul\"]=function(){return(_BatchMatMul=Module[\"_BatchMatMul\"]=Module[\"asm\"][\"Q\"]).apply(null,arguments)};var
_Ceil=Module[\"_Ceil\"]=function(){return(_Ceil=Module[\"_Ceil\"]=Module[\"asm\"][\"R\"]).apply(null,arguments)};var
_ClipByValue=Module[\"_ClipByValue\"]=function(){return(_ClipByValue=Module[\"_ClipByValue\"]=Module[\"asm\"][\"S\"]).apply(null,arguments)};var
_Conv2D=Module[\"_Conv2D\"]=function(){return(_Conv2D=Module[\"_Conv2D\"]=Module[\"asm\"][\"T\"]).apply(null,arguments)};var
_Conv2DBackpropInput=Module[\"_Conv2DBackpropInput\"]=function(){return(_Conv2DBackpropInput=Module[\"_Conv2DBackpropInput\"]=Module[\"asm\"][\"U\"]).apply(null,arguments)};var
_Cos=Module[\"_Cos\"]=function(){return(_Cos=Module[\"_Cos\"]=Module[\"asm\"][\"V\"]).apply(null,arguments)};var
_Cosh=Module[\"_Cosh\"]=function(){return(_Cosh=Module[\"_Cosh\"]=Module[\"asm\"][\"W\"]).apply(null,arguments)};var
_CropAndResize=Module[\"_CropAndResize\"]=function(){return(_CropAndResize=Module[\"_CropAndResize\"]=Module[\"asm\"][\"X\"]).apply(null,arguments)};var
_Cumsum=Module[\"_Cumsum\"]=function(){return(_Cumsum=Module[\"_Cumsum\"]=Module[\"asm\"][\"Y\"]).apply(null,arguments)};var
_DepthToSpace=Module[\"_DepthToSpace\"]=function(){return(_DepthToSpace=Module[\"_DepthToSpace\"]=Module[\"asm\"][\"Z\"]).apply(null,arguments)};var
_DepthwiseConv2dNative=Module[\"_DepthwiseConv2dNative\"]=function(){return(_DepthwiseConv2dNative=Module[\"_DepthwiseConv2dNative\"]=Module[\"asm\"][\"_\"]).apply(null,arguments)};var
_Elu=Module[\"_Elu\"]=function(){return(_Elu=Module[\"_Elu\"]=Module[\"asm\"][\"$\"]).apply(null,arguments)};var
_Equal=Module[\"_Equal\"]=function(){return(_Equal=Module[\"_Equal\"]=Module[\"asm\"][\"aa\"]).apply(null,arguments)};var
_Exp=Module[\"_Exp\"]=function(){return(_Exp=Module[\"_Exp\"]=Module[\"asm\"][\"ba\"]).apply(null,arguments)};var
_FlipLeftRight=Module[\"_FlipLeftRight\"]=function(){return(_FlipLeftRight=Module[\"_FlipLeftRight\"]=Module[\"asm\"][\"ca\"]).apply(null,arguments)};var
_Floor=Module[\"_Floor\"]=function(){return(_Floor=Module[\"_Floor\"]=Module[\"asm\"][\"da\"]).apply(null,arguments)};var
_FloorDiv=Module[\"_FloorDiv\"]=function(){return(_FloorDiv=Module[\"_FloorDiv\"]=Module[\"asm\"][\"ea\"]).apply(null,arguments)};var
_FusedBatchNorm=Module[\"_FusedBatchNorm\"]=function(){return(_FusedBatchNorm=Module[\"_FusedBatchNorm\"]=Module[\"asm\"][\"fa\"]).apply(null,arguments)};var
_FusedConv2D=Module[\"_FusedConv2D\"]=function(){return(_FusedConv2D=Module[\"_FusedConv2D\"]=Module[\"asm\"][\"ga\"]).apply(null,arguments)};var
_FusedDepthwiseConv2D=Module[\"_FusedDepthwiseConv2D\"]=function(){return(_FusedDepthwiseConv2D=Module[\"_FusedDepthwiseConv2D\"]=Module[\"asm\"][\"ha\"]).apply(null,arguments)};var
_Gather=Module[\"_Gather\"]=function(){return(_Gather=Module[\"_Gather\"]=Module[\"asm\"][\"ia\"]).apply(null,arguments)};var
_GatherNd=Module[\"_GatherNd\"]=function(){return(_GatherNd=Module[\"_GatherNd\"]=Module[\"asm\"][\"ja\"]).apply(null,arguments)};var
_Greater=Module[\"_Greater\"]=function(){return(_Greater=Module[\"_Greater\"]=Module[\"asm\"][\"ka\"]).apply(

null,arguments)};var
_GreaterEqual=Module[\"_GreaterEqual\"]=function(){return(_GreaterEqual=Module[\"_GreaterEqual\"]=Module[\"asm\"][\"la\"]).apply(null,arguments)};var
_LeakyRelu=Module[\"_LeakyRelu\"]=function(){return(_LeakyRelu=Module[\"_LeakyRelu\"]=Module[\"asm\"][\"ma\"]).apply(null,arguments)};var
_Less=Module[\"_Less\"]=function(){return(_Less=Module[\"_Less\"]=Module[\"asm\"][\"na\"]).apply(null,arguments)};var
_LessEqual=Module[\"_LessEqual\"]=function(){return(_LessEqual=Module[\"_LessEqual\"]=Module[\"asm\"][\"oa\"]).apply(null,arguments)};var
_Log=Module[\"_Log\"]=function(){return(_Log=Module[\"_Log\"]=Module[\"asm\"][\"pa\"]).apply(null,arguments)};var
_LogicalAnd=Module[\"_LogicalAnd\"]=function(){return(_LogicalAnd=Module[\"_LogicalAnd\"]=Module[\"asm\"][\"qa\"]).apply(null,arguments)};var
_Max=Module[\"_Max\"]=function(){return(_Max=Module[\"_Max\"]=Module[\"asm\"][\"ra\"]).apply(null,arguments)};var
_MaxPool=Module[\"_MaxPool\"]=function(){return(_MaxPool=Module[\"_MaxPool\"]=Module[\"asm\"][\"sa\"]).apply(null,arguments)};var
_Maximum=Module[\"_Maximum\"]=function(){return(_Maximum=Module[\"_Maximum\"]=Module[\"asm\"][\"ta\"]).apply(null,arguments)};var
_Mean=Module[\"_Mean\"]=function(){return(_Mean=Module[\"_Mean\"]=Module[\"asm\"][\"ua\"]).apply(null,arguments)};var
_Min=Module[\"_Min\"]=function(){return(_Min=Module[\"_Min\"]=Module[\"asm\"][\"va\"]).apply(null,arguments)};var
_Minimum=Module[\"_Minimum\"]=function(){return(_Minimum=Module[\"_Minimum\"]=Module[\"asm\"][\"wa\"]).apply(null,arguments)};var
_MirrorPad=Module[\"_MirrorPad\"]=function(){return(_MirrorPad=Module[\"_MirrorPad\"]=Module[\"asm\"][\"xa\"]).apply(null,arguments)};var
_Multiply=Module[\"_Multiply\"]=function(){return(_Multiply=Module[\"_Multiply\"]=Module[\"asm\"][\"ya\"]).apply(null,arguments)};var
_Neg=Module[\"_Neg\"]=function(){return(_Neg=Module[\"_Neg\"]=Module[\"asm\"][\"za\"]).apply(null,arguments)};var
_NonMaxSuppressionV3=Module[\"_NonMaxSuppressionV3\"]=function(){return(_NonMaxSuppressionV3=Module[\"_NonMaxSuppressionV3\"]=Module[\"asm\"][\"Aa\"]).apply(null,arguments)};var
_NonMaxSuppressionV4=Module[\"_NonMaxSuppressionV4\"]=function(){return(_NonMaxSuppressionV4=Module[\"_NonMaxSuppressionV4\"]=Module[\"asm\"][\"Ba\"]).apply(null,arguments)};var
_NonMaxSuppressionV5=Module[\"_NonMaxSuppressionV5\"]=function(){return(_NonMaxSuppressionV5=Module[\"_NonMaxSuppressionV5\"]=Module[\"asm\"][\"Ca\"]).apply(null,arguments)};var
_NotEqual=Module[\"_NotEqual\"]=function(){return(_NotEqual=Module[\"_NotEqual\"]=Module[\"asm\"][\"Da\"]).apply(null,arguments)};var
_OneHot=Module[\"_OneHot\"]=function(){return(_OneHot=Module[\"_OneHot\"]=Module[\"asm\"][\"Ea\"]).apply(null,arguments)};var
_PadV2=Module[\"_PadV2\"]=function(){return(_PadV2=Module[\"_PadV2\"]=Module[\"asm\"][\"Fa\"]).apply(null,arguments)};var
_Pow=Module[\"_Pow\"]=function(){return(_Pow=Module[\"_Pow\"]=Module[\"asm\"][\"Ga\"]).apply(null,arguments)};var
_Prelu=Module[\"_Prelu\"]=function(){return(_Prelu=Module[\"_Prelu\"]=Module[\"asm\"][\"Ha\"]).apply(null,arguments)};var

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_Prod=Module[\"_Prod\"]=function(){return(_Prod=Module[\"_Prod\"]=Module[\"asm\"][\"Ia\"]).apply(null,argum
ents)};var
_RealDiv=Module[\"_RealDiv\"]=function(){return(_RealDiv=Module[\"_RealDiv\"]=Module[\"asm\"][\"Ja\"]).app
ly(null,arguments)};var
_Relu=Module[\"_Relu\"]=function(){return(_Relu=Module[\"_Relu\"]=Module[\"asm\"][\"Ka\"]).apply(null,argum
ents)};var
_Relu6=Module[\"_Relu6\"]=function(){return(_Relu6=Module[\"_Relu6\"]=Module[\"asm\"][\"La\"]).apply(null,a
rguments)};var
_ResizeBilinear=Module[\"_ResizeBilinear\"]=function(){return(_ResizeBilinear=Module[\"_ResizeBilinear\"]=Mo
dule[\"asm\"][\"Ma\"]).apply(null,arguments)};var
_Reverse=Module[\"_Reverse\"]=function(){return(_Reverse=Module[\"_Reverse\"]=Module[\"asm\"][\"Na\"]).app
ly(null,arguments)};var
_RotateWithOffset=Module[\"_RotateWithOffset\"]=function(){return(_RotateWithOffset=Module[\"_RotateWith
Offset\"]=Module[\"asm\"][\"Oa\"]).apply(null,arguments)};var
_Round=Module[\"_Round\"]=function(){return(_Round=Module[\"_Round\"]=Module[\"asm\"][\"Pa\"]).apply(nul
l,arguments)};var
_Rsqrt=Module[\"_Rsqrt\"]=function(){return(_Rsqrt=Module[\"_Rsqrt\"]=Module[\"asm\"][\"Qa\"]).apply(null,arg
uments)};var
_ScatterNd=Module[\"_ScatterNd\"]=function(){return(_ScatterNd=Module[\"_ScatterNd\"]=Module[\"asm\"][\"Ra
\"]).apply(null,arguments)};var
_SelectV2=Module[\"_SelectV2\"]=function(){return(_SelectV2=Module[\"_SelectV2\"]=Module[\"asm\"][\"Sa\"]).
apply(null,arguments)};var
_Sigmoid=Module[\"_Sigmoid\"]=function(){return(_Sigmoid=Module[\"_Sigmoid\"]=Module[\"asm\"][\"Ta\"]).ap
ply(null,arguments)};var
_Sin=Module[\"_Sin\"]=function(){return(_Sin=Module[\"_Sin\"]=Module[\"asm\"][\"Ua\"]).apply(null,arguments)
};var
_Softmax=Module[\"_Softmax\"]=function(){return(_Softmax=Module[\"_Softmax\"]=Module[\"asm\"][\"Va\"]).a
pply(null,arguments)};var
_Sqrt=Module[\"_Sqrt\"]=function(){return(_Sqrt=Module[\"_Sqrt\"]=Module[\"asm\"][\"Wa\"]).apply(null,argume
nts)};var
_Square=Module[\"_Square\"]=function(){return(_Square=Module[\"_Square\"]=Module[\"asm\"][\"Xa\"]).apply(n
ull,arguments)};var
_SquaredDifference=Module[\"_SquaredDifference\"]=function(){return(_SquaredDifference=Module[\"_Squared
Difference\"]=Module[\"asm\"][\"Ya\"]).apply(null,arguments)};var
_Step=Module[\"_Step\"]=function(){return(_Step=Module[\"_Step\"]=Module[\"asm\"][\"Za\"]).apply(null,argume
nts)};var
_StridedSlice=Module[\"_StridedSlice\"]=function(){return(_StridedSlice=Module[\"_StridedSlice\"]=Module[\"as
m\"][\"_a\"]).apply(null,arguments)};var
_Sub=Module[\"_Sub\"]=function(){return(_Sub=Module[\"_Sub\"]=Module[\"asm\"][\"$a\"]).apply(null,argument
s)};var
_Sum=Module[\"_Sum\"]=function(){return(_Sum=Module[\"_Sum\"]=Module[\"asm\"][\"ab\"]).apply(null,argume
nts)};var
_Tan=Module[\"_Tan\"]=function(){return(_Tan=Module[\"_Tan\"]=Module[\"asm\"][\"bb\"]).apply(null,argument
s)};var
_Tanh=Module[\"_Tanh\"]=function(){return(_Tanh=Module[\"_Tanh\"]=Module[\"asm\"][\"cb\"]).apply(null,argu
ments)};var
_Tile=Module[\"_Tile\"]=function(){return(_Tile=Module[\"_Tile\"]=Module[\"asm\"][\"db\"]).apply(null,argument
s)};var
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_TopK=Module[\"_TopK\"]=function(){return(_TopK=Module[\"_TopK\"]=Module[\"asm\"][\"eb\"]).apply(null,arguments)};var
_Transform=Module[\"_Transform\"]=function(){return(_Transform=Module[\"_Transform\"]=Module[\"asm\"][\"fb\"]).apply(null,arguments)};var
_Transpose=Module[\"_Transpose\"]=function(){return(_Transpose=Module[\"_Transpose\"]=Module[\"asm\"][\"gb\"]).apply(null,arguments)};var
__FusedMatMul=Module[\"__FusedMatMul\"]=function(){return(__FusedMatMul=Module[\"__FusedMatMul\"]=Module[\"asm\"][\"hb\"]).apply(null,arguments)};var
_malloc=Module[\"_malloc\"]=function(){return(_malloc=Module[\"_malloc\"]=Module[\"asm\"][\"ib\"]).apply(null,arguments)};var
_free=Module[\"_free\"]=function(){return(_free=Module[\"_free\"]=Module[\"asm\"][\"jb\"]).apply(null,arguments)};var
___errno_location=Module[\"___errno_location\"]=function(){return(___errno_location=Module[\"___errno_location\"]=Module[\"asm\"][\"kb\"]).apply(null,arguments)};var
_emscripten_get_global_libc=Module[\"_emscripten_get_global_libc\"]=function(){return(_emscripten_get_global_libc=Module[\"_emscripten_get_global_libc\"]=Module[\"asm\"][\"lb\"]).apply(null,arguments)};var
_pthread_self=Module[\"_pthread_self\"]=function(){return(_pthread_self=Module[\"_pthread_self\"]=Module[\"asm\"][\"mb\"]).apply(null,arguments)};var
___pthread_tsd_run_dtors=Module[\"___pthread_tsd_run_dtors\"]=function(){return(___pthread_tsd_run_dtors=Module[\"___pthread_tsd_run_dtors\"]=Module[\"asm\"][\"nb\"]).apply(null,arguments)};var
_emscripten_main_thread_process_queued_calls=Module[\"_emscripten_main_thread_process_queued_calls\"]=function(){return(_emscripten_main_thread_process_queued_calls=Module[\"_emscripten_main_thread_process_queued_calls\"]=Module[\"asm\"][\"ob\"]).apply(null,arguments)};var
_emscripten_current_thread_process_queued_calls=Module[\"_emscripten_current_thread_process_queued_calls\"]=function(){return(_emscripten_current_thread_process_queued_calls=Module[\"_emscripten_current_thread_process_queued_calls\"]=Module[\"asm\"][\"pb\"]).apply(null,arguments)};var
_emscripten_register_main_browser_thread_id=Module[\"_emscripten_register_main_browser_thread_id\"]=function(){return(_emscripten_register_main_browser_thread_id=Module[\"_emscripten_register_main_browser_thread_id\"]=Module[\"asm\"][\"qb\"]).apply(null,arguments)};var
_emscripten_main_browser_thread_id=Module[\"_emscripten_main_browser_thread_id\"]=function(){return(_emscripten_main_browser_thread_id=Module[\"_emscripten_main_browser_thread_id\"]=Module[\"asm\"][\"rb\"]).apply(null,arguments)};var
__emscripten_do_dispatch_to_thread=Module[\"__emscripten_do_dispatch_to_thread\"]=function(){return(__emscripten_do_dispatch_to_thread=Module[\"__emscripten_do_dispatch_to_thread\"]=Module[\"asm\"][\"sb\"]).apply(null,arguments)};var
_emscripten_sync_run_in_main_thread_4=Module[\"_emscripten_sync_run_in_main_thread_4\"]=function(){return(_emscripten_sync_run_in_main_thread_4=Module[\"_emscripten_sync_run_in_main_thread_4\"]=Module[\"asm\"][\"tb\"]).apply(null,arguments)};var
_emscripten_run_in_main_runtime_thread_js=Module[\"_emscripten_run_in_main_runtime_thread_js\"]=function(){return(_emscripten_run_in_main_runtime_thread_js=Module[\"_emscripten_run_in_main_runtime_thread_js\"]=Module[\"asm\"][\"ub\"]).apply(null,arguments)};var
__emscripten_call_on_thread=Module[\"__emscripten_call_on_thread\"]=function(){return(__emscripten_call_on_thread=Module[\"__emscripten_call_on_thread\"]=Module[\"asm\"][\"vb\"]).apply(null,arguments)};var
_emscripten_tls_init=Module[\"_emscripten_tls_init\"]=function(){return(_emscripten_tls_init=Module[\"_emscripten_tls_init\"]=Module[\"asm\"][\"wb\"]).apply(null,arguments)};var
__emscripten_thread_init=Module[\"__emscripten_thread_init\"]=function(){return(__emscripten_thread_init=Module[\"__emscripten_thread_init\"]=Module[\"asm\"][\"xb\"]).apply(null,arguments)};var
stackSave=Module[\"stackSave\"]=function(){return(stackSave=Module[\"stackSave\"]=Module[\"asm\"][\"yb\"]).a

pply(null,arguments)};var
stackRestore=Module[\"stackRestore\"]=function(){return(stackRestore=Module[\"stackRestore\"]=Module[\"asm\"][\"zb\"]).apply(null,arguments)};var
stackAlloc=Module[\"stackAlloc\"]=function(){return(stackAlloc=Module[\"stackAlloc\"]=Module[\"asm\"][\"Ab\"]).apply(null,arguments)};var
_emscripten_stack_set_limits=Module[\"_emscripten_stack_set_limits\"]=function(){return(_emscripten_stack_set_limits=Module[\"_emscripten_stack_set_limits\"]=Module[\"asm\"][\"Bb\"]).apply(null,arguments)};var
_memalign=Module[\"_memalign\"]=function(){return(_memalign=Module[\"_memalign\"]=Module[\"asm\"][\"Cb\"]).apply(null,arguments)};var
__emscripten_allow_main_runtime_queued_calls=Module[\"__emscripten_allow_main_runtime_queued_calls\"]=10512;var
__emscripten_main_thread_futex=Module[\"__emscripten_main_thread_futex\"]=12148;Module[\"cwrap\"]=cwrap;Module[\"PThread\"]=PThread;Module[\"PThread\"]=PThread;Module[\"wasmMemory\"]=wasmMemory;Module[\"ExitStatus\"]=ExitStatus;var
calledRun;function ExitStatus(status){this.name=\"ExitStatus\";this.message=\"Program terminated with exit(\"+status+\")\";this.status=status}dependenciesFulfilled=function
runCaller(){if(!calledRun)run();if(!calledRun)dependenciesFulfilled=runCaller};function
run(args){args=args||arguments_;if(runDependencies>0){return}if(ENVIRONMENT_IS_PTHREAD){readyPromiseResolve(Module);initRuntime();postMessage({\"cmd\":\"loaded\"});return}preRun();if(runDependencies>0){return}function
doRun(){if(calledRun)return;calledRun=true;Module[\"calledRun\"]=true;if(ABORT)return;initRuntime();preMain();readyPromiseResolve(Module);if(Module[\"onRuntimeInitialized\"])Module[\"onRuntimeInitialized\"]();postRun()}if(Module[\"setStatus\"]){Module[\"setStatus\"](\"Running...\");setTimeout(function(){setTimeout(function(){Module[\"setStatus\"](\"\")},1);doRun()},1)}else{doRun()}}Module[\"run\"]=run;function
exit(status,implicit){if(implicit&&noExitRuntime&&status===0){return}if(!implicit){if(ENVIRONMENT_IS_PTHREAD){postMessage({\"cmd\":\"exitProcess\",\"returnCode\":status});throw
new
ExitStatus(status)}else{}}if(noExitRuntime){}else{PThread.terminateAllThreads();EXITSTATUS=status;exitRuntime();if(Module[\"onExit\"])Module[\"onExit\"](status);ABORT=true}quit_(status,new
ExitStatus(status))}if(Module[\"preInit\"]){if(typeof
Module[\"preInit\"]==\"function\")Module[\"preInit\"]=[Module[\"preInit\"]];while(Module[\"preInit\"].length>0){Module[\"preInit\"].pop()()}}if(ENVIRONMENT_IS_PTHREAD){noExitRuntime=false;PThread.initWorker()}run();\n\n\n return WasmBackendModuleThreadedSimd.ready\n}\n);\n})();\nif (typeof exports === 'object' && typeof module === 'object')\n module.exports = WasmBackendModuleThreadedSimd;\nelse if (typeof define === 'function' && define['amd'])\n define([], function() { return WasmBackendModuleThreadedSimd; });\nelse if (typeof exports === 'object')\n exports[\"WasmBackendModuleThreadedSimd\"]
= WasmBackendModuleThreadedSimd;\n","export const wasmWorkerContents = 'var Module={};function
threadPrintErr(){var text=Array.prototype.slice.call(arguments).join(\" \");console.error(text)}function
threadAlert(){var text=Array.prototype.slice.call(arguments).join(\"
\");postMessage({cmd:\"alert\",text:text,threadId:Module[\"_pthread_self\"]()})}var
err=threadPrintErr;this.alert=threadAlert;Module[\"instantiateWasm\"]=function(info,receiveInstance){var
instance=new
WebAssembly.Instance(Module[\"wasmModule\"],info);Module[\"wasmModule\"]=null;receiveInstance(instance);return instance.exports};function
moduleLoaded(){}this.onmessage=function(e){try{if(e.data.cmd===\"load\"){Module[\"wasmModule\"]=e.data.wasmModule;Module[\"wasmMemory\"]=e.data.wasmMemory;Module[\"buffer\"]=Module[\"wasmMemory\"].buffer;Module[\"ENVIRONMENT_IS_PTHREAD\"]=true;if(typeof
e.data.urlOrBlob===\"string\"){importScripts(e.data.urlOrBlob)}else{var

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objectUrl=URL.createObjectURL(e.data.urlOrBlob);importScripts(objectUrl);URL.revokeObjectURL(objectUrl)}
WasmBackendModuleThreadedSimd(Module).then(function(instance){Module=instance;moduleLoaded()})}else
 if(e.data.cmd===\"objectTransfer\"){Module[\"PThread\"].receiveObjectTransfer(e.data)}else
if(e.data.cmd===\"run\"){Module[\"__performance_now_clock_drift\"]=performance.now()-
e.data.time;Module[\"__emscripten_thread_init\"](e.data.threadInfoStruct,0,0);var max=e.data.stackBase;var
top=e.data.stackBase+e.data.stackSize;Module[\"establishStackSpace\"](top,max);Module[\"_emscripten_tls_init\"](
);Module[\"PThread\"].receiveObjectTransfer(e.data);Module[\"PThread\"].setThreadStatus(Module[\"_pthread_self
\"](),1);try{var
result=Module[\"invokeEntryPoint\"](e.data.start_routine,e.data.arg);if(!Module[\"getNoExitRuntime\"]())Module[\
"PThread\"].threadExit(result)}catch(ex){if(ex===\"Canceled!\"){Module[\"PThread\"].threadCancel()}else
if(ex!=\"unwind\"){if(ex instanceof
Module[\"ExitStatus\"]){if(Module[\"getNoExitRuntime\"]()){}else{Module[\"PThread\"].threadExit(ex.status)}}el
se{Module[\"PThread\"].threadExit(-2);throw
 ex}}}}else
if(e.data.cmd===\"cancel\"){if(Module[\"_pthread_self\"]()){Module[\"PThread\"].threadCancel()}}else
if(e.data.target===\"setimmediate\"){}else
if(e.data.cmd===\"processThreadQueue\"){if(Module[\"_pthread_self\"]()){Module[\"_emscripten_current_thread_
process_queued_calls\"]()}}else{err(\"worker.js received unknown command
\"+e.data.cmd);err(e.data)}}catch(ex){err(\"worker.js onmessage() captured an uncaught exception:
\"+ex);if(ex&&ex.stack)err(ex.stack);throw ex}};if(typeof process===\"object\"&&typeof
process.versions===\"object\"&&typeof process.versions.node===\"string\"){self={location:{href:__filename}};var
onmessage=this.onmessage;var
nodeWorkerThreads=require(\"worker_threads\");global.Worker=nodeWorkerThreads.Worker;var
parentPort=nodeWorkerThreads.parentPort;parentPort.on(\"message\",function(data){onmessage({data:data})});var
nodeFS=require(\"fs\");var nodeRead=function(filename){return
 nodeFS.readFileSync(filename,\"utf8\")};function
globalEval(x){global.require=require;global.Module=Module;eval.call(null,x)}importScripts=function(f){globalEva
l(nodeRead(f))};postMessage=function(msg){parentPort.postMessage(msg)};if(typeof
performance===\"undefined\"){performance={now:function(){return Date.now()}}}';","\nvar
WasmBackendModule = (function() {\n  var _scriptDir = typeof document !== 'undefined' &&
document.currentScript ? document.currentScript.src : undefined;\n  if (typeof __filename !== 'undefined')
_scriptDir = _scriptDir || __filename;\n  return (\nfunction(WasmBackendModule) {\n  WasmBackendModule =
WasmBackendModule || {};\n\nvar Module=typeof
WasmBackendModule!==\"undefined\"?WasmBackendModule:{};var
readyPromiseResolve,readyPromiseReject;Module[\"ready\"]=new
Promise(function(resolve,reject){readyPromiseResolve=resolve;readyPromiseReject=reject});var
moduleOverrides={};var key;for(key in
Module){if(Module.hasOwnProperty(key)){moduleOverrides[key]=Module[key]}}var
 arguments_=[];var thisProgram=\"./this.program\";var quit_=function(status,toThrow){throw toThrow};var
ENVIRONMENT_IS_WEB=false;var ENVIRONMENT_IS_WORKER=false;var
ENVIRONMENT_IS_NODE=false;var ENVIRONMENT_IS_SHELL=false;ENVIRONMENT_IS_WEB=typeof
window===\"object\";ENVIRONMENT_IS_WORKER=typeof
importScripts===\"function\";ENVIRONMENT_IS_NODE=typeof process===\"object\"&&typeof
process.versions===\"object\"&&typeof
process.versions.node===\"string\";ENVIRONMENT_IS_SHELL=!ENVIRONMENT_IS_WEB&&!ENVIRONM
ENT_IS_NODE&&!ENVIRONMENT_IS_WORKER;var scriptDirectory=\"\";function
locateFile(path){if(Module[\"locateFile\"]){return Module[\"locateFile\"](path,scriptDirectory)}return
scriptDirectory+path}var read_,readAsync,readBinary,setWindowTitle;var nodeFS;var
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nodePath;if(ENVIRONMENT_IS_NODE){if(ENVIRONMENT_IS_WORKER){scriptDirectory=require(\"path\").dirname(scriptDirectory)+\"/\"}else{scriptDirectory=__dirname+\"/\"}read_=function shell_read(filename,binary){if(!nodeFS)nodeFS=require(\"fs\");if(!nodePath)nodePath=require(\"path\");filename=nodePath[\"normalize\"](filename);return nodeFS[\"readFileSync\"](filename,binary?null:\"utf8\")};readBinary=function readBinary(filename){var ret=read_(filename,true);if(!ret.buffer){ret=new Uint8Array(ret)}assert(ret.buffer);return ret};if(process[\"argv\"].length>1){thisProgram=process[\"argv\"][1].replace(/\\\\/g,\"/\")}arguments_=process[\"argv\"].slice(2);process[\"on\"](\"uncaughtException\",function(ex){if(!(ex instanceof ExitStatus)){throw ex}});process[\"on\"](\"unhandledRejection\",abort);quit_=function(status){process[\"exit\"](status)};Module[\"inspect\"]=function(){return\"[Emscripten Module object]\"}}else if(ENVIRONMENT_IS_SHELL){if(typeof read!=\"undefined\"){read_=function shell_read(f){return read(f)}}readBinary=function readBinary(f){var data;if(typeof readbuffer===\"function\"){return new Uint8Array(readbuffer(f))}data=read(f,\"binary\");assert(typeof data===\"object\");return data};if(typeof scriptArgs!=\"undefined\"){arguments_=scriptArgs}else if(typeof arguments!=\"undefined\"){arguments_=arguments}if(typeof quit===\"function\"){quit_=function(status){quit(status)}}if(typeof print!==\"undefined\"){if(typeof console===\"undefined\")console={};console.log=print;console.warn=console.error=typeof printErr!==\"undefined\"?printErr:print}}else if(ENVIRONMENT_IS_WEB||ENVIRONMENT_IS_WORKER){if(ENVIRONMENT_IS_WORKER){scriptDirectory=self.location.href}else if(typeof document!==\"undefined\"&&document.currentScript){scriptDirectory=document.currentScript.src}if(_scriptDir){scriptDirectory=_scriptDir}if(scriptDirectory.indexOf(\"blob:\")!==0){scriptDirectory=scriptDirectory.substr(0,scriptDirectory.lastIndexOf(\"/\")+1)}else{scriptDirectory=\"\"}{read_=function(url){var xhr=new XMLHttpRequest;xhr.open(\"GET\",url,false);xhr.send(null);return xhr.responseText};if(ENVIRONMENT_IS_WORKER){readBinary=function(url){var xhr=new XMLHttpRequest;xhr.open(\"GET\",url,false);xhr.responseType=\"arraybuffer\";xhr.send(null);return new Uint8Array(xhr.response)}}readAsync=function(url,onload,onerror){var xhr=new XMLHttpRequest;xhr.open(\"GET\",url,true);xhr.responseType=\"arraybuffer\";xhr.onload=function(){if(xhr.status==200||xhr.status==0&&xhr.response){onload(xhr.response);return}onerror()};xhr.onerror=onerror;xhr.send(null)}}setWindowTitle=function(title){document.title=title}}else{}var out=Module[\"print\"]||console.log.bind(console);var err=Module[\"printErr\"]||console.warn.bind(console);for(key in moduleOverrides){if(moduleOverrides.hasOwnProperty(key)){Module[key]=moduleOverrides[key]}}moduleOverrides=null;if(Module[\"arguments\"])arguments_=Module[\"arguments\"];if(Module[\"thisProgram\"])thisProgram=Module[\"thisProgram\"];if(Module[\"quit\"])quit_=Module[\"quit\"];var wasmBinary;if(Module[\"wasmBinary\"])wasmBinary=Module[\"wasmBinary\"];var noExitRuntime=Module[\"noExitRuntime\"]||true;if(typeof WebAssembly!==\"object\"){abort(\"no native wasm support detected\")}var wasmMemory;var ABORT=false;var EXITSTATUS;function assert(condition,text){if(!condition){abort(\"Assertion failed: \"+text)}}function getCFunc(ident){var func=Module[\"_\"+ident];assert(func,\"Cannot call unknown function \"+ident+\", make sure it is exported\");return func}function ccall(ident,returnType,argTypes,args,opts){var toC={\"string\":function(str){var ret=0;if(str!==null&&str!==undefined&&str!==0){var len=(str.length<<2)+1;ret=stackAlloc(len);stringToUTF8(str,ret,len)}return ret},\"array\":function(arr){var ret=stackAlloc(arr.length);writeArrayToMemory(arr,ret);return ret}};function convertReturnValue(ret){if(returnType===\"string\")return UTF8ToString(ret);if(returnType===\"boolean\")return Boolean(ret);return ret}var func=getCFunc(ident);var cArgs=[];var stack=0;if(args){for(var i=0;i<args.length;i++){var converter=toC[argTypes[i]];if(converter){if(stack===0)stack=stackSave();cArgs[i]=converter(args[i])}else{cArgs[i

]=args[i]}}}var ret=func.apply(null,cArgs);ret=convertReturnValue(ret);if(stack!==0)stackRestore(stack);return ret}function cwrap(ident,returnType,argTypes,opts){argTypes=argTypes||[];var numericArgs=argTypes.every(function(type){return type===\"number\"});var numericRet=returnType!==\"string\";if(numericRet&&numericArgs&&!opts){return getCFunc(ident)}return function(){return ccall(ident,returnType,argTypes,arguments,opts)}}var UTF8Decoder=typeof TextDecoder!==\"undefined\"?new TextDecoder(\"utf8\"):undefined;function UTF8ArrayToString(heap,idx,maxBytesToRead){var endIdx=idx+maxBytesToRead;var endPtr=idx;while(heap[endPtr]&&!(endPtr>=endIdx))++endPtr;if(endPtr-idx>16&&heap.subarray&&UTF8Decoder){return UTF8Decoder.decode(heap.subarray(idx,endPtr))}else{var str=\"\";while(idx<endPtr){var u0=heap[idx++];if(!(u0&128)){str+=String.fromCharCode(u0);continue}var u1=heap[idx++]&63;if((u0&224)==192){str+=String.fromCharCode((u0&31)<<6|u1);continue}var u2=heap[idx++]&63;if((u0&240)==224){u0=(u0&15)<<12|u1<<6|u2}else{u0=(u0&7)<<18|u1<<12|u2<<6|heap[idx++]&63}if(u0<65536){str+=String.fromCharCode(u0)}else{var ch=u0-65536;str+=String.fromCharCode(55296|ch>>10,56320|ch&1023)}}}return str}function UTF8ToString(ptr,maxBytesToRead){return ptr?UTF8ArrayToString(HEAPU8,ptr,maxBytesToRead):\"\"}function stringToUTF8Array(str,heap,outIdx,maxBytesToWrite){if(!(maxBytesToWrite>0))return 0;var startIdx=outIdx;var endIdx=outIdx+maxBytesToWrite-1;for(var i=0;i<str.length;++i){var u=str.charCodeAt(i);if(u>=55296&&u<=57343){var u1=str.charCodeAt(++i);u=65536+((u&1023)<<10)|u1&1023}if(u<=127){if(outIdx>=endIdx)break;heap[outIdx++]=u}else if(u<=2047){if(outIdx+1>=endIdx)break;heap[outIdx++]=192|u>>6;heap[outIdx++]=128|u&63}else if(u<=65535){if(outIdx+2>=endIdx)break;heap[outIdx++]=224|u>>12;heap[outIdx++]=128|u>>6&63;heap[outIdx++]=128|u&63}else{if(outIdx+3>=endIdx)break;heap[outIdx++]=240|u>>18;heap[outIdx++]=128|u>>12&63;heap[outIdx++]=128|u>>6&63;heap[outIdx++]=128|u&63}}heap[outIdx]=0;return outIdx-startIdx}function stringToUTF8(str,outPtr,maxBytesToWrite){return stringToUTF8Array(str,HEAPU8,outPtr,maxBytesToWrite)}function writeArrayToMemory(array,buffer){HEAP8.set(array,buffer)}function alignUp(x,multiple){if(x%multiple>0){x+=multiple-x%multiple}return x}var buffer,HEAP8,HEAPU8,HEAP16,HEAPU16,HEAP32,HEAPU32,HEAPF32,HEAPF64;function updateGlobalBufferAndViews(buf){buffer=buf;Module[\"HEAP8\"]=HEAP8=new Int8Array(buf);Module[\"HEAP16\"]=HEAP16=new Int16Array(buf);Module[\"HEAP32\"]=HEAP32=new Int32Array(buf);Module[\"HEAPU8\"]=HEAPU8=new Uint8Array(buf);Module[\"HEAPU16\"]=HEAPU16=new Uint16Array(buf);Module[\"HEAPU32\"]=HEAPU32=new Uint32Array(buf);Module[\"HEAPF32\"]=HEAPF32=new Float32Array(buf);Module[\"HEAPF64\"]=HEAPF64=new Float64Array(buf)}var INITIAL_MEMORY=Module[\"INITIAL_MEMORY\"]||16777216;var wasmTable;var __ATPRERUN__=[];var __ATINIT__=[];var __ATMAIN__=[];var __ATPOSTRUN__=[];var runtimeInitialized=false;__ATINIT__.push({func:function(){___wasm_call_ctors()}});function preRun(){if(Module[\"preRun\"]){if(typeof Module[\"preRun\"]==\"function\")Module[\"preRun\"]=[Module[\"preRun\"]];while(Module[\"preRun\"].length){addOnPreRun(Module[\"preRun\"].shift())}}callRuntimeCallbacks(__ATPRERUN__)}function initRuntime(){runtimeInitialized=true;callRuntimeCallbacks(__ATINIT__)}function preMain(){callRuntimeCallbacks(__ATMAIN__)}function postRun(){if(Module[\"postRun\"]){if(typeof Module[\"postRun\"]==\"function\")Module[\"postRun\"]=[Module[\"postRun\"]];while(Module[\"postRun\"].length){addOnPostRun(Module[\"postRun\"].shift())}}callRuntimeCallbacks(__ATPOSTRUN__)}function addOnPreRun(cb){__ATPRERUN__.unshift(cb)}function addOnPostRun(cb){__ATPOSTRUN__.unshift(cb)}var runDependencies=0;var runDependencyWatcher=null;var dependenciesFulfilled=null;function addRunDependency(id){runDependencies++;if(Module[\"monitorRunDependencies\"]){Module[\"monitorRunDep

endencies\"](runDependencies)}}function removeRunDependency(id){runDependencies--
;if(Module[\"monitorRunDependencies\"]){Module[\"monitorRunDependencies\"](runDependencies)}if(runDependencies==0){if(runDependencyWatcher!==null){clearInterval(runDependencyWatcher);runDependencyWatcher=null}if(dependenciesFulfilled){var
callback=dependenciesFulfilled;dependenciesFulfilled=null;callback()}}}Module[\"preloadedImages\"]={};Module[\"preloadedAudios\"]={};function
abort(what){if(Module[\"onAbort\"]){Module[\"onAbort\"](what)}what+=\"\";err(what);ABORT=true;EXITSTATUS=1;what=\"abort(\"+what+\"). Build with -s ASSERTIONS=1 for more info.\";var e=new
WebAssembly.RuntimeError(what);readyPromiseReject(e);throw e}function hasPrefix(str,prefix){return
String.prototype.startsWith?str.startsWith(prefix):str.indexOf(prefix)===0}var
dataURIPrefix=\"data:application/octet-stream; base64,\";function isDataURI(filename){return
hasPrefix(filename,dataURIPrefix)}var fileURIPrefix=\"file://\";function isFileURI(filename){return
hasPrefix(filename,fileURIPrefix)}var wasmBinaryFile=\"tfjs-backend-wasm.wasm\";if(!isDataURI(wasmBinaryFile)){wasmBinaryFile=locateFile(wasmBinaryFile)}function
getBinary(file){try{if(file==wasmBinaryFile&&wasmBinary){return new
Uint8Array(wasmBinary)}if(readBinary){return readBinary(file)}else{throw\"both async and sync fetching of the wasm failed\"}}catch(err){abort(err)}}function
getBinaryPromise(){if(!wasmBinary&&(ENVIRONMENT_IS_WEB||ENVIRONMENT_IS_WORKER)){if(typeof
fetch===\"function\"&&!isFileURI(wasmBinaryFile)){return fetch(wasmBinaryFile,{credentials:\"same-origin\"}).then(function(response){if(!response[\"ok\"]){throw\"failed to load wasm binary file at
\'\"+wasmBinaryFile+\"\'\"}return response[\"arrayBuffer\"]()}).catch(function(){return
getBinary(wasmBinaryFile)})}else{if(readAsync){return new
Promise(function(resolve,reject){readAsync(wasmBinaryFile,function(response){resolve(new
Uint8Array(response))},reject)})}}}return Promise.resolve().then(function(){return
getBinary(wasmBinaryFile)})}function createWasm(){var info={\"a\":asmLibraryArg};function
receiveInstance(instance,module){var
exports=instance.exports;Module[\"asm\"]=exports;wasmMemory=Module[\"asm\"][\"j\"];updateGlobalBufferAndViews(wasmMemory.buffer);wasmTable=Module[\"asm\"][\"r\"];removeRunDependency(\"wasm-instantiate\")}addRunDependency(\"wasm-instantiate\");function
receiveInstantiatedSource(output){receiveInstance(output[\"instance\"])}function
instantiateArrayBuffer(receiver){return getBinaryPromise().then(function(binary){return
WebAssembly.instantiate(binary,info)}).then(receiver,function(reason){err(\"failed to asynchronously prepare wasm: \"+reason);abort(reason)})}function instantiateAsync(){if(!wasmBinary&&typeof
WebAssembly.instantiateStreaming===\"function\"&&!isDataURI(wasmBinaryFile)&&!isFileURI(wasmBinaryFile)&&typeof fetch===\"function\"){return fetch(wasmBinaryFile,{credentials:\"same-origin\"}).then(function(response){var result=WebAssembly.instantiateStreaming(response,info);return
result.then(receiveInstantiatedSource,function(reason){err(\"wasm streaming compile failed: \"+reason);err(\"falling back to ArrayBuffer
instantiation\");return instantiateArrayBuffer(receiveInstantiatedSource)})})}else{return
instantiateArrayBuffer(receiveInstantiatedSource)}}if(Module[\"instantiateWasm\"]){try{var
exports=Module[\"instantiateWasm\"](info,receiveInstance);return exports}catch(e){err(\"Module.instantiateWasm callback failed with error: \"+e);return false}}instantiateAsync().catch(readyPromiseReject);return{}}function
callRuntimeCallbacks(callbacks){while(callbacks.length>0){var callback=callbacks.shift();if(typeof
callback==\"function\"){callback(Module);continue}var func=callback.func;if(typeof
func===\"number\"){if(callback.arg===undefined){wasmTable.get(func)()}else{wasmTable.get(func)(callback.arg)}}else{func(callback.arg===undefined?null:callback.arg)}}}function _abort(){abort()}function
_emscripten_memcpy_big(dest,src,num){HEAPU8.copyWithin(dest,src,src+num)}function
_emscripten_get_heap_size(){return HEAPU8.length}function

emscripten_realloc_buffer(size){try{wasmMemory.grow(size-buffer.byteLength+65535>>>16);updateGlobalBufferAndViews(wasmMemory.buffer);return 1}catch(e){}}function _emscripten_resize_heap(requestedSize){var oldSize=_emscripten_get_heap_size();var maxHeapSize=2147483648;if(requestedSize>maxHeapSize){return false}for(var cutDown=1;cutDown<=4;cutDown*=2){var overGrownHeapSize=oldSize*(1+.2/cutDown);overGrownHeapSize=Math.min(overGrownHeapSize,requestedSize+100663296);var newSize=Math.min(maxHeapSize,alignUp(Math.max(requestedSize,overGrownHeapSize),65536));var replacement=emscripten_realloc_buffer(newSize);if(replacement){return true}}return false}var SYSCALLS={mappings:{},buffers:[null,[],[]],printChar:function(stream,curr){var buffer=SYSCALLS.buffers[stream];if(curr===0||curr===10){(stream===1?out:err)(UTF8ArrayToString(buffer,0));buffer.length=0}else{buffer.push(curr)}},varargs:undefined,get:function(){SYSCALLS.varargs+=4;var ret=HEAP32[SYSCALLS.varargs-4>>2];return ret},getStr:function(ptr){var ret=UTF8ToString(ptr);return ret},get64:function(low,high){return low}};function _fd_close(fd){return 0}function _fd_seek(fd,offset_low,offset_high,whence,newOffset){}function _fd_write(fd,iov,iovcnt,pnum){var num=0;for(var i=0;i<iovcnt;i++){var ptr=HEAP32[iov+i*8>>2];var len=HEAP32[iov+(i*8+4)>>2];for(var j=0;j<len;j++){SYSCALLS.printChar(fd,HEAPU8[ptr+j])}num+=len}HEAP32[pnum>>2]=num;return 0}function _pthread_create(){return 6}function _pthread_join(){return 28}function setErrNo(value){HEAP32[___errno_location()>>2]=value;return value}function _sysconf(name){switch(name){case 30:return 16384;case 85:var maxHeapSize=2147483648;return maxHeapSize/16384;case 132:case 133:case 12:case 137:case 138:case 15:case 235:case 16:case 17:case 18:case 19:case 20:case 149:case 13:case 10:case 236:case 153:case 9:case 21:case 22:case 159:case 154:case 14:case 77:case 78:case 139:case 82:case 68:case 67:case 164:case 11:case 29:case 47:case 48:case 95:case 52:case 51:case 46:return 200809;case 27:case 246:case 127:case 128:case 23:case 24:case 160:case 161:case 181:case 182:case 242:case 183:case 184:case 243:case 244:case 245:case 165:case 178:case 179:case 49:case 50:case 168:case 169:case 175:case 170:case 171:case 172:case 97:case 76:case 32:case 173:case 35:case 80:case 81:case 79:return-1;case 176:case 177:case 7:case 155:case 8:case 157:case 125:case 126:case 92:case 93:case 129:case 130:case 131:case 94:case 91:return 1;case 74:case 60:case 69:case 70:case 4:return 1024;case 31:case 42:case 72:return 32;case 87:case 26:case 33:return 2147483647;case 34:case 1:return 47839;case 38:case 36:return 99;case 43:case 37:return 2048;case 0:return 2097152;case 3:return 65536;case 28:return 32768;case 44:return 32767;case 75:return 16384;case 39:return 1e3;case 89:return 700;case 71:return 256;case 40:return 255;case 2:return 100;case 180:return 64;case 25:return 20;case 5:return 16;case 6:return 6;case 73:return 4;case 84:{if(typeof navigator===\"object\")return navigator[\"hardwareConcurrency\"]||1;return 1}}setErrNo(28);return-1}var asmLibraryArg={\"a\":_abort,\"d\":_emscripten_memcpy_big,\"e\":_emscripten_resize_heap,\"f\":_fd_close,\"c\":_fd_seek,\"b\":_fd_write,\"h\":_pthread_create,\"g\":_pthread_join,\"i\":_sysconf};var asm=createWasm();var ___wasm_call_ctors=Module[\"___wasm_call_ctors\"]=function(){return(___wasm_call_ctors=Module[\"___wasm_call_ctors\"]=Module[\"asm\"][\"k\"]).apply(null,arguments)};var _init=Module[\"_init\"]=function(){return(_init=Module[\"_init\"]=Module[\"asm\"][\"l\"]).apply(null,arguments)};var _init_with_threads_count=Module[\"_init_with_threads_count\"]=function(){return(_init_with_threads_count=Module[\"_init_with_threads_count\"]=Module[\"asm\"][\"m\"]).apply(null,arguments)};var _get_threads_count=Module[\"_get_threads_count\"]=function(){return(_get_threads_count=Module[\"_get_threads_count\"]=Module[\"asm\"][\"n\"]).apply(null,arguments)};var _register_tensor=Module[\"_register_tensor\"]=function(){return(_register_tensor=Module[\"_register_tensor\"]=Module[\"asm\"][\"o\"]).apply(null,arguments)};var

_dispose_data=Module[\"_dispose_data\"]=function(){return(_dispose_data=Module[\"_dispose_data\"]=Module[\"asm\"][\"p\"]).apply(null,arguments)};var
_dispose=Module[\"_dispose\"]=function(){return(_dispose=Module[\"_dispose\"]=Module[\"asm\"][\"q\"]).apply(null,arguments)};var
_Abs=Module[\"_Abs\"]=function(){return(_Abs=Module[\"_Abs\"]=Module[\"asm\"][\"s\"]).apply(null,arguments)};var
_Add=Module[\"_Add\"]=function(){return(_Add=Module[\"_Add\"]=Module[\"asm\"][\"t\"]).apply(null,arguments)};var
_AddN=Module[\"_AddN\"]=function(){return(_AddN=Module[\"_AddN\"]=Module[\"asm\"][\"u\"]).apply(null,arguments)};var
_All=Module[\"_All\"]=function(){return(_All=Module[\"_All\"]=Module[\"asm\"][\"v\"]).apply(null,arguments)};var
_Any=Module[\"_Any\"]=function(){return(_Any=Module[\"_Any\"]=Module[\"asm\"][\"w\"]).apply(null,arguments)};var
_ArgMax=Module[\"_ArgMax\"]=function(){return(_ArgMax=Module[\"_ArgMax\"]=Module[\"asm\"][\"x\"]).apply(null,arguments)};var
_AvgPool=Module[\"_AvgPool\"]=function(){return(_AvgPool=Module[\"_AvgPool\"]=Module[\"asm\"][\"y\"]).apply(null,arguments)};var
_BatchMatMul=Module[\"_BatchMatMul\"]=function(){return(_BatchMatMul=Module[\"_BatchMatMul\"]=Module[\"asm\"][\"z\"]).apply(null,arguments)};var
_Ceil=Module[\"_Ceil\"]=function(){return(_Ceil=Module[\"_Ceil\"]=Module[\"asm\"][\"A\"]).apply(null,arguments)};var
_ClipByValue=Module[\"_ClipByValue\"]=function(){return(_ClipByValue=Module[\"_ClipByValue\"]=Module[\"asm\"][\"B\"]).apply(null,arguments)};var
_Conv2D=Module[\"_Conv2D\"]=function(){return(_Conv2D=Module[\"_Conv2D\"]=Module[\"asm\"][\"C\"]).apply(null,arguments)};var
_Conv2DBackpropInput=Module[\"_Conv2DBackpropInput\"]=function(){return(_Conv2DBackpropInput=Module[\"_Conv2DBackpropInput\"]=Module[\"asm\"][\"D\"]).apply(null,arguments)};var
_Cos=Module[\"_Cos\"]=function(){return(_Cos=Module[\"_Cos\"]=Module[\"asm\"][\"E\"]).apply(null,arguments)};var
_Cosh=Module[\"_Cosh\"]=function(){return(_Cosh=Module[\"_Cosh\"]=Module[\"asm\"][\"F\"]).apply(null,arguments)};var
_CropAndResize=Module[\"_CropAndResize\"]=function(){return(_CropAndResize=Module[\"_CropAndResize\"]=Module[\"asm\"][\"G\"]).apply(null,arguments)};var
_Cumsum=Module[\"_Cumsum\"]=function(){return(_Cumsum=Module[\"_Cumsum\"]=Module[\"asm\"][\"H\"]).apply(null,arguments)};var
_DepthToSpace=Module[\"_DepthToSpace\"]=function(){return(_DepthToSpace=Module[\"_DepthToSpace\"]=Module[\"asm\"][\"I\"]).apply(null,arguments)};var
_DepthwiseConv2dNative=Module[\"_DepthwiseConv2dNative\"]=function(){return(_DepthwiseConv2dNative=Module[\"_DepthwiseConv2dNative\"]=Module[\"asm\"][\"J\"]).apply(null,arguments)};var
_Elu=Module[\"_Elu\"]=function(){return(_Elu=Module[\"_Elu\"]=Module[\"asm\"][\"K\"]).apply(null,arguments)};var
_Equal=Module[\"_Equal\"]=function(){return(_Equal=Module[\"_Equal\"]=Module[\"asm\"][\"L\"]).apply(null,arguments)};var
_Exp=Module[\"_Exp\"]=function(){return(_Exp=Module[\"_Exp\"]=Module[\"asm\"][\"M\"]).apply(null,arguments)};var
_FlipLeftRight=Module[\"_FlipLeftRight\"]=function(){return(_FlipLeftRight=Module[\"_FlipLeftRight\"]=Module[\"asm\"][\"N\"]).apply(null,arguments)};var

_Floor=Module[\"_Floor\"]=function(){return(_Floor=Module[\"_Floor\"]=Module[\"asm\"][\"O\"]).apply(null,arguments)};var
_FloorDiv=Module[\"_FloorDiv\"]=function(){return(_FloorDiv=Module[\"_FloorDiv\"]=Module[\"asm\"][\"P\"]).apply(null,arguments)};var
_FusedBatchNorm=Module[\"_FusedBatchNorm\"]=function(){return(_FusedBatchNorm=Module[\"_FusedBatchNorm\"]=Module[\"asm\"][\"Q\"]).apply(null,arguments)};var
_FusedConv2D=Module[\"_FusedConv2D\"]=function(){return(_FusedConv2D=Module[\"_FusedConv2D\"]=Module[\"asm\"][\"R\"]).apply(null,arguments)};var
_FusedDepthwiseConv2D=Module[\"_FusedDepthwiseConv2D\"]=function(){return(_FusedDepthwiseConv2D=Module[\"_FusedDepthwiseConv2D\"]=Module[\"asm\"][\"S\"]).apply(null,arguments)};var
_Gather=Module[\"_Gather\"]=function(){return(_Gather=Module[\"_Gather\"]=Module[\"asm\"][\"T\"]).apply(null,arguments)};var
_GatherNd=Module[\"_GatherNd\"]=function(){return(_GatherNd=Module[\"_GatherNd\"]=Module[\"asm\"][\"U\"]).apply(null,arguments)};var
_Greater=Module[\"_Greater\"]=function(){return(_Greater=Module[\"_Greater\"]=Module[\"asm\"][\"V\"]).apply(null,arguments)};var
_GreaterEqual=Module[\"_GreaterEqual\"]=function(){return(_GreaterEqual=Module[\"_GreaterEqual\"]=Module[\"asm\"][\"W\"]).apply(null,arguments)};var
_LeakyRelu=Module[\"_LeakyRelu\"]=function(){return(_LeakyRelu=Module[\"_LeakyRelu\"]=Module[\"asm\"][\"X\"]).apply(null,arguments)};var
_Less=Module[\"_Less\"]=function(){return(_Less=Module[\"_Less\"]=Module[\"asm\"][\"Y\"]).apply(null,arguments)};var
_LessEqual=Module[\"_LessEqual\"]=function(){return(_LessEqual=Module[\"_LessEqual\"]=Module[\"asm\"][\"Z\"]).apply(null,arguments)};var
_Log=Module[\"_Log\"]=function(){return(_Log=Module[\"_Log\"]=Module[\"asm\"][\"_\"]).apply(null,arguments)};var
_LogicalAnd=Module[\"_LogicalAnd\"]=function(){return(_LogicalAnd=Module[\"_LogicalAnd\"]=Module[\"asm\"][\"$\"]).apply(null,arguments)};var
_Max=Module[\"_Max\"]=function(){return(_Max=Module[\"_Max\"]=Module[\"asm\"][\"aa\"]).apply(null,arguments)};var
_MaxPool=Module[\"_MaxPool\"]=function(){return(_MaxPool=Module[\"_MaxPool\"]=Module[\"asm\"][\"ba\"]).apply(null,arguments)};var
_Maximum=Module[\"_Maximum\"]=function(){return(_Maximum=Module[\"_Maximum\"]=Module[\"asm\"][\"ca\"]).apply(null,arguments)};var
_Mean=Module[\"_Mean\"]=function(){return(_Mean=Module[\"_Mean\"]=Module[\"asm\"][\"da\"]).apply(null,arguments)};var
_Min=Module[\"_Min\"]=function(){return(_Min=Module[\"_Min\"]=Module[\"asm\"][\"ea\"]).apply(null,arguments)};var
_Minimum=Module[\"_Minimum\"]=function(){return(_Minimum=Module[\"_Minimum\"]=Module[\"asm\"][\"fa\"]).apply(null,arguments)};var
_MirrorPad=Module[\"_MirrorPad\"]=function(){return(_MirrorPad=Module[\"_MirrorPad\"]=Module[\"asm\"][\"ga\"]).apply(null,arguments)};var
_Multiply=Module[\"_Multiply\"]=function(){return(_Multiply=Module[\"_Multiply\"]=Module[\"asm\"][\"ha\"]).apply(null,arguments)};var
_Neg=Module[\"_Neg\"]=function(){return(_Neg=Module[\"_Neg\"]=Module[\"asm\"][\"ia\"]).apply(null,arguments)};var
_NonMaxSuppressionV3=Module[\"_NonMaxSuppressionV3\"]=function(){return(_NonMaxSuppressionV3=Module[\"_NonMaxSuppressionV3\"]=Module[\"asm\"][\"ja\"]).apply(null,arguments)};var

_NonMaxSuppressionV4=Module[\"_NonMaxSuppressionV4\"]=function(){return(_NonMaxSuppressionV4=Module[\"_NonMaxSuppressionV4\"]=Module[\"asm\"][\"ka\"]).apply(null,arguments)};var
_NonMaxSuppressionV5=Module[\"_NonMaxSuppressionV5\"]=function(){return(_NonMaxSuppressionV5=Module[\"_NonMaxSuppressionV5\"]=Module[\"asm\"][\"la\"]).apply(null,arguments)};var
_NotEqual=Module[\"_NotEqual\"]=function(){return(_NotEqual=Module[\"_NotEqual\"]=Module[\"asm\"][\"ma\"]).apply(null,arguments)};var
_OneHot=Module[\"_OneHot\"]=function(){return(_OneHot=Module[\"_OneHot\"]=Module[\"asm\"][\"na\"]).apply(null,arguments)};var
_PadV2=Module[\"_PadV2\"]=function(){return(_PadV2=Module[\"_PadV2\"]=Module[\"asm\"][\"oa\"]).apply(null,arguments)};var
_Pow=Module[\"_Pow\"]=function(){return(_Pow=Module[\"_Pow\"]=Module[\"asm\"][\"pa\"]).apply(null,arguments)};var
_Prelu=Module[\"_Prelu\"]=function(){return(_Prelu=Module[\"_Prelu\"]=Module[\"asm\"][\"qa\"]).apply(null,arguments)};var
_Prod=Module[\"_Prod\"]=function(){return(_Prod=Module[\"_Prod\"]=Module[\"asm\"][\"ra\"]).apply(null,arguments)};var
_RealDiv=Module[\"_RealDiv\"]=function(){return(_RealDiv=Module[\"_RealDiv\"]=Module[\"asm\"][\"sa\"]).apply(null,arguments)};var
_Relu=Module[\"_Relu\"]=function(){return(_Relu=Module[\"_Relu\"]=Module[\"asm\"][\"ta\"]).apply(null,arguments)};var
_Relu6=Module[\"_Relu6\"]=function(){return(_Relu6=Module[\"_Relu6\"]=Module[\"asm\"][\"ua\"]).apply(null,arguments)};var
_ResizeBilinear=Module[\"_ResizeBilinear\"]=function(){return(_ResizeBilinear=Module[\"_ResizeBilinear\"]=Module[\"asm\"][\"va\"]).apply(null,arguments)};var
_Reverse=Module[\"_Reverse\"]=function(){return(_Reverse=Module[\"_Reverse\"]=Module[\"asm\"][\"wa\"]).apply(null,arguments)};var
_RotateWithOffset=Module[\"_RotateWithOffset\"]=function(){return(_RotateWithOffset=Module[\"_RotateWithOffset\"]=Module[\"asm\"][\"xa\"]).apply(null,arguments)};var
_Round=Module[\"_Round\"]=function(){return(_Round=Module[\"_Round\"]=Module[\"asm\"][\"ya\"]).apply(null,arguments)};var
_Rsqrt=Module[\"_Rsqrt\"]=function(){return(_Rsqrt=Module[\"_Rsqrt\"]=Module[\"asm\"][\"za\"]).apply(null,arguments)};var
_ScatterNd=Module[\"_ScatterNd\"]=function(){return(_ScatterNd=Module[\"_ScatterNd\"]=Module[\"asm\"][\"Aa\"]).apply(null,arguments)};var
_SelectV2=Module[\"_SelectV2\"]=function(){return(_SelectV2=Module[\"_SelectV2\"]=Module[\"asm\"][\"Ba\"]).apply(null,arguments)};var
_Sigmoid=Module[\"_Sigmoid\"]=function(){return(_Sigmoid=Module[\"_Sigmoid\"]=Module[\"asm\"][\"Ca\"]).apply(null,arguments)};var
_Sin=Module[\"_Sin\"]=function(){return(_Sin=Module[\"_Sin\"]=Module[\"asm\"][\"Da\"]).apply(null,arguments)};var
_Softmax=Module[\"_Softmax\"]=function(){return(_Softmax=Module[\"_Softmax\"]=Module[\"asm\"][\"Ea\"]).apply(null,arguments)};var
_Sqrt=Module[\"_Sqrt\"]=function(){return(_Sqrt=Module[\"_Sqrt\"]=Module[\"asm\"][\"Fa\"]).apply(null,arguments)};var
_Square=Module[\"_Square\"]=function(){return(_Square=Module[\"_Square\"]=Module[\"asm\"][\"Ga\"]).apply(null,arguments)};var
_SquaredDifference=Module[\"_SquaredDifference\"]=function(){return(_SquaredDifference=Module[\"_SquaredDifference\"]=Module[\"asm\"][\"Ha\"]).apply(null,arguments)};var

_Step=Module[\"_Step\"]=function(){return(_Step=Module[\"_Step\"]=Module[\"asm\"][\"Ia\"]).apply(null,argume
nts)};var
_StridedSlice=Module[\"_StridedSlice\"]=function(){return(_StridedSlice=Module[\"_StridedSlice\"]=Module[\"as
m\"][\"Ja\"]).apply(null,arguments)};var
_Sub=Module[\"_Sub\"]=function(){return(_Sub=Module[\"_Sub\"]=Module[\"asm\"][\"Ka\"]).apply(null,argument
s)};var
_Sum=Module[\"_Sum\"]=function(){return(_Sum=Module[\"_Sum\"]=Module[\"asm\"][\"La\"]).apply(null,argum
ents)};var
_Tan=Module[\"_Tan\"]=function(){return(_Tan=Module[\"_Tan\"]=Module[\"asm\"][\"Ma\"]).apply(null,argumen
ts)};var
_Tanh=Module[\"_Tanh\"]=function(){return(_Tanh=Module[\"_Tanh\"]=Module[\"asm\"][\"Na\"]).apply(null,argu
ments)};var
_Tile=Module[\"_Tile\"]=function(){return(_Tile=Module[\"_Tile\"]=Module[\"asm\"][\"Oa\"]).apply(null,argumen
ts)};var
_TopK=Module[\"_TopK\"]=function(){return(_TopK=Module[\"_TopK\"]=Module[\"asm\"][\"Pa\"]).apply(null,ar
guments)};var
_Transform=Module[\"_Transform\"]=function(){return(_Transform=Module[\"_Transform\"]=Module[\"asm\"][\"
Qa\"]).apply(null,arguments)};var
_Transpose=Module[\"_Transpose\"]=function(){return(_Transpose=Module[\"_Transpose\"]=Module[\"asm\"][\"R
a\"]).apply(null,arguments)};var
__FusedMatMul=Module[\"__FusedMatMul\"]=function(){return(__FusedMatMul=Module[\"__FusedMatMul\"]=
Module[\"asm\"][\"Sa\"]).apply(null,arguments)};var
_malloc=Module[\"_malloc\"]=function(){return(_malloc=Module[\"_malloc\"]=Module[\"asm\"][\"Ta\"]).apply(nu
ll,arguments)};var
_free=Module[\"_free\"]=function(){return(_free=Module[\"_free\"]=Module[\"asm\"][\"Ua\"]).apply(null,argument
s)};var
___errno_location=Module[\"___errno_location\"]=function(){return(___errno_location=Module[\"___errno_locati
on\"]=Module[\"asm\"][\"Va\"]).apply(null,arguments)};var
stackSave=Module[\"stackSave\"]=function(){return(stackSave=Module[\"stackSave\"]=Module[\"asm\"][\"Wa\"]).
apply(null,arguments)};var
stackRestore=Module[\"stackRestore\"]=function(){return(stackRestore=Module[\"stackRestore\"]=Module[\"asm\"
][\"Xa\"]).apply(null,arguments)};var
stackAlloc=Module[\"stackAlloc\"]=function(){return(stackAlloc=Module[\"stackAlloc\"]=Module[\"asm\"][\"Ya\"
]).apply(null,arguments)};Module[\"cwrap\"]=cwrap;var calledRun;function
ExitStatus(status){this.name=\"ExitStatus\";this.message=\"Program terminated with
exit(\"+status+\")\";this.status=status}dependenciesFulfilled=function
runCaller(){if(!calledRun)run();if(!calledRun)dependenciesFulfilled=runCaller};function
run(args){args=args||arguments_;if(runDependencies>0){return}preRun();if(runDependencies>0){return}function
doRun(){if(calledRun)return;calledRun=true;Module[\"calledRun\"]=true;if(ABORT)return;initRuntime();preMain(
);readyPromiseResolve(Module);if(Module[\"onRuntimeInitialized\"])Module[\"onRuntimeInitialized\"]();postRun(
)}if(Module[\"setStatus\"]){Module[\"setStatus\"](\"Running...\");setTimeout(function(){setTimeout(function(){Mo
dule[\"setStatus\"](\"\")},1);doRun()},1)}else{doRun()}}Module[\"run\"]=run;if(Module[\"preInit\"]){if(typeof
Module[\"preInit\"]==\"function\")Module[\"preInit\"]=[Module[\"preInit\"]];while(Module[\"preInit\"].length>0){
Module[\"preInit\"].pop()()}}run();\n\n\n\n return WasmBackendModule.ready\n}\n);\n})();\nif (typeof exports ===
'object' && typeof module === 'object')\n module.exports = WasmBackendModule;\nelse if (typeof define ===
'function' && define['amd'])\n define([], function() { return WasmBackendModule; });\nelse if (typeof exports ===
'object')\n exports[\"WasmBackendModule\"] = WasmBackendModule;\n","/**\n * @license\n * Copyright 2019
Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you

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may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========================================================================\n */\nimport './flags_wasm';\n\nimport {backend_util, BackendTimingInfo, DataStorage, DataType, deprecationWarn, engine, env, KernelBackend, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasmModule, WasmFactoryConfig} from '../wasm-out/tfjs-backend-wasm';\nimport {BackendWasmThreadedSimdModule} from '../wasm-out/tfjs-backend-wasm-threaded-simd';\nimport wasmFactoryThreadedSimd from '../wasm-out/tfjs-backend-wasm-threaded-simd.js';\n// @ts-ignore\nimport {wasmWorkerContents} from '../wasm-out/tfjs-backend-wasm-threaded-simd.worker.js';\nimport wasmFactory from '../wasm-out/tfjs-backend-wasm.js';\n\ninterface TensorData {\n  id: number;\n  memoryOffset: number;\n  shape: number[];\n  dtype: DataType;\n  refCount: number;\n  /** Only used for string tensors, storing encoded bytes. */\n  stringBytes?: Uint8Array[];\n}\n\nexport type DataId = object;  // object instead of {} to force non-primitive.\n\nexport class BackendWasm extends KernelBackend {\n  // 0 is reserved for null data ids.\n  private dataIdNextNumber = 1;\n  dataIdMap: DataStorage<TensorData>;\n\n  constructor(public
  wasm: BackendWasmModule|BackendWasmThreadedSimdModule) {\n    super();\n    this.wasm.tfjs.initWithThreadsCount(threadsCount);\n    actualThreadsCount = this.wasm.tfjs.getThreadsCount();\n    this.dataIdMap = new DataStorage(this, engine());\n  }\n\n  write(values: backend_util.BackendValues, shape: number[], dtype: DataType):\n      DataId {\n    const dataId = {id: this.dataIdNextNumber++};\n    this.move(dataId, values, shape, dtype, 1);\n    return dataId;\n  }\n\n  numDataIds(): number {\n    return this.dataIdMap.numDataIds();\n  }\n\n  async time(f: () => void): Promise<BackendTimingInfo> {\n    const start = util.now();\n    f();\n    const kernelMs = util.now() - start;\n    return {kernelMs};\n  }\n\n  move(\n      dataId: DataId, values: backend_util.BackendValues, shape: number[],\n      dtype: DataType, refCount: number): void {\n    const id = this.dataIdNextNumber++;\n    if (dtype === 'string') {\n      const stringBytes = values as Uint8Array[];\n      this.dataIdMap.set(\n          dataId,\n          {id, stringBytes, shape, dtype, memoryOffset: null, refCount});\n      return;\n    }\n\n    const size = util.sizeFromShape(shape);\n    const numBytes = size * util.bytesPerElement(dtype);\n    const memoryOffset = this.wasm._malloc(numBytes);\n\n    this.dataIdMap.set(dataId, {id, memoryOffset, shape, dtype, refCount});\n\n    this.wasm.tfjs.registerTensor(id, size, memoryOffset);\n\n    if (values != null) {\n      this.wasm.HEAPU8.set(\n          new Uint8Array(\n              (values as backend_util.TypedArray).buffer,\n              (values as backend_util.TypedArray).byteOffset, numBytes),\n          memoryOffset);\n    }\n  }\n\n  async read(dataId: DataId): Promise<backend_util.BackendValues> {\n    return this.readSync(dataId);\n  }\n\n  readSync(dataId: DataId): backend_util.BackendValues {\n    const {memoryOffset, dtype, shape, stringBytes} =\n        this.dataIdMap.get(dataId);\n    if (dtype === 'string') {\n      return
  stringBytes;\n    }\n    const bytes = this.wasm.HEAPU8.slice(\n        memoryOffset,\n        memoryOffset + util.sizeFromShape(shape) * util.bytesPerElement(dtype));\n    return typedArrayFromBuffer(bytes.buffer, dtype);\n  }\n\n  /**\n   * Dispose the memory if the dataId has 0 refCount. Return true if the memory\n   * is released, false otherwise.\n   * @param dataId\n   * @oaram force Optional, remove the data regardless of refCount\n   */\n  disposeData(dataId: DataId, force = false): boolean {\n    if (this.dataIdMap.has(dataId)) {\n      const data = this.dataIdMap.get(dataId);\n      data.refCount--;\n      if (!force && data.refCount > 0) {\n        return false;\n      }\n\n      this.wasm._free(data.memoryOffset);\n      this.wasm.tfjs.disposeData(data.id);\n      this.dataIdMap.delete(dataId);\n    }\n    return true;\n  }\n\n  /** Return refCount of a `TensorData`. */\n  refCount(dataId: DataId): number {\n    if (this.dataIdMap.has(dataId)) {\n      const tensorData = this.dataIdMap.get(dataId);\n
      return tensorData.refCount;\n    }\n    return 0;\n  }\n\n  incRef(dataId: DataId) {\n    const data = this.dataIdMap.get(dataId);\n    if (data != null) {\n      data.refCount++;\n    }\n  }\n\n  floatPrecision(): 32 {\n
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return 32;\n  }\n\n  // Returns the memory offset of a tensor. Useful for debugging and unit\n  // testing.\n
getMemoryOffset(dataId: DataId): number {\n    return this.dataIdMap.get(dataId).memoryOffset;\n  }\n\n
dispose() {\n    this.wasm.tfjs.dispose();\n    if ('PThread' in this.wasm) {\n
this.wasm.PThread.terminateAllThreads();\n    }\n    this.wasm = null;\n  }\n\n  memory() {\n    return {unreliable:
false};\n  }\n\n  /**\n   * Make a tensor info for the output of an op. If `memoryOffset` is not\n   * present, this
method allocates memory on the WASM heap. If `memoryOffset`\n   * is present, the memory was allocated
elsewhere (in c++) and we just record\n   * the pointer where that memory lives.\n   */\n  makeOutput(shape:
 number[], dtype: DataType, memoryOffset?: number):\n      TensorInfo {\n    let dataId: {};\n    if (memoryOffset
== null) {\n      dataId = this.write(null /* values */, shape, dtype);\n    } else {\n      const id =
this.dataIdNextNumber++;\n      dataId = {id};\n      this.dataIdMap.set(dataId, {id, memoryOffset, shape, dtype,
refCount: 1});\n      const size = util.sizeFromShape(shape);\n      this.wasm.tfjs.registerTensor(id, size,
memoryOffset);\n    }\n    return {dataId, shape, dtype};\n  }\n\n  typedArrayFromHeap({shape, dtype, dataId}:
TensorInfo):\n      backend_util.TypedArray {\n    const buffer = this.wasm.HEAPU8.buffer;\n    const
{memoryOffset} = this.dataIdMap.get(dataId);\n    const size = util.sizeFromShape(shape);\n    switch (dtype) {\n
case 'float32':\n        return new Float32Array(buffer, memoryOffset, size);\n      case 'int32':\n        return new
Int32Array(buffer, memoryOffset, size);\n      case 'bool':\n        return new Uint8Array(buffer, memoryOffset,
 size);\n      default:\n        throw new Error(`Unknown dtype ${dtype}`);\n    }\n  }\n}\n\nfunction
createInstantiateWasmFunc(path: string) {\n  // this will be replace by rollup plugin patchWechatWebAssembly in\n
// minprogram's output.\n  // tslint:disable-next-line:no-any\n  return (imports: any, callback: any) => {\n
util.fetch(path, {credentials: 'same-origin'}).then((response) => {\n    if (!response['ok']) {\n
imports.env.a(`failed to load wasm binary file at '${path}'`);\n    }\n    response.arrayBuffer().then(binary => {\n
  WebAssembly.instantiate(binary, imports).then(output => {\n        callback(output.instance, output.module);\n
});\n    });\n  });\n  return {};\n  };\n}\n\n/**\n * Returns the path of the WASM binary.\n * @param
simdSupported whether SIMD is supported\n * @param threadsSupported whether multithreading is supported\n *
@param wasmModuleFolder the directory containing the WASM binaries.\n */\nfunction getPathToWasmBinary(\n
   simdSupported: boolean, threadsSupported: boolean,\n    wasmModuleFolder: string) {\n  if (wasmPath != null)
{\n    // If wasmPath is defined, the user has supplied a full path to\n    // the vanilla .wasm binary.\n    return
wasmPath;\n  }\n\n  let path: WasmBinaryName = 'tfjs-backend-wasm.wasm';\n  if (simdSupported &&
threadsSupported) {\n    path = 'tfjs-backend-wasm-threaded-simd.wasm';\n  } else if (simdSupported) {\n    path =
'tfjs-backend-wasm-simd.wasm';\n  }\n\n  if (wasmFileMap != null) {\n    if (wasmFileMap[path] != null) {\n
return wasmFileMap[path];\n    }\n  }\n\n  return wasmModuleFolder + path;\n}\n\n/**\n * Initializes the wasm
module and creates the js <--> wasm bridge.\n *\n * NOTE: We wrap the wasm module in a object with property
'wasm' instead of\n * returning Promise<BackendWasmModule> to avoid freezing Chrome (last tested\n * in
Chrome 76).\n */\nexport async function init(): Promise<{wasm: BackendWasmModule}> {\n  const
[simdSupported,
 threadsSupported] = await Promise.all([\n    env().getAsync('WASM_HAS_SIMD_SUPPORT'),\n
env().getAsync('WASM_HAS_MULTITHREAD_SUPPORT')\n  ]);\n\n  return new Promise((resolve, reject) =>
{\n    const factoryConfig: WasmFactoryConfig = {};\n\n    /**\n     * This function overrides the Emscripten
module locateFile utility.\n     * @param path The relative path to the file that needs to be loaded.\n     * @param
prefix The path to the main JavaScript file's directory.\n     */\n    factoryConfig.locateFile = (path, prefix) => {\n
if (path.endsWith('.worker.js')) {\n        const response = wasmWorkerContents;\n        const blob = new
Blob([response], {type: 'application/javascript'});\n        return URL.createObjectURL(blob);\n      }\n\n      if
(path.endsWith('.wasm')) {\n        return getPathToWasmBinary(\n            simdSupported as boolean,
threadsSupported as boolean,\n            wasmPathPrefix != null ? wasmPathPrefix : prefix);\n      }\n      return prefix
+ path;\n
    };\n\n    // Use the instantiateWasm override when system fetch is not available.\n    // Reference:\n    //
https://github.com/emscripten-
core/emscripten/blob/2bca083cbbd5a4133db61fbd74d04f7feecfa907/tests/manual_wasm_instantiate.html#L170\n
```

```
if (customFetch) {\n      factoryConfig.instantiateWasm =\n
createInstantiateWasmFunc(getPathToWasmBinary(\n              simdSupported as boolean, threadsSupported as
boolean,\n              wasmPathPrefix != null ? wasmPathPrefix : ''));\n    }\n\n    let initialized = false;\n
factoryConfig.onAbort = () => {\n      if (initialized) {\n        // Emscripten already called console.warn so no need to
double log.\n        return;\n      }\n      if (initAborted) {\n        // Emscripten calls `onAbort` twice, resulting in double
error\n        // messages.\n        return;\n      }\n      initAborted = true;\n      const rejectMsg =\n          'Make sure the
server can serve the `.wasm` file relative to the ' +\n          'bundled
 js file. For more details see https://github.com/tensorflow/tfjs/blob/master/tfjs-backend-wasm/README.md#using-
bundlers';\n      reject({message: rejectMsg});\n    };\n\n    let wasm: Promise<BackendWasmModule>;\n    // If
`wasmPath` has been defined we must initialize the vanilla module.\n    if (threadsSupported && simdSupported
&& wasmPath == null) {\n      factoryConfig.mainScriptUrlOrBlob = new Blob(\n          [`var
WasmBackendModuleThreadedSimd = ` +\n              wasmFactoryThreadedSimd.toString()],\n          {type:
'text/javascript'});\n      wasm = wasmFactoryThreadedSimd(factoryConfig);\n    } else {\n      // The wasmFactory
works for both vanilla and SIMD binaries.\n      wasm = wasmFactory(factoryConfig);\n    }\n\n    // The WASM
module has been successfully created by the factory.\n    // Any error will be caught by the onAbort callback defined
above.\n    wasm.then((module) => {\n      initialized = true;\n      initAborted = false;\n\n      const voidReturnType:
string
 = null;\n      // Using the tfjs namespace to avoid conflict with emscripten's API.\n      module.tfjs = {\n        init:
module.cwrap('init', null, []),\n        initWithThreadsCount:\n            module.cwrap('init_with_threads_count', null,
['number']),\n        getThreadsCount: module.cwrap('get_threads_count', 'number', []),\n        registerTensor:
module.cwrap(\n            'register_tensor', null,\n            [\n              'number',  // id\n              'number',  // size\n
  'number',  // memoryOffset\n            ]),\n        disposeData: module.cwrap('dispose_data', voidReturnType,
['number']),\n        dispose: module.cwrap('dispose', voidReturnType, []),\n      };\n\n      resolve({wasm: module});\n
  });\n  });\n}\n\nfunction typedArrayFromBuffer(\n    buffer: ArrayBuffer, dtype: DataType):
backend_util.TypedArray {\n  switch (dtype) {\n    case 'float32':\n      return new Float32Array(buffer);\n    case
'int32':\n      return new Int32Array(buffer);\n
    case 'bool':\n      return new Uint8Array(buffer);\n    default:\n      throw new Error(`Unknown dtype ${dtype}`);\n
}\n}\n\nconst wasmBinaryNames = [\n  'tfjs-backend-wasm.wasm', 'tfjs-backend-wasm-simd.wasm',\n  'tfjs-
backend-wasm-threaded-simd.wasm'\n] as const ;\ntype WasmBinaryName = typeof
wasmBinaryNames[number];\n\nlet wasmPath: string = null;\nlet wasmPathPrefix: string = null;\nlet wasmFileMap:
{[key in WasmBinaryName]?: string} = {};\nlet initAborted = false;\nlet customFetch = false;\n\n/**\n *
@deprecated Use `setWasmPaths` instead.\n * Sets the path to the `.wasm` file which will be fetched when the
wasm\n * backend is initialized. See\n * https://github.com/tensorflow/tfjs/blob/master/tfjs-backend-
wasm/README.md#using-bundlers\n * for more details.\n * @param path wasm file path or url\n * @param
usePlatformFetch optional boolean to use platform fetch to download\n *     the wasm file, default to false.\n *\n *
@doc {heading: 'Environment', namespace: 'wasm'}\n */\nexport
 function setWasmPath(path: string, usePlatformFetch = false): void {\n  deprecationWarn(\n      'setWasmPath has
been deprecated in favor of setWasmPaths and' +\n      ' will be removed in a future release.');\n  if (initAborted) {\n
throw new Error(\n          'The WASM backend was already initialized. Make sure you call ' +\n          '`setWasmPath()`
before you call `tf.setBackend()` or `tf.ready()`');\n  }\n  wasmPath = path;\n  customFetch =
usePlatformFetch;\n}\n\n/**\n * Configures the locations of the WASM binaries.\n *\n * ```js\n * setWasmPaths({\n
*  'tfjs-backend-wasm.wasm': 'renamed.wasm',\n *  'tfjs-backend-wasm-simd.wasm': 'renamed-simd.wasm',\n *
'tfjs-backend-wasm-threaded-simd.wasm': 'renamed-threaded-simd.wasm'\n * });\n * tf.setBackend('wasm');\n *
```\n *\n * @param prefixOrFileMap This can be either a string or object:\n *  - (string) The path to the directory
where the WASM binaries are located.\n *   Note that this prefix will be used to load each binary
 (vanilla,\n *   SIMD-enabled, threading-enabled, etc.).\n * - (object) Mapping from names of WASM binaries to
custom\n *   full paths specifying the locations of those binaries. This is useful if\n *   your WASM binaries are
not all located in the same directory, or if your\n *   WASM binaries have been renamed.\n * @param
```
```

usePlatformFetch optional boolean to use platform fetch to download\n *   the wasm file, default to false.\n *\n * @doc {heading: 'Environment', namespace: 'wasm'}\n */\nexport function setWasmPaths(\n   prefixOrFileMap: string|{[key in WasmBinaryName]?: string},\n   usePlatformFetch = false): void {\n if (initAborted) {\n   throw new Error(\n   'The WASM backend was already initialized. Make sure you call ' +\n   '`setWasmPaths()` before you call `tf.setBackend()` or ' +\n   '`tf.ready()`');\n }\n\n if (typeof prefixOrFileMap === 'string') {\n   wasmPathPrefix = prefixOrFileMap;\n } else {\n   wasmFileMap = prefixOrFileMap;\n   const missingPaths =\n   wasmBinaryNames.filter(name => wasmFileMap[name] == null);\n   if (missingPaths.length > 0) {\n   throw new Error(\n   `There were no entries found for the following binaries: ` +\n   `${missingPaths.join(',')}. Please either call setWasmPaths with a ` +\n   `map providing a path for each binary, or with a string indicating ` +\n   `the directory where all the binaries can be found.`);\n   }\n }\n\n customFetch = usePlatformFetch;\n}\n\n/** Used in unit tests. */\nexport function resetWasmPath(): void {\n wasmPath = null;\n wasmPathPrefix = null;\n wasmFileMap = {};\n customFetch = false;\n initAborted = false;\n}\n\nlet threadsCount = -1;\nlet actualThreadsCount = -1;\n\n/**\n * Sets the number of threads that will be used by XNNPACK to create\n * threadpool (default to the number of logical CPU cores).\n *\n * This must be called before calling `tf.setBackend('wasm')`.\n */\nexport function setThreadsCount(numThreads: number) {\n threadsCount = numThreads;\n}\n\n/**\n * Gets the actual threads count that is used by XNNPACK.\n *\n * It is set after the backend is intialized.\n */\nexport function getThreadsCount(): number {\n if (actualThreadsCount === -1) {\n   throw new Error(`WASM backend not initialized.`);\n }\n return actualThreadsCount;\n}\n","/** @license See the LICENSE file. */\n\n// This code is auto-generated, do not modify this file!\nconst version = '3.11.0';\nexport {version};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==\n */\n\nimport './flags_wasm';\n\nimport {registerBackend} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm, init} from './backend_wasm';\n\nexport {BackendWasm, getThreadsCount, setThreadsCount, setWasmPath, setWasmPaths} from './backend_wasm';\nexport {version as version_wasm} from './version';\n\nconst WASM_PRIORITY = 2;\nregisterBackend('wasm', async () => {\n const {wasm} = await init();\n return new BackendWasm(wasm);\n}, WASM_PRIORITY);\n"],"names":["_FusedMatMul","util","Abs","backend_util","Add","AddN","Identity","setup","Transpose","All","Any","wasmFunc","ArgMax","AvgPool","Reshape","BatchMatMul","slice_util","buffer","sliceImplCPU","Slice","BatchToSpaceND","Cast","Ceil","ClipByValue","concatImplCPU","Concat","Conv2D","Conv2DBackpropInput","Cos","Cosh","CropAndResize","Cumsum","DepthToSpace","DepthwiseConv2dNative","Elu","supportsFullBroadcast","Equal","Exp","ExpandDims","Fill","FlipLeftRight","Floor","FloorDiv","FusedBatchNorm","FusedConv2D","FusedDepthwiseConv2D","GatherNd","GatherV2","Greater","GreaterEqual","setupFunc","LeakyRelu","Less","LessEqual","Log","LogicalAnd","Max","Maximum","MaxPool","Mean","Min","Minimum","MirrorPad","Multiply","Neg","NonMaxSuppressionV3","NonMaxSuppressionV4","NonMaxSuppressionV5","kernelFunc","NotEqual","OneHot","OnesLike","Pack","PadV2","Pow","Prelu","Prod","rangeImplCPU","Range","RealDiv","Relu","Relu6","ResizeBilinear","Reverse","RotateWithOffset","Round","Rsqrt","ScatterNd","Select","Sigmoid","Sin","Softmax","SpaceToBatchND","SplitV","Sqrt","Square","SquaredDifference","Step","StridedSlice","Sub","Sum","Tan","Tanh","Tile","TopK","Transform","Unpack","ZerosLike","registerKernel","env","require$$0","require$$1","require$$2","global","require$$3","require$$4","tslib_1.__extends","DataStorage","engine","KernelBackend","wasmFactoryThreadedSimd","wasmFactory","deprecationWarn","registerBackend"],"mappings":";;;;

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CxC;IAED,IAAI,QAAQ,EAAE;;QAEZ,IAAM,QAAQ,GAAGE,qBAAY,CAAC,oBAAoB,CAAC,GAAG,CAAC,K
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==========\n
*/\n\n// This enum must align with the enum defined in cc/backend.h.\nexport enum CppDType {\n float32 = 0,\n int32 = 1,\n bool = 2,\n string = 3,\n complex64 = 4\n}\n\n// Must match enum in cc/fusable_activations.h.\nexport enum FusableActivation {\n linear = 0,\n relu = 1,\n relu6 = 2,\n prelu = 3,\n leakyrelu = 4,\n sigmoid = 5,\n elu = 6\n}\n\"]}

Found in path(s):
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernels/types.js.map
No license file was found, but licenses were detected in source scan.

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'@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {identity} from './Identity';\nimport {reshape} from './Reshape';\n\nlet wasmReverse: (\n xId: number, axes: Uint8Array, axesLength: number, outShape: Uint8Array,\n outShapeLength: number, outId: number) => void;\n\nfunction setup(backend:
BackendWasm) {\n wasmReverse = backend.wasm.cwrap(Reverse, null, [\n 'number', // x_id\n 'array', // axes\n 'number', // axes_length\n 'array', // out_shape\n 'number', // out_shape_length\n 'number' // out_id\n]);\n}\n\nexport function reverse(\n args: {inputs: ReverseInputs, backend: BackendWasm, attrs: ReverseAttrs}):\n TensorInfo {\n const {inputs, backend, attrs} = args;\n const {x} = inputs;\n const {dims} = attrs;\n\n const axes = util.parseAxisParam(dims, x.shape);\n\n if (x.shape.length === 0) {\n return identity({inputs: {x}, backend});\n }\n\n const out = backend.makeOutput(x.shape, x.dtype);\n const xId = backend.dataIdMap.get(x.dataId).id;\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n const axesBytes = new Uint8Array(new Int32Array(axes).buffer);\n const outShapeBytes = new Uint8Array(new Int32Array(x.shape).buffer);\n\n wasmReverse(\n xId, axesBytes, axes.length, outShapeBytes, x.shape.length, outId);\n\n
const reshaped =\n reshape({inputs: {x: out}, attrs: {shape: x.shape}, backend});\n\n backend.disposeData(out.dataId);\n return reshaped;\n}\n\nexport const reverseConfig: KernelConfig = {\n kernelName: Reverse,\n backendName: 'wasm',\n kernelFunc: reverse as {} as KernelFunc,\n setupFunc: setup\n};\n"]}

Found in path(s):
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernels/Reverse.js.map
No license file was found, but licenses were detected in source scan.

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* distributed under the License is distributed on an "AS IS" BASIS,
* WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.
* See the License for the specific language governing permissions and
* limitations under the License.
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* /tfjs-backend-wasm-zip/tfjs-backend-wasm/src/kernels/Mean.ts
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/src/kernels/Reverse.ts
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernels/NotEqual.d.ts
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/wasm-out/tfjs-backend-wasm-threaded-simd.d.ts
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernels/NonMaxSuppressionV4.d.ts
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/src/kernels/Equal.ts
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernels/Pack.d.ts
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernels/Equal.js
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernels/SplitV.js
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernels/Reverse.d.ts
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernels/Range.d.ts
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernel_utils/shared.d.ts
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/src/kernels/Fill.ts
*
 /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernels/Cumsum.d.ts
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/src/kernels/Identity.ts
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/src/kernels/OneHot.ts
No license file was found, but licenses were detected in source scan.

{"version":3,"file":"Ceil.js","sourceRoot":"","sources":["../../src/kernels/Ceil.ts"],"names":[],"mappings":"AAAA;;;;;;;;;;;;;GAaeG;AACH,OAAO,EAAe,IAAI,EAAC,MAAM,uBAAuB,CAAC;AAEzD,OAAO,EAAC,uBAAuB,EAAC,MAAM,gBAAgB,CAAC;AAEvD,MAAM,CAAC,MAAM,UAAU,GAAe,uBAAuB,CAAC,IAAI,CAAC,CAAC","sourcesContent":["/**\n * @license\n * Copyright 2021 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n
 * ===\n
*/\nimport {KernelConfig, Ceil} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\n\nexport const ceilConfig: KernelConfig = createUnaryKernelConfig(Ceil);\n"]}

Found in path(s):
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernels/Ceil.js.map
No license file was found, but licenses were detected in source scan.

{"version":3,"file":"Tile.js","sourceRoot":"","sources":["../../src/kernels/Tile.ts"],"names":[],"mappings":"AAAA;;;;;;;;;;;;;GAeG;AAEH,OAAO,EAA2B,IAAI,EAAwB,MAAM,uBAAuB,CAAC;AAI5F,OAAO,EAAC,QAAQ,EAAC,MAAM,SAAS,CAAC;AAEjC,OAAO,EAAE,IAAI,EAAE,MAAM,SAAS,CAAC;AAEhE,OAAO,EAAC,QAAQ,EAAE,MAAM,EAAE,MAAM,EAAE,MAAM

Found in path(s):
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernels/Tile.js.map
No license file was found, but licenses were detected in source scan.

{"version":3,"file":"Cosh.js","sourceRoot":"","sources":["../../src/kernels/Cosh.ts"],"names":[],"mappings":"AAAA;;;;;;;;;;;;;;GAeG;AACH,OAAO,EAAC,EAAE,IAAI,EAAEe,MAAM,uBAAAuB,CAAC;AAEzD,OAAO,EAAC,EAAE,IAAI,EAAE,MAAM,gBAAAgB,CAAC;AAEvD,MAAM,CAAC,MAAM,UAAU,GAAGiB,MAAM,CAAC,MAAM,CAAC,MAAM,UAAU,GAAG,CAAC,CAAC,","sourcesContent":["/**\n * @license\n * Copyright 2021 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n\n * ===\n*/\nimport {Cosh, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\n\nexport const coshConfig: KernelConfig = createUnaryKernelConfig(Cosh);\n"]}

Found in path(s):
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernels/Cosh.js.map
No license file was found, but licenses were detected in source scan.

{"version":3,"file":"DepthToSpace.js","sourceRoot":"","sources":["../../src/kernels/DepthToSpace.ts"],"names":[],"mappings":"AAAA;;;;;;;;;;;;;;GAeG;AAEH,OAAO,EAAC,EAAE,IAAI,EAAE,YAAY,EAAE,EAAE,IAAI,EAAE,EAAE,IAAI,EAAE,MAAM,uBAAAuB,CAAC;AAEtD,OAAO,EAAC,EAAE,IAAI,EAAE,MAAM,gBAAAgB,CAAC;AAEvD,MAAM,CAAC,MAAM,UAAU,GAAGiB,MAAM,CAAC,MAAM,CAAC,MAAM,UAAU,GAAG,CAAC,CAAC,","sourcesContent":["/**\n * @license\n * Copyright 2021 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n\n * ===\n*/\nimport {DepthToSpace, DepthToSpaceAttrs, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\n\nexport const depthToSpaceConfig: KernelConfig = createUnaryKernelConfig(DepthToSpace);\n"]}

C,CAAC,CAAC,CAAC,CAAC,CAAC,CAAC,CAAC,CAAC;IACnD,gBAAgB,CACZ,GAAG,EAAE,SAAS,EAAE,YAAY,EAAE,aAAa,EAAE,CAAC,CAAC,KAAK,CAAC,MAAM,GAAG,CAAC,EAC/D,gBAAgB,EAAE,eAAe,EAAE,WAAW,CAAC,MAAM,EAAE,KAAK,CAAC,CAAC,CAAC;IAElE,OAAO,GAAG,CAAC,CAAC;AACb,CAAC,CAAC;AAED,MAAM,CAAC,MAAM,kBAAkB,GAAG,EAAE,CAAC,IAAI,CAAC,MAAM,CAAC,CAAC,CAAC,CAAC,CAAC,CAAC,CAAC,CAAC

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/\n\nimport {_FusedMatMul, _FusedMatMulAttrs, _FusedMatMulInputs, KernelConfig, KernelFunc} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {FusableActivation} from './types';\n\nlet wasmFusedMatMul:\n (aId: number, aShape: Uint8Array, aShapeSize: number, bId: number,\n bShape: Uint8Array, bShapeSize: number, transposeA: boolean,\n transposeB: boolean, activation: number, biasId: number,\n preluActivationWeightsId: number, leakyreluAlpha: number, outId: number) =>\n void;\n\nfunction setup(backend: BackendWasm) {\n wasmFusedMatMul = backend.wasm.cwrap(_FusedMatMul, null / void */, [\n 'number', // a_id\n 'array', // a_shape\n 'number', // a_shape.length\n 'number', // b_id\n 'array', // b_shape\n 'number', // b_shape.length\n 'number', // transpose_a\n 'number', // transpose_b\n 'number', // activation\n 'number', // biasId\n 'number', // preluActivationWeightsId\n 'number', // leakyreluAlpha\n 'number' // out_id\n]);\n}\n\nfunction fusedBatchMatMul(args: {\n inputs: _FusedMatMulInputs,\n backend: BackendWasm,\n attrs: _FusedMatMulAttrs\n}) {\n const {inputs, backend, attrs} = args;\n const {a, b, bias, preluActivationWeights} = inputs;\n\n if (a.dtype !== 'float32' || b.dtype !== 'float32') {\n throw new Error(\n `_FusedMatMul for non non-float32 tensors not yet supported.`);\n }\n\n const {transposeA, transposeB, activation, leakyreluAlpha} = attrs;\n const aId = backend.dataIdMap.get(a.dataId).id;\n const bId = backend.dataIdMap.get(b.dataId).id;\n\n let biasId = 0;\n if (bias != null)\n {\n const biasData = backend.dataIdMap.get(bias.dataId);\n if (biasData.shape.length !== 1) {\n throw new Error(\n `_FusedMatMul only supports rank-1 bias but got ` +\n `rank ${biasData.shape.length}.`);\n }\n biasId = biasData.id;\n }\n const preluActivationWeightsId = preluActivationWeights == null ?\n 0 :\n backend.dataIdMap.get(preluActivationWeights.dataId).id;\n const fusedActivation =\n FusableActivation[activation as {} as keyof typeof FusableActivation];\n if (fusedActivation == null) {\n throw new Error(\n `${activation} activation not yet supported for FusedConv2D ` +\n `in the wasm backend.`);\n }\n\n const leftDim = transposeA ? a.shape[2] : a.shape[1];\n const rightDim = transposeB ? b.shape[1] : b.shape[2];\n const batchDim = a.shape[0];\n\n const out = backend.makeOutput([batchDim, leftDim, rightDim], a.dtype);\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n const aShapeBytes = new Uint8Array(new Int32Array(a.shape).buffer);\n const bShapeBytes = new Uint8Array(new Int32Array(b.shape).buffer);\n\n wasmFusedMatMul(\n aId, aShapeBytes, a.shape.length, bId, bShapeBytes, b.shape.length,\n transposeA, transposeB, fusedActivation, biasId, preluActivationWeightsId,\n leakyreluAlpha || 0, outId);\n\n return out;\n}\n\nexport const fusedMatMulConfig: KernelConfig = {\n kernelName: _FusedMatMul,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: fusedBatchMatMul as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT
WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n
/\n\nimport {DataType, KernelConfig, TensorInfo, UnaryInputs, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {CppDType} from './types';\n\nexport function createUnaryKernelConfig(\n kernelName: string, outType?: DataType): KernelConfig {\n let wasmFunc: (xId: number, dtype: number, outId: number) => void;\n\n function setupFunc(backend: BackendWasm): void {\n wasmFunc = backend.wasm.cwrap(kernelName, null / void */, [\n 'number', // x_id\n 'number', // dtype\n 'number', // out_id\n]);\n }\n\n function kernelFunc(args: {backend: BackendWasm, inputs: UnaryInputs}):\n TensorInfo {\n const {backend, inputs: {x}} = args;\n const xId = backend.dataIdMap.get(x.dataId).id;\n const out = backend.makeOutput(x.shape, outType || x.dtype);\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n // Short-circuit zero-sized tensors.\n if (util.sizeFromShape(out.shape) === 0) {\n return out;\n }\n\n wasmFunc(xId, CppDType[x.dtype], outId);\n return out;\n }\n\n return

{kernelName, backendName: 'wasm', setupFunc, kernelFunc};\n}\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions
and\n * limitations under the License.\n *
==========\n */\nimport {Abs, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\n\nexport const absConfig: KernelConfig = createUnaryKernelConfig(Abs);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {backend_util, BinaryInputs, DataType, KernelConfig, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {CppDType} from './types';\n\nexport function createBinaryKernelConfig(\n kernelName: string, supportsFullBroadcast: boolean,\n dtype?: DataType): KernelConfig {\n let wasmFunc:\n (aId: number, aShape: Uint8Array, aShapeLen: number, bId: number,\n bShape: Uint8Array, bShapeLen: number, dtype: number, outId: number) =>\n void;\n\n function setupFunc(backend: BackendWasm): void {\n wasmFunc = backend.wasm.cwrap(kernelName, null /* void */, [\n 'number', // a_id,\n 'array', // a_shape\n 'number', // a_shape.length\n 'number', // b_id\n 'array', // b_shape\n 'number', // b_shape.length\n 'number', // dtype\n 'number' // out_id\n]);\n }\n\n function kernelFunc(args: {backend: BackendWasm, inputs:
BinaryInputs}):\n TensorInfo {\n const {backend, inputs} = args;\n const {a, b} = inputs;\n const aId = backend.dataIdMap.get(a.dataId).id;\n const bId = backend.dataIdMap.get(b.dataId).id;\n\n const outputType = dtype != null ? dtype : a.dtype;\n const newShape = backend_util.assertAndGetBroadcastShape(a.shape, b.shape);\n const out = backend.makeOutput(newShape, outputType);\n\n // Short-circuit zero-sized tensors.\n if (util.sizeFromShape(newShape) === 0) {\n return out;\n }\n\n const aShapeBytes = new Uint8Array(new Int32Array(a.shape).buffer);\n const bShapeBytes = new Uint8Array(new Int32Array(b.shape).buffer);\n const outId = backend.dataIdMap.get(out.dataId).id;\n const kernelFunc = () => wasmFunc(\n aId, aShapeBytes, a.shape.length, bId, bShapeBytes, b.shape.length,\n CppDType[a.dtype], outId);\n\n // Currently only some float operations support full broadcast.\n if (supportsFullBroadcast && a.dtype ===
'float32') {\n kernelFunc();\n return out;\n }\n\n const aBroadcastDims = backend_util.getBroadcastDims(a.shape, newShape);\n const bBroadcastDims = backend_util.getBroadcastDims(b.shape, newShape);\n const loopsOverAllOfA = aBroadcastDims.every((v, i) => v === i);\n const loopsOverAllOfB = bBroadcastDims.every((v, i) => v === i);\n if (loopsOverAllOfA && loopsOverAllOfB) {\n kernelFunc();\n return out;\n } else {\n throw new Error(\n `Broadcasting along outer dims is not yet ` +\n `supported for ${a.dtype} ${kernelName}.`);\n }\n }\n\n return {kernelName, backendName: 'wasm', setupFunc, kernelFunc};\n}\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless
required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n

* See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {Add, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from './binary_kernel';\n\nconst supportsFullBroadcast = true;\n\nexport const addConfig: KernelConfig =\n createBinaryKernelConfig(Add, supportsFullBroadcast);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required
 by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {AddN, KernelConfig, KernelFunc, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {CppDType} from './types';\n\nlet wasmFunc:\n (inputIds: Uint8Array, inputIdsLen: number, dtype: number, outId: number) =>\n void;\n\nfunction setupFunc(backend: BackendWasm): void {\n wasmFunc = backend.wasm.cwrap(AddN, null /* void */, [\n 'array', // input_ids\n 'number', // input_ids.length\n 'number', // dtype\n 'number', // out_id\n]);\n}\n\nfunction addn(args: {inputs: TensorInfo[], backend: BackendWasm}) {\n const
 {inputs, backend} = args;\n const out = backend.makeOutput(inputs[0].shape, inputs[0].dtype);\n\n // Short-circuit zero-sized tensors.\n if (util.sizeFromShape(out.shape) === 0) {\n return out;\n }\n\n const inputIds = inputs.map(x => backend.dataIdMap.get(x.dataId).id);\n const inputIdsBytes = new Uint8Array(new Int32Array(inputIds).buffer);\n const outId = backend.dataIdMap.get(out.dataId).id;\n wasmFunc(inputIdsBytes, inputIds.length, CppDType[out.dtype], outId);\n\n return out;\n}\n\nexport const addNConfig: KernelConfig = {\n kernelName: AddN,\n backendName: 'wasm',\n setupFunc,\n kernelFunc: addn as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law
 or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {Identity, IdentityInputs, KernelConfig, KernelFunc} from '@tensorflow/tfjs-core';\nimport {TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nexport function identity(args: {inputs: IdentityInputs, backend: BackendWasm}):\n TensorInfo {\n const {inputs: {x}, backend} = args;\n const out = backend.makeOutput(x.shape, x.dtype);\n const inVals = backend.typedArrayFromHeap(x);\n const outVals = backend.typedArrayFromHeap(out);\n outVals.set(inVals);\n return out;\n}\n\nexport const identityConfig: KernelConfig = {\n kernelName: Identity,\n backendName: 'wasm',\n
 kernelFunc: identity as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {KernelConfig, KernelFunc, TensorInfo, Transpose, TransposeAttrs, TransposeInputs} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {identity} from

'./Identity';\nimport
{CppDType} from './types';\n\nlet wasmTranspose: (\n xId: number, xShape: Uint8Array, xShapeLength:
number, dtype: CppDType,\n outId: number, perm: Uint8Array, permLength: number) => void;\n\nfunction
setup(backend: BackendWasm) {\n wasmTranspose = backend.wasm.cwrap(Transpose, null /* void */, [\n
'number', // xId\n 'array', // x.shape\n 'number', // x.shape.length\n 'number', // dtype\n 'number', // outId\n
'array', // perm\n 'number', // perm.length\n]);\n}\n\nexport function transpose(\n args:\n {inputs:
TransposeInputs, backend: BackendWasm, attrs: TransposeAttrs}):\n TensorInfo {\n const {inputs, backend,
attrs} = args;\n // Reduce any dimensions with size one. Lower-rank transpose kernel performs\n // better due to
simpler memory access pattern.\n const [reducedShape, perm] = removeOneSizeDims(inputs.x.shape,
attrs.perm);\n\n let permIsNoOp = true;\n for (let i = 0; i < perm.length; i++) {\n if (perm[i] !== i) {\n
permIsNoOp = false;\n }\n }\n const outShape = computeOutShape(inputs.x.shape, attrs.perm);\n const x = {\n
dataId: inputs.x.dataId,\n shape: reducedShape,\n dtype: inputs.x.dtype\n };\n\n if (permIsNoOp) {\n const
cloned = identity({inputs, backend});\n cloned.shape = outShape;\n return cloned;\n }\n\n const out =
backend.makeOutput(outShape, x.dtype);\n const xId = backend.dataIdMap.get(x.dataId).id;\n const outId =
backend.dataIdMap.get(out.dataId).id;\n const permBytes = new Uint8Array(new Int32Array(perm).buffer);\n
const xShapeBytes = new Uint8Array(new Int32Array(x.shape).buffer);\n\n wasmTranspose(\n xId,
xShapeBytes, x.shape.length, CppDType[x.dtype], outId, permBytes,\n perm.length);\n return
out;\n}\n\nfunction computeOutShape(inShape: number[], perm: number[]): number[] {\n const outShape = new
Array(inShape.length);\n for (let i = 0; i < outShape.length; i++) {\n outShape[i] = inShape[perm[i]];\n }\n
return outShape;\n}\n\nfunction
removeOneSizeDims(\n shape: number[], perm: number[]): [number[], number[]] {\n const newShape: number[]
= [];\n const newPerm: number[] = [];\n for (let i = 0; i < shape.length; ++i) {\n if (shape[i] !== 1) {\n
newShape.push(shape[i]);\n }\n if (shape[perm[i]] !== 1) {\n newPerm.push(perm[i]);\n }\n }\n for (let i =
0; i < newPerm.length; ++i) {\n let minValIdx = -1;\n for (let j = 0; j < newPerm.length; ++j) {\n if
(newPerm[j] >= i &&\n (minValIdx === -1 || newPerm[minValIdx] > newPerm[j])) {\n minValIdx = j;\n
}\n }\n newPerm[minValIdx] = i;\n }\n return [newShape, newPerm];\n}\n\nexport const transposeConfig:
KernelConfig = {\n kernelName: Transpose,\n backendName: 'wasm',\n kernelFunc: transpose as {} as
KernelFunc,\n setupFunc: setup,\n};\n","/**\n * @license\n * Copyright 2020 Google Inc. All Rights Reserved.\n *
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==\n
*/\n\nimport {backend_util, TensorInfo, util} from '@tensorflow/tfjs-core';\nimport {BackendWasm} from
'../backend_wasm';\nimport {transpose} from './Transpose';\n\n/**\n * Compute permutation axes and do a transpose
if necessary.\n *\n * Used by reduction ops.\n * @param x input TensorInfo\n * @param axis reduction axes\n *
@param backend wasm backend instance\n */\nexport function permuteAxesAndTranspose(\n x: TensorInfo,
axis:
number|number[], backend: BackendWasm): {\n transposed: TensorInfo|null,\n axes: number[],\n originalAxes:
number[],\n inputWasTransposed: boolean\n} {\n const xShape = x.shape;\n const xRank = x.shape.length;\n\n
const originalAxes = util.parseAxisParam(axis, xShape);\n let axes = originalAxes;\n const permutedAxes =
backend_util.getAxesPermutation(axes, xRank);\n let xTransposed = null;\n let inputWasTransposed = false;\n if
(permutedAxes != null) {\n const newShape: number[] = new Array(xRank);\n for (let i = 0; i <
newShape.length; i++) {\n newShape[i] = xShape[permutedAxes[i]];\n }\n\n axes =
backend_util.getInnerMostAxes(axes.length, xRank);\n xTransposed =\n transpose({inputs: {x}, attrs: {perm:
permutedAxes}, backend});\n\n const xId = backend.dataIdMap.get(x.dataId).id;\n const transposedId =

backend.dataIdMap.get(xTransposed.dataId).id;\n if (transposedId !== xId) {\n inputWasTransposed = true;\n }\n }\n\n return {transposed:
 xTransposed, originalAxes, axes, inputWasTransposed};\n}\n","/**\n * @license\n * Copyright 2021 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {All, AllAttrs, AllInputs, backend_util, KernelConfig, KernelFunc, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {permuteAxesAndTranspose}
 from './kernel_utils';\n\nlet wasmAll: (xId: number, reduceSize: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n wasmAll = backend.wasm.cwrap(All, null /*void*/, ['number, number, number']);\n}\n\nfunction all(args: {backend: BackendWasm, inputs: AllInputs, attrs: AllAttrs}):\n TensorInfo {\n const {backend, inputs, attrs} = args;\n const {axis, keepDims} = attrs;\n const {x} = inputs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n let inputId = xId;\n let input = x;\n\n const {transposed, axes, originalAxes, inputWasTransposed} =\n   permuteAxesAndTranspose(x, axis, backend);\n\n if (inputWasTransposed) {\n const transposedId = backend.dataIdMap.get(transposed.dataId).id;\n input = transposed;\n inputId = transposedId;\n }\n\n const inputRank = input.shape.length;\n backend_util.assertAxesAreInnerMostDims('all', axes, inputRank);\n const [outShape, reduceShape] =\n backend_util.computeOutAndReduceShapes(input.shape,
 axes);\n const reduceSize = util.sizeFromShape(reduceShape);\n\n const out = backend.makeOutput(outShape, x.dtype);\n if (util.sizeFromShape(input.shape) !== 0) {\n const outId = backend.dataIdMap.get(out.dataId).id;\n wasmAll(inputId, reduceSize, outId);\n }\n\n if (inputWasTransposed) {\n // dispose of the transposed tensor.\n backend.disposeData(transposed.dataId);\n }\n\n if (keepDims) {\n // reshape\n const newShape = backend_util.expandShapeToKeepDim(out.shape, originalAxes);\n out.shape = newShape;\n }\n\n return out;\n}\n\nexport const allConfig: KernelConfig = {\n kernelName: All,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: all as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2021 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n
 *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {Any, AnyAttrs, AnyInputs, backend_util, KernelConfig, KernelFunc, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {permuteAxesAndTranspose} from './kernel_utils';\n\nlet wasmAny: (xId: number, reduceSize: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n wasmAny = backend.wasm.cwrap(Any, null /*void*/, ['number, number, number']);\n}\n\nfunction any(args: {backend: BackendWasm, inputs: AnyInputs, attrs: AnyAttrs}):\n TensorInfo {\n const {backend,
 inputs, attrs} = args;\n const {axis, keepDims} = attrs;\n const {x} = inputs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n let inputId = xId;\n let input = x;\n\n const {transposed, axes, originalAxes, inputWasTransposed} =\n   permuteAxesAndTranspose(x, axis, backend);\n\n if (inputWasTransposed) {\n const transposedId = backend.dataIdMap.get(transposed.dataId).id;\n input = transposed;\n inputId =

transposedId;\n }\n\n const inputRank = input.shape.length;\n backend_util.assertAxesAreInnerMostDims('any', axes, inputRank);\n const [outShape, reduceShape] =\n backend_util.computeOutAndReduceShapes(input.shape, axes);\n const reduceSize = util.sizeFromShape(reduceShape);\n\n const out = backend.makeOutput(outShape, x.dtype);\n if (util.sizeFromShape(input.shape) !== 0) {\n   const outId = backend.dataIdMap.get(out.dataId).id;\n wasmAny(inputId, reduceSize, outId);\n }\n\n if (inputWasTransposed) {\n   // dispose of the transposed tensor.\n   backend.disposeData(transposed.dataId);\n }\n\n if (keepDims) {\n   // reshape\n   const newShape = backend_util.expandShapeToKeepDim(out.shape, originalAxes);\n   out.shape = newShape;\n }\n\n return out;\n}\n\nexport const anyConfig: KernelConfig = {\n kernelName: Any,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: any as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the
 License.\n *
==\n */\n\nimport {ArgMax, ArgMaxAttrs, ArgMaxInputs, KernelConfig, KernelFunc, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {permuteAxesAndTranspose} from './kernel_utils';\nimport {CppDType} from './types';\n\nlet wasmFunc: (\n   xId: number, dtype: number, outerSize: number, innerSize: number,\n   outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmFunc = backend.wasm.cwrap(ArgMax, null /* void */, [\n   'number', // x_id\n   'number', // dtype\n 'number', // outer_size\n   'number', // inner_size\n   'number'   // out_id\n]);\n}\n\nfunction argmax(\n   args: {inputs: ArgMaxInputs, backend: BackendWasm, attrs: ArgMaxAttrs}) {\n const {backend, inputs, attrs} = args;\n const {axis} = attrs as {} as ArgMaxAttrs;\n const {x} = inputs as {} as ArgMaxInputs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n
  let inputId = xId;\n let input = x;\n\n const {transposed, axes, inputWasTransposed} =\n permuteAxesAndTranspose(x, axis, backend);\n\n if (inputWasTransposed) {\n   const transposedId = backend.dataIdMap.get(transposed.dataId).id;\n   if (transposedId !== xId) {\n   // transpose was not a no-op. We will need to dispose of this\n   // once we are done.\n   input = transposed;\n   inputId = transposedId;\n   }\n }\n\n const outShape = input.shape.slice(0, -1);\n const out = backend.makeOutput(outShape, 'int32');\n const outId = backend.dataIdMap.get(out.dataId).id;\n const outerSize = util.sizeFromShape(out.shape);\n const innerSize = input.shape[axes[0]];\n wasmFunc(inputId, CppDType[input.dtype], outerSize, innerSize, outId);\n\n if (inputWasTransposed) {\n   // dispose of the transposed tensor.\n   backend.disposeData(transposed.dataId);\n }\n\n return out;\n}\n\nexport const argMaxConfig: KernelConfig = {\n kernelName: ArgMax,\n backendName: 'wasm',\n
  kernelFunc: argmax as {} as KernelFunc,\n setupFunc: setup\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n */\n\nimport {AvgPool, AvgPoolAttrs, AvgPoolInputs, backend_util, KernelConfig, KernelFunc, Tensor4D} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmAvgPool: (\n

xId: number, batchSize: number, inputHeight: number, inputWidth: number,\n filterHeight: number, filterWidth: number, padTop: number, padRight: number,\n padBottom: number, padLeft: number, strideHeight: number,\n strideWidth: number, channels: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmAvgPool = backend.wasm.cwrap(AvgPool, null /* void */, [\n 'number', // xId\n 'number', // batchSize\n 'number', // inputHeight\n 'number', // inputWidth\n 'number', // filterHeight\n 'number', // filterWidth\n 'number', // padTop\n 'number', // padRight\n 'number', // padBottom\n 'number', // padLeft\n 'number', // strideHeight\n 'number', // strideWidth\n 'number', // channels\n 'number', // outId\n]);\n}\n\nfunction avgPool(\n args: {inputs: AvgPoolInputs, backend: BackendWasm, attrs: AvgPoolAttrs}) {\n const {inputs, attrs, backend} = args;\n\n const x = inputs.x as Tensor4D;\n const xId = backend.dataIdMap.get(x.dataId).id;\n\n const {filterSize, strides, pad, dimRoundingMode} = attrs;\n const convInfo = backend_util.computePool2DInfo(\n x.shape, filterSize, strides, 1 /* dilations */, pad, dimRoundingMode);\n\n const filterHeight = convInfo.filterHeight;\n const filterWidth = convInfo.filterWidth;\n const padTop = convInfo.padInfo.top;\n const padRight = convInfo.padInfo.right;\n const padBottom = convInfo.padInfo.bottom;\n const padLeft = convInfo.padInfo.left;\n const strideHeight = convInfo.strideHeight;\n const strideWidth = convInfo.strideWidth;\n const channels = convInfo.inChannels;\n\n if (convInfo.dataFormat !== 'channelsLast') {\n throw new Error(\n `wasm backend does not support dataFormat:'` +\n `${convInfo.dataFormat}'. Please use 'channelsLast'.`);\n }\n\n if (convInfo.dilationWidth !== 1 || convInfo.dilationHeight !== 1) {\n throw new Error(\n `was backend only supports average pooling with dilation = [1, 1],\n ` +\n `got [${convInfo.dilationHeight}, ${convInfo.dilationWidth}].`);\n }\n\n const out = backend.makeOutput(convInfo.outShape, 'float32');\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n wasmAvgPool(\n xId, x.shape[0], x.shape[1], x.shape[2], filterHeight, filterWidth,\n padTop, padRight, padBottom, padLeft, strideHeight, strideWidth, channels,\n outId);\n return out;\n}\n\nexport const avgPoolConfig: KernelConfig = {\n kernelName: AvgPool,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: avgPool as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {KernelConfig, KernelFunc, Reshape, ReshapeAttrs, ReshapeInputs, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nexport function reshape(\n args: {inputs: ReshapeInputs, attrs: ReshapeAttrs, backend: BackendWasm}) {\n const {inputs, attrs} = args;\n const {x} = inputs;\n const {shape} = attrs;\n\n const xSize = util.sizeFromShape(x.shape);\n const $shape = util.inferFromImplicitShape(shape, xSize);\n\n util.assert(\n xSize === util.sizeFromShape($shape),\n () => `new shape: ${$shape}, old shape: ${x.shape}. New shape and old ` +\n `shape must have the same number of elements.`);\n\n // Backend needs to track refCount for the dataId for reshape op\n args.backend.incRef(x.dataId);\n return {dataId: x.dataId, shape: $shape, dtype: x.dtype};\n}\n\nexport const reshapeConfig: KernelConfig = {\n kernelName: Reshape,\n backendName: 'wasm',\n kernelFunc: reshape as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language

governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {BatchMatMul, BatchMatMulAttrs, BatchMatMulInputs, KernelConfig, KernelFunc, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {reshape} from './Reshape';\n\nlet wasmBatchMatMul: (\n aId: number, aShape: Uint8Array, aShapeSize: number, bId: number,\n bShape: Uint8Array, bShapeSize: number, transposeA: boolean,\n transposeB: boolean, outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmBatchMatMul = backend.wasm.cwrap(BatchMatMul, null /* void */, [\n 'number', // a_id\n 'array', // a_shape\n 'number', // a_shape.length\n 'number', // b_id\n 'array', // b_shape\n 'number', // b_shape.length\n 'number', // transpose_a\n 'number', // transpose_b\n 'number' // out_id\n]);\n}\n\nfunction batchMatMul(args: {\n inputs: BatchMatMulInputs,\n backend: BackendWasm,\n attrs: BatchMatMulAttrs\n}) {\n const {inputs, backend, attrs} = args;\n const {a, b} = inputs;\n const {transposeA, transposeB} = attrs;\n\n if (a.dtype !== 'float32' || b.dtype !== 'float32') {\n throw new Error(\n `BatchMatMul for non non-float32 tensors not yet supported.`);\n }\n\n const aRank = a.shape.length;\n const bRank = b.shape.length;\n\n const innerShapeA = transposeA ? a.shape[aRank - 2] : a.shape[aRank - 1];\n const innerShapeB = transposeB ? b.shape[bRank - 1] : b.shape[bRank - 2];\n\n const outerShapeA = transposeA ? a.shape[aRank - 1] : a.shape[aRank - 2];\n const outerShapeB = transposeB ? b.shape[bRank - 2] : b.shape[bRank - 1];\n\n const outerDimsA = a.shape.slice(0, -2);\n const outerDimsB = b.shape.slice(0, -2);\n\n const batchDimA = util.sizeFromShape(outerDimsA);\n const batchDimB = util.sizeFromShape(outerDimsB);\n\n const batchDimsCompatible =\n batchDimA === batchDimB || batchDimA === 1 || batchDimB === 1;\n\n util.assert(\n aRank >= 2 && bRank >= 2 && batchDimsCompatible,\n () => `Error in matMul: the input batch dimensions must either be the ` +\n `same or at least one input batch dimension must be 1. Got input ` +\n `batch dimensions of (${outerDimsA}) and (${outerDimsB}).`);\n\n const outShapeOuterDims =\n batchDimA > batchDimB ? a.shape.slice(0, -2) : b.shape.slice(0, -2);\n const outShape = outShapeOuterDims.concat([outerShapeA, outerShapeB]);\n\n util.assert(\n innerShapeA === innerShapeB,\n () => `Error in matMul: inner shapes (${innerShapeA}) and (` +\n `${innerShapeB}) of Tensors with shapes ${a.shape} and ` +\n `${b.shape} and transposeA=${transposeA}` +\n ` and transposeB=${transposeB} must match.`);\n\n const a3dShape = transposeA ? [batchDimA, innerShapeA, outerShapeA] :\n [batchDimA, outerShapeA, innerShapeA];\n const b3dShape = transposeB ? [batchDimB, outerShapeB, innerShapeB] :\n [batchDimB, innerShapeB, outerShapeB];\n\n // The rest of the implementation\n is designed to operate on rank-3 tensors\n const a3d = reshape({inputs: {x: a}, backend, attrs: {shape: a3dShape}});\n const b3d = reshape({inputs: {x: b}, backend, attrs: {shape: b3dShape}});\n\n const a3dId = backend.dataIdMap.get(a3d.dataId).id;\n const b3dId = backend.dataIdMap.get(b3d.dataId).id;\n\n const leftDim = transposeA ? a3d.shape[2] : a3d.shape[1];\n const rightDim = transposeB ? b3d.shape[1] : b3d.shape[2];\n const batchDim = Math.max(batchDimA, batchDimB);\n\n const out = backend.makeOutput([batchDim, leftDim, rightDim], a3d.dtype);\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n const aShapeBytes = new Uint8Array(new Int32Array(a3d.shape).buffer);\n const bShapeBytes = new Uint8Array(new Int32Array(b3d.shape).buffer);\n\n wasmBatchMatMul(\n a3dId, aShapeBytes, a3d.shape.length, b3dId, bShapeBytes,\n b3d.shape.length, transposeA, transposeB, outId);\n\n backend.disposeData(a3d.dataId);\n backend.disposeData(b3d.dataId);\n\n out.shape
= outShape;\n return out;\n}\n\nexport const batchMatMulConfig: KernelConfig = {\n kernelName: BatchMatMul,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: batchMatMul as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or

implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n===\n*/\nimport { backend_util, buffer, Slice, slice_util, util } from '@tensorflow/tfjs-core';\nimport { assertNotComplex } from '../cpu_util';\nexport function sliceImpl(vals, begin, size, shape, dtype) {\n const isContinous = slice_util.isSliceContinous(shape, begin, size);\n const length = util.sizeFromShape(size);\n const xStrides = util.computeStrides(shape);\n if (isContinous) {\n const flatOffset = slice_util.computeFlatOffset(begin, xStrides);\n if (dtype === 'string') {\n return vals.slice(flatOffset, flatOffset + length);\n }\n return vals.subarray(flatOffset, flatOffset + length);\n }\n const decodedData = dtype === 'string' ?\n backend_util.fromUint8ToStringArray(vals) :\n vals;\n const inBuf = buffer(shape, dtype, decodedData);\n const outBuf = buffer(size, dtype);\n for (let i = 0; i < outBuf.size; ++i) {\n const outLoc = outBuf.indexToLoc(i);\n const inLoc = outLoc.map((idx, j) => idx + begin[j]);\n outBuf.set(inBuf.get(...inLoc), ...outLoc);\n }\n if (dtype === 'string') {\n return backend_util.fromStringArrayToUint8(outBuf.values);\n }\n return outBuf.values;\n}\nexport function slice(args) {\n const { inputs, backend, attrs } = args;\n const { x } = inputs;\n const { begin, size } = attrs;\n assertNotComplex(x, 'slice');\n const [$begin, $size] = slice_util.parseSliceParams(x, begin, size);\n slice_util.assertParamsValid(x, $begin, $size);\n const vals = backend.data.get(x.dataId).values;\n const outVals = sliceImpl(vals, $begin, $size, x.shape, x.dtype);\n return backend.makeTensorInfo($size, x.dtype, outVals);\n}\nexport const sliceConfig = {\n kernelName: Slice,\n backendName: 'cpu',\n kernelFunc: slice\n};\n//#
sourceMappingURL=data:application/json; base64,eyJ2ZXJzaW9uIjozLCJmaWxlIjoiU2xpY2UuanMiLCJzb3VyY2VSb290IjoiIiwic291cmNlcyI6WyIuLi8uLi8uLi8uLi8uLi8uLi90ZmpzLWJhY2tlbmQtY3B1L3NyYy9rZXJuZWxzL1NsaWNlLnRzIl0sIm5hbWVzIjpbXSwibWFwcGluZ3MiOiJBQUFBOzs7Ozs7Ozs7Ozs7R0FlRztBQU8sRUFBQyxRQUFRLEVBQUUsTUFBTSxFQUFFLEtBQUssRUFBRSxXQUFXLEVBQUUsSUFBSSxFQUFDLE1BQU0sdUJBQXVCO0FBQUMsRUFBQyxvQkFBb0IsRUFBQyxNQUFNLGVBQWU7QUFBQyxFQUFDLFNBQVMsU0FBUyxDQUFDLElBQUksRUFBRSxLQUFLLEVBQUUsSUFBSSxFQUFFLEtBQUssRUFBRSxLQUFLLEVBQUUsS0FBSyxFQUFFO0VBQUMsTUFBTSxVQUFVLEdBQUcsV0FBVyxDQUFDLGlCQUFpQixDQUFDLEtBQUssRUFBRSxLQUFLLEVBQUUsSUFBSSxDQUFDO0VBQUMsTUFBTSxNQUFNLEdBQUcsSUFBSSxDQUFDLGFBQWEsQ0FBQyxJQUFJLENBQUM7RUFBQyxNQUFNLFFBQVEsR0FBRyxJQUFJLENBQUMsY0FBYyxDQUFDLEtBQUssQ0FBQztFQUFDLElBQUksVUFBVSxFQUFFO0lBQUMsTUFBTSxVQUFVLEdBQUcsV0FBVyxDQUFDLGlCQUFpQixDQUFDLEtBQUssRUFBRSxRQUFRLENBQUM7SUFBQyxJQUFJLEtBQUssS0FBSyxRQUFRLEVBQUU7TUFBQyxPQUFPLElBQUksQ0FBQyxLQUFLLENBQUMsVUFBVSxFQUFFLFVBQVUsR0FBRyxNQUFNLENBQUM7SUFBQztJQUFDLE9BQU8sSUFBSSxDQUFDLFFBQVEsQ0FBQyxVQUFVLEVBQUUsVUFBVSxHQUFHLE1BQU0sQ0FBQztFQUFDO0VBQUMsTUFBTSxXQUFXLEdBQUcsS0FBSyxLQUFLLFFBQVEsR0FBRyxFQUFFLFlBQVksQ0FBQyx3QkFBd0IsQ0FBQyxJQUFJLENBQUMsR0FBRyxJQUFJO0VBQUMsTUFBTSxLQUFLLEdBQUcsTUFBTSxDQUFDLEtBQUssRUFBRSxLQUFLLEVBQUUsV0FBVyxDQUFDO0VBQUMsTUFBTSxNQUFNLEdBQUcsTUFBTSxDQUFDLElBQUksRUFBRSxLQUFLLENBQUM7RUFBQyxLQUFLLElBQUksQ0FBQyxHQUFHLENBQUMsRUFBRSxDQUFDLEdBQUcsTUFBTSxDQUFDLElBQUksRUFBRSxFQUFFLENBQUMsRUFBRTtJQUFDLE1BQU0sTUFBTSxHQUFHLE1BQU0sQ0FBQyxVQUFVLENBQUMsQ0FBQyxDQUFDO0lBQUMsTUFBTSxLQUFLLEdBQUcsTUFBTSxDQUFDLEdBQUcsQ0FBQyxDQUFDLEdBQUcsRUFBRSxDQUFDLENBQUMsS0FBSyxHQUFHLEdBQUcsS0FBSyxDQUFDLENBQUMsQ0FBQyxDQUFDO0lBQUMsTUFBTSxDQUFDLEdBQUcsQ0FBQyxLQUFLLENBQUMsR0FBRyxDQUFDLEdBQUcsS0FBSyxDQUFDLEVBQUUsR0FBRyxNQUFNLENBQUM7RUFBQztFQUFDLElBQUksS0FBSyxLQUFLLFFBQVEsRUFBRTtJQUFDLE9BQU8sV0FBVyxDQUFDLHdCQUF3QixDQUFDLE1BQU0sQ0FBQyxNQUFNLENBQUM7RUFBQztFQUFDLE9BQU8sTUFBTSxDQUFDLE1BQU07QUFBQztBQUFDLEVBQUMsU0FBUyxLQUFLLENBQUMsSUFBSSxFQUFFO0VBQUMsTUFBTSxFQUFFLE1BQU0sRUFBRSxPQUFPLEVBQUUsS0FBSyxFQUFDLEdBQUcsSUFBSTtFQUFDLE1BQU0sRUFBRSxDQUFDLEVBQUMsR0FBRyxNQUFNO0VBQUMsTUFBTSxFQUFFLEtBQUssRUFBRSxJQUFJLEVBQUMsR0FBRyxLQUFLO0VBQUMsZ0JBQWdCLENBQUMsQ0FBQyxFQUFFLE9BQU8sQ0FBQztFQUFDLE1BQU0sQ0FBQyxNQUFNLEVBQUUsS0FBSyxDQUFDLEdBQUcsVUFBVSxDQUFDLGlCQUFpQixDQUFDLENBQUMsRUFBRSxLQUFLLEVBQUUsSUFBSSxDQUFDO0VBQUMsVUFBVSxDQUFDLGlCQUFpQixDQUFDLENBQUMsRUFBRSxNQUFNLEVBQUUsS0FBSyxDQUFDO0VBQUMsTUFBTSxJQUFJLEdBQUcsT0FBTyxDQUFDLElBQUksQ0FBQyxHQUFHLENBQUMsQ0FBQyxDQUFDLE1BQU0sQ0FBQyxDQUFDLE1BQU07RUFBQyxNQUFNLE9BQU8sR0FBRyxRQUFRLENBQUMsSUFBSSxFQUFFLE1BQU0sRUFBRSxLQUFLLEVBQUUsQ0FBQyxDQUFDLEtBQUssRUFBRSxDQUFDLENBQUMsS0FBSyxDQUFDO0VBQUMsT0FBTyxPQUFPLENBQUMsY0FBYyxDQUFDLEtBQUssRUFBRSxDQUFDLENBQUMsS0FBSyxFQUFFLE9BQU8sQ0FBQztBQUFDO0FBQUMsRUFBQyxPQUFPLE1BQU0sV0FBVyxHQUFHO0VBQUMsVUFBVSxFQUFFLEtBQUs7RUFBQyxXQUFXLEVBQUUsS0FBSztFQUFDLFVBQVUsRUFBRTtBQUFLLENBQUM7QUFBQyxFQUFDLFNBQVMsQ0FBQyxDQUFDO0FBQUMsRUFBQyJ9

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ViYXJyYXkoZmxhdE9mZnNldCwgZmxhdE9mZnNldCArIHV0aWwuc2l6ZUZyb21TaGFwZShzaXplXykpKTtcbiAg
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endJ; j++) {\n const xOffset = i * xStride1 + j * xStride2 + beginK;\n outVals.set(xVals.subarray(xOffset, xOffset + size[2]), outOffset);\n outOffset += size[2];\n }\n }\n}\n\nfunction slice4d(\n xVals: backend_util.TypedArray, xStride1: number, xStride2: number,\n xStride3: number, outVals: backend_util.TypedArray,\n begin: [number, number, number, number],\n size: [number, number, number, number]): void {\n let outOffset = 0;\n const beginI = begin[0];\n const beginJ = begin[1];\n const beginK = begin[2];\n const endI = beginI + size[0];\n const endJ = beginJ + size[1];\n const endK = beginK + size[2];\n const beginL = begin[3];\n\n for (let i = beginI; i < endI; i++) {\n for (let j = beginJ; j < endJ; j++) {\n for (let k = beginK; k < endK; k++) {\n const xOffset = i * xStride1 + j * xStride2 + k * xStride3 + beginL;\n outVals.set(xVals.subarray(xOffset, xOffset + size[3]), outOffset);\n outOffset += size[3];\n }\n }\n }\n}\n\nexport const sliceConfig: KernelConfig = {\n kernelName: Slice,\n backendName: 'wasm',\n kernelFunc: slice as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2021 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==\n */\n\nimport {backend_util, BatchToSpaceND, BatchToSpaceNDAttrs, BatchToSpaceNDInputs, KernelConfig, KernelFunc} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {reshape} from './Reshape';\nimport {slice} from './Slice';\nimport {transpose} from './Transpose';\n\nfunction batchToSpaceND(args: {\n inputs: BatchToSpaceNDInputs,\n backend: BackendWasm,\n attrs: BatchToSpaceNDAttrs\n}) {\n const {inputs, backend, attrs} = args;\n const {x} = inputs;\n const {blockShape, crops} = attrs;\n\n const prod = blockShape.reduce((a, b) => a * b);\n\n const reshaped = backend_util.getReshaped(x.shape, blockShape, prod);\n const permuted = backend_util.getPermuted(reshaped.length, blockShape.length);\n const reshapedPermuted =\n backend_util.getReshapedPermuted(x.shape, blockShape, prod);\n const sliceBeginCoords =\n backend_util.getSliceBeginCoords(crops, blockShape.length);\n const sliceSize =\n backend_util.getSliceSize(reshapedPermuted, crops, blockShape.length);\n\n const xReshaped = reshape({inputs: {x}, backend, attrs: {shape: reshaped}});\n const xTransposed =\n transpose({inputs: {x: xReshaped}, backend, attrs: {perm: permuted}});\n const xTransposedReshaped = reshape(\n {inputs: {x: xTransposed}, backend, attrs: {shape: reshapedPermuted}});\n const result = slice({\n inputs: {x: xTransposedReshaped},\n backend,\n attrs: {begin: sliceBeginCoords,\n size: sliceSize}\n });\n\n backend.disposeData(xReshaped.dataId);\n backend.disposeData(xTransposed.dataId);\n backend.disposeData(xReshaped.dataId);\n\n return result;\n}\n\nexport const batchToSpaceNDConfig: KernelConfig = {\n kernelName: BatchToSpaceND,\n backendName: 'wasm',\n kernelFunc: batchToSpaceND as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==\n */\n\nimport {Cast, CastAttrs, CastInputs, KernelConfig, KernelFunc} from '@tensorflow/tfjs-core';\nimport {TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nexport function cast(\n args: {inputs: CastInputs, attrs: CastAttrs, backend: BackendWasm}):\n TensorInfo {\n const {inputs: {x}, attrs: {dtype}, backend} = args;\n const out = backend.makeOutput(x.shape, dtype);\n const inVals =

backend.typedArrayFromHeap(x);\n const outVals = backend.typedArrayFromHeap(out);\n outVals.set(inVals);\n return out;\n}\n\nexport const castConfig: KernelConfig = {\n kernelName: Cast,\n backendName: 'wasm',\n kernelFunc: cast as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2021 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You
 may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n
*/\nimport {KernelConfig, Ceil} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\n\nexport const ceilConfig: KernelConfig = createUnaryKernelConfig(Ceil);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n
 *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n
/\n\nimport {ClipByValue, ClipByValueAttrs, ClipByValueInputs, KernelConfig, KernelFunc} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmClip: (xId: number, min: number, max: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmClip = backend.wasm.cwrap(ClipByValue, null / void */, [\n   'number', // x_id\n   'number', // min\n   'number', // max\n   'number'   // out_id\n]);\n}\n\nfunction clip(args: {\n inputs: ClipByValueInputs,\n backend: BackendWasm,\n attrs: ClipByValueAttrs\n}) {\n const
 {inputs, backend, attrs} = args;\n const {x} = inputs;\n const {clipValueMin, clipValueMax} = attrs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n const out = backend.makeOutput(x.shape, x.dtype);\n const outId = backend.dataIdMap.get(out.dataId).id;\n wasmClip(xId, clipValueMin, clipValueMax, outId);\n return out;\n}\n\nexport const clipByValueConfig: KernelConfig = {\n kernelName: ClipByValue,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: clip as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF
 ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n
*/\n\nimport {backend_util, Concat, ConcatAttrs, ConcatInputs, KernelConfig, KernelFunc, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\nimport {concatImplCPU} from '../kernel_utils/shared';\nimport {identity} from './Identity';\nimport {reshape} from './Reshape';\n\nexport function concat(\n   args: {inputs: ConcatInputs, backend: BackendWasm, attrs: ConcatAttrs}) {\n const {inputs, backend} = args;\n\n const axis = util.parseAxisParam(args.attrs.axis, inputs[0].shape)[0];\n\n let outShape = backend_util.computeOutShape(inputs.map(t => t.shape), axis);\n\n // Keep only non-empty tensors (ignore tensors with 0 in their shape).\n const $inputs = inputs.filter(t => util.sizeFromShape(t.shape) > 0);\n if ($inputs.length
 === 1) {\n   return identity({inputs: {x: $inputs[0]}, backend});\n }\n\n const out = backend.makeOutput(outShape, inputs[0].dtype);\n\n if (util.sizeFromShape(outShape) === 0) {\n   return out;\n

}\n\n const shapes = $inputs.map(t => t.shape);\n backend_util.assertParamsConsistent(shapes, axis);\n\n if ($inputs[0].dtype === 'string') {\n   // Any concat of n-dimensional tensors across any axis can be reduced to\n   // a concatenation of two-dimensional tensors across the axis 1 by first\n   // partitioning the axes of the original tensors into those less than the\n   // axis to be concatenated and the rest. Then reshape the tensors\n   // into a two-dimensional tensor by collapsing these two sets of axes and\n   // concatenate the resulting matrices across the axis 1, finally reshaping\n   // the result to have the proper shape.\n   const inputs2D = $inputs.map(t => {\n   const innerSize = util.sizeFromShape(t.shape.slice(axis));\n   const shape = [-1, innerSize];\n   return reshape({inputs: {x: t}, backend, attrs: {shape}});\n   });\n\n   const inputsValShapes = inputs2D.map(t => {\n   return {vals: backend.readSync(t.dataId), shape: t.shape};\n   });\n\n   // Concats 2d tensors along axis=1.\n   outShape =\n   backend_util.computeOutShape(inputs2D.map(t => t.shape), 1 /* axis */);\n   const simplyConcat = inputs2D[0].shape[0] === 1;\n   const outVals = concatImplCPU(\n inputsValShapes, outShape, inputs[0].dtype,\n   simplyConcat) as string[];\n\n   const finalOutShape =\n   backend_util.computeOutShape($inputs.map(t => t.shape), axis);\n\n   out.shape = finalOutShape;\n const outData = backend.dataIdMap.get(out.dataId);\n   outData.stringBytes = backend_util.fromStringArrayToUint8(outVals);\n\n   inputs2D.forEach(t => backend.disposeData(t.dataId));\n\n return out;\n }\n\n const batchDim = util.sizeFromShape($inputs[0].shape.slice(0, axis));\n let sumInnerDims = 0;\n const innerDims = $inputs.map(input => {\n   const innerDim = util.sizeFromShape(input.shape.slice(axis));\n   sumInnerDims += innerDim;\n   return innerDim;\n });\n const inVals = $inputs.map(input => backend.typedArrayFromHeap(input));\n const outVals = backend.typedArrayFromHeap(out);\n for (let b = 0; b < batchDim; b++) {\n   let outOffset = b * sumInnerDims;\n   for (let i = 0; i < inVals.length; i++) {\n   const innerDim = innerDims[i];\n   const inOffset = b * innerDim;\n   const vals = inVals[i].subarray(inOffset, inOffset + innerDim);\n   outVals.set(vals, outOffset);\n   outOffset += innerDim;\n   }\n }\n return out;\n}\n\nexport const concatConfig: KernelConfig = {\n kernelName: Concat,\n backendName: 'wasm',\n kernelFunc: concat as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ===\n */\nimport { backend_util, util } from '@tensorflow/tfjs-core';\nexport function concatImpl(inputs, outShape, dtype, simplyConcat) {\n   const outVals = util.getArrayFromDType(dtype, util.sizeFromShape(outShape));\n   if (simplyConcat && dtype !== 'string') {\n   // Use built-in TypedArray.set() method for speed.\n   let offset = 0;\n   inputs.forEach(input => {\n   const size = util.sizeFromShape(input.shape);\n   outVals.set(input.vals, offset);\n   offset += size;\n   });\n   }\n   else {\n   let colOffset = 0;\n   inputs.forEach(input => {\n   const decodedData = dtype === 'string' ?\n   backend_util.fromUint8ToStringArray(input.vals) :\n   input.vals;\n   let tIdx = 0;\n   for (let row = 0; row < input.shape[0]; ++row) {\n   const resIdx = row * outShape[1] + colOffset;\n   for (let col = 0; col < input.shape[1]; ++col) {\n   outVals[resIdx + col] = decodedData[tIdx++];\n   }\n   }\n   colOffset += input.shape[1];\n   });\n   }\n   return outVals;\n}\n//# sourceMappingURL=data:application/json; base64,eyJ2ZXJzaW9uIjozLCJmaWxlIjoiQ29uY2F0X2ltcGwuanMiLCJzb3VyY2VSb290IjoiIiwic291cmNlcyI6WyIuLi8uLi8uLi8uLi8uLi8uLi90ZmpzLWJhY2tlbmQtY3B1L3NyYy9rZXJuZWxzL0NvbmNhdF9pbXBsLnRzIl0sIm5hbWVzIjpbXSwibWFwcGluZ3MiOiJBQUFBOzs7OztzOzs7OzsyOzs7OzsyOzs7Ozsy

xFQUFFLFlBQXFCO0lBQ3hDLE1BQU0sT0FBTyxHQUFHLElBQUksQ0FBQyxpQkFBaUIsQ0FBQyxLQUFLL
EVBQUUsSUFBSSxDQUFDLGFBQWEsQ0FBQyxRQUFRLENBQUMsQ0FBQyxDQUFDO0lBRTVFLElBQUk
sWUFBWSxJQUFJLEtBQUssS0FBSyxRQUFRLEVBQUU7UUFDdEMsa0RBQWtEO1FBQ2xELELElBQUksTUFB
TSxHQUFHLENBQUMsQ0FBQztRUNmLE1BQU0sQ0FBQyxPQUFPLENBQUMsS0FBSyxDQUFDLEVBQU
U7WUFDckIsTUFBTSxJQUFJLEdBQUcsSUFBSSxDQUFDLGFBQWEsQ0FBQyxLQUFLLLENBQUMsS0FBSy
xDQUFDLENBQUM7WUFFNUMsSUFBSSxHQUFHLENBQUMsQ0FBQyxLQUFLLENBQUMsS0FBSyxDQUFDLElsQ0FBQyxyQkFBQyxDQUFDLEVB
QUUsTUFBTSxTSxJQUFJLEtBQUssS0FBSyxRQUFRLENBQUMsQ0FBQztRUNqQixxDQUFDLENBQ
QUFLLEtBQUssUUFBUSxDQUFDLENBQUM7Z0JBQ3BCLEtBQUssQ0FBQyxJQUFJLEtBQUssS0FBSyxRQUFRLENBQUMsQ0FBQyxDQUFDLENBQUMsQ0FBQyxDQUFDLENBQUMsQ0FBQyxDQ
ENBQUMsSUFBb0IsQ0FBQyxDQUFDLENBQUM7Z0JBQ2pCLEtBQUssQ0FBQyxJQUFJLEtBQUssS0FBSyxRQUFRLENBQUMsQ0FBQyxDQUFDLENBQUMsQ0FBQyxDQUFDLENBQUMsQ0FDCLElBQUksSUFBSSxLQUFLLEtBQUssUUFBUSxDQUFDLENBQUMsQ0FBQyxDQUFDLENBQUMsQ0FBQyxDQUFDLENBQUMsQ0FBQ
F
QUFFLEdBQUcsR0FBRyxLQUFLLENBQUMsS0FBSyxDQUFDLENBQUMsQ0FBQyxDQUFDLENBQUMsQ0FBQyxDQUFDLENBQUMsQ0FBQ
BRyxFQUFFO2dCQUM3QyxNQUFNLE1BQU0sR0FBRyxHQUFHLEdBQUcsUUFBQyxDQUFDLENBQUMsQ0FBQyxDQ0FBQyxDQ
0FBQyxHQUFHLFNBQUMsQ0FBQyxDQ0FBQyxDQ0FBQyxD

gICAgIGZvciAobGV0IGNvbCA9IDA7IGNvbCA8IGlucHV0LnNoYXBlWzFdOyArK2NvbCkge1xuICAgICAgICAgIGICAgIG91dFZhbHNbcmVzSWR4ICsgY29sXSA9IGRlY29kZWREYXRhW3RJZHgrK107XG4gICAgICAgIH1cbiAgICAgIH1cblxuICAgICAgY29sT2Zmc2V0ICs9IGlucHV0LnNoYXBlWzFdO1xuICAgICAgY29sT2Zmc2V0ICs9IDE7XG5cbiAgICAgIGlmIChjb2xPZmZzZXQgPT09IGlucHV0LnNoYXBlWzFdKSB7XG4gICAgICAgIGNvbE9mZnNldCA9IDA7XG4gICAgICAgIHJvdyArPSAxO1xuICAgICAgfVxuICAgIH1cbiAgfVxuXG4gIHJldHVybiBvdXQ7XG59XG5cbmV4cG9ydCBjb25zdCBjb252RGVjb2RlQ29uZmlnOiBLZXJuZWxDb25maWcgPSB7XG4gIGtlcm5lbE5hbWU6IENvbnYyREJhY2tlbmQsXG4gIGJhY2tlbmROYW1lOiAnd2FzbScsXG4gIGtlcm5lbEZ1bmM6IGNvbnYyRGVjb2RlXG59O1xuIiXX0=","/**\n
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 Conv2D, Conv2DAttrs, Conv2DInputs, KernelConfig, KernelFunc, Tensor4D} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmConv2d: (\n   xId: number, batchSize: number, inputHeight: number, inputWidth: number,\n   filterId: number, filterHeight: number, filterWidth: number, padTop: number,\n   padRight: number, padBottom: number, padLeft: number, isSamePad: number,\n   dilationHeight: number, dilationWidth: number, strideHeight: number,\n   strideWidth: number, inputChannels: number, outputChannels: number,\n   outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmConv2d = backend.wasm.cwrap(Conv2D, null /* void */, [\n   'number', // xId\n   'number', // batchSize\n   'number', // inputHeight\n   'number', // inputWidth\n   'number', // filterId\n   'number', // filterHeight\n   'number', // filterWidth\n   'number', // padTop\n   'number', // padRight\n   'number', // padBottom\n   'number', //
 padLeft\n   'number', // isSamePad\n   'number', // dilationHeight\n   'number', // dilationWidth\n   'number', // strideHeight\n   'number', // strideWidth\n   'number', // inputChannels\n   'number', // outputChannels\n   'number', // outId\n]);\n}\n\nfunction conv2d(\n   args: {inputs: Conv2DInputs, backend: BackendWasm, attrs: Conv2DAttrs}) {\n const {inputs, attrs, backend} = args;\n\n const {x, filter} = inputs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n const filterId = backend.dataIdMap.get(filter.dataId).id;\n\n const {strides, dilations, pad, dimRoundingMode, dataFormat} = attrs;\n const $dataFormat = backend_util.convertConv2DDataFormat(dataFormat);\n const convInfo = backend_util.computeConv2DInfo(\n   (x as Tensor4D).shape, (filter as Tensor4D).shape, strides, dilations,\n   pad, dimRoundingMode, false, $dataFormat);\n\n const filterHeight = convInfo.filterHeight;\n const filterWidth = convInfo.filterWidth;\n const padTop = convInfo.padInfo.top;\n
  const padRight = convInfo.padInfo.right;\n const padBottom = convInfo.padInfo.bottom;\n const padLeft = convInfo.padInfo.left;\n const dilationHeight = convInfo.dilationHeight;\n const dilationWidth = convInfo.dilationWidth;\n const strideHeight = convInfo.strideHeight;\n const strideWidth = convInfo.strideWidth;\n const inputChannels = convInfo.inChannels;\n const outputChannels = convInfo.outChannels;\n const isSamePad = convInfo.padInfo.type === 'SAME' ? 1 : 0;\n\n if (convInfo.dataFormat !== 'channelsLast') {\n   throw new Error(\n   `wasm backend Conv2D does not support dataFormat:` +\n   `${convInfo.dataFormat}'. Please use 'channelsLast'.`);\n }\n\n const out = backend.makeOutput(convInfo.outShape, 'float32');\n const outId = backend.dataIdMap.get(out.dataId).id;\n wasmConv2d(\n   xId, x.shape[0], x.shape[1], x.shape[2], filterId, filterHeight,\n   filterWidth, padTop, padRight, padBottom, padLeft, isSamePad,\n   dilationHeight,
 dilationWidth, strideHeight, strideWidth, inputChannels,\n   outputChannels, outId);\n return out;\n}\n\nexport const conv2DConfig: KernelConfig = {\n kernelName: Conv2D,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: conv2d as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing,

software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport
{backend_util, Conv2DBackpropInput, Conv2DBackpropInputAttrs, Conv2DBackpropInputInputs, KernelConfig, KernelFunc, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmConv2DBackpropInput: (\n dyId: number, filterId: number, batchSize: number, filterHeight: number,\n filterWidth: number, inHeight: number, inWidth: number, inChannels: number,\n outHeight: number, outWidth: number, outChannels: number,\n strideHeight: number, strideWidth: number, topPad: number, leftPad: number,\n fltS0: number, fltS1: number, fltS2: number, xBatchStride: number,\n xRowStride: number, xColStride: number, xChannelStride: number,\n yBatchStride: number, yRowStride: number, yColStride: number,\n yChannelStride: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n wasmConv2DBackpropInput = backend.wasm.cwrap(Conv2DBackpropInput, null, [\n 'number', // dyId\n 'number', // filterId\n
'number', // batchSize\n 'number', // filterHeight\n 'number', // filterWidth\n 'number', // inHeight\n 'number', // inWidth\n 'number', // inChannels\n 'number', // outHeight\n 'number', // outWidth\n 'number', // outChannels\n 'number', // strideHeight\n 'number', // strideWidth\n 'number', // topPad\n 'number', // leftPad\n 'number', // fltS0\n 'number', // fltS1\n 'number', // fltS2\n 'number', // xBatchStride\n 'number', // xRowStride\n 'number', // xColStride\n 'number', // xChannelStride\n 'number', // yBatchStride\n 'number', // yRowStride\n 'number', // yColStride\n 'number', // yChannelStride\n 'number', // outId\n]);\n}\n\nfunction conv2DBackpropInput(args: {\n backend: BackendWasm,\n inputs: Conv2DBackpropInputInputs,\n attrs: Conv2DBackpropInputAttrs\n}): TensorInfo {\n const {backend, inputs, attrs} = args;\n const {dy, filter} = inputs;\n const {strides, pad, dataFormat,
dimRoundingMode, inputShape} = attrs;\n\n const dilations = 1;\n\n const $dataFormat = backend_util.convertConv2DDataFormat(dataFormat);\n const convInfo = backend_util.computeConv2DInfo(\n inputShape, filter.shape as [number, number, number, number], strides,\n dilations, pad, dimRoundingMode, false /* depthwise */, $dataFormat);\n const {\n batchSize,\n filterHeight,\n filterWidth,\n inChannels,\n inHeight,\n inWidth,\n outChannels,\n outHeight,\n outWidth,\n strideHeight,\n strideWidth\n } = convInfo;\n\n const topPad = filterHeight - 1 - convInfo.padInfo.top;\n const leftPad = filterWidth - 1 - convInfo.padInfo.left;\n\n const isChannelsLast = convInfo.dataFormat === 'channelsLast';\n const dxStrides = util.computeStrides(convInfo.inShape);\n const dyStrides = util.computeStrides(dy.shape);\n const [fltS0, fltS1, fltS2] = util.computeStrides(filter.shape);\n const xBatchStride = dxStrides[0];\n const xRowStride = isChannelsLast
? dxStrides[1] : dxStrides[2];\n const xColStride = isChannelsLast ? dxStrides[2] : 1;\n const xChannelStride = isChannelsLast ? 1 : dxStrides[1];\n const yBatchStride = dyStrides[0];\n const yRowStride = isChannelsLast ? dyStrides[1] : dyStrides[2];\n const yColStride = isChannelsLast ? dyStrides[2] : 1;\n const yChannelStride = isChannelsLast ? 1 : dyStrides[1];\n\n const out = backend.makeOutput(convInfo.inShape, 'float32');\n const outId = backend.dataIdMap.get(out.dataId).id;\n const dyId = backend.dataIdMap.get(dy.dataId).id;\n const filterId = backend.dataIdMap.get(filter.dataId).id;\n\n wasmConv2DBackpropInput(\n dyId, filterId, batchSize,
filterHeight, filterWidth, inHeight, inWidth,\n inChannels, outHeight, outWidth, outChannels, strideHeight, strideWidth,\n topPad, leftPad, fltS0, fltS1, fltS2, xBatchStride, xRowStride,\n xColStride, xChannelStride, yBatchStride, yRowStride, yColStride,\n yChannelStride, outId);\n return out;\n}\n\nexport
const conv2DBackpropInputConfig: KernelConfig = {\n kernelName: Conv2DBackpropInput,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: conv2DBackpropInput as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or

agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {Cos, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\n\nexport const cosConfig: KernelConfig = createUnaryKernelConfig(Cos);\n","/**\n * @license\n * Copyright 2021 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\nimport {Cosh, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\n\nexport const coshConfig: KernelConfig = createUnaryKernelConfig(Cosh);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {CropAndResize, CropAndResizeAttrs, CropAndResizeInputs, KernelConfig, KernelFunc, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {cast} from './Cast';\n\n// Must match enum in CropAndResize.cc\nenum InterpolationMethod {\n bilinear = 0,\n nearest = 1\n}\n\nlet wasmCropAndResize: (\n   imagesId: number, boxesId: number, boxIndId: number, numBoxes: number,\n   imagesShape: Uint8Array, cropHeight: number, cropWidth: number,\n   method: number, extrapolationValue: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n wasmCropAndResize = backend.wasm.cwrap(CropAndResize, null /*void*/, [\n   'number', // imagesId\n   'number', // boxesId\n   'number', // boxIndId\n   'number', // numBoxes\n   'array',   // images shape\n   'number', // cropHeight\n   'number', // cropWidth\n   'number', // method\n   'number', // extrapolation value\n   'number'   // out id\n]);\n}\n\nfunction cropAndResize(args: {\n backend: BackendWasm,\n inputs: CropAndResizeInputs,\n attrs: CropAndResizeAttrs\n}): TensorInfo {\n const {backend, inputs, attrs} = args;\n const {method, extrapolationValue, cropSize} = attrs;\n const {image, boxes, boxInd} = inputs;\n\n const numBoxes = boxes.shape[0];\n\n const [cropHeight, cropWidth] = cropSize as [number, number];\n const outShape = [numBoxes, cropHeight, cropWidth, image.shape[3]];\n\n let imagesData = backend.dataIdMap.get(image.dataId);\n let castedData;\n if (image.dtype !== 'float32') {\n   castedData = cast({backend, inputs: {x: image}, attrs: {dtype: 'float32'}});\n   imagesData = backend.dataIdMap.get(castedData.dataId);\n }\n\n const imagesId = imagesData.id;\n const boxesId = backend.dataIdMap.get(boxes.dataId).id;\n const boxIndId = backend.dataIdMap.get(boxInd.dataId).id;\n\n const out = backend.makeOutput(outShape, 'float32');\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n const imagesShapeBytes = new Uint8Array(new Int32Array(image.shape).buffer);\n\n wasmCropAndResize(\n   imagesId, boxesId, boxIndId, numBoxes, imagesShapeBytes, cropHeight,\n   cropWidth,\n   InterpolationMethod[method as {} as keyof typeof InterpolationMethod],\n   extrapolationValue, outId);\n\n if (castedData != null) {\n   backend.disposeData(castedData.dataId);\n }\n\n return out;\n}\n\nexport const cropAndResizeConfig: KernelConfig = {\n kernelName: CropAndResize,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: cropAndResize as {} as KernelFunc\n};\n","/**\n *

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]);\n}\n\nexport function depthToSpace(args: {\n  backend: BackendWasm,\n  inputs: DepthToSpaceInputs,\n
attrs: DepthToSpaceAttrs\n}): TensorInfo {\n  const {backend, inputs, attrs} = args;\n  const {x} = inputs;\n  const
{blockSize, dataFormat} = attrs;\n\n  const batchSize = x.shape[0];\n  const inputHeight = (dataFormat ===
'NHWC') ? x.shape[1] : x.shape[2];\n  const inputWidth = (dataFormat === 'NHWC') ? x.shape[2] : x.shape[3];\n
const inputDepth = (dataFormat === 'NHWC') ? x.shape[3] : x.shape[1];\n\n  const outputHeight = inputHeight *
blockSize;\n  const outputWidth = inputWidth * blockSize;\n  const outputDepth = inputDepth / (blockSize *
blockSize);\n\n  const outputShape = (dataFormat === 'NHWC') ?\n      [batchSize, outputHeight, outputWidth,
outputDepth] :\n      [batchSize, outputDepth, outputHeight, outputWidth];\n\n  const out =
backend.makeOutput(outputShape, 'float32');\n\n  const xData = backend.dataIdMap.get(x.dataId);\n  const xId =
xData.id;\n  const xStridesBytes
 =\n      new Uint8Array(new Int32Array(util.computeStrides(x.shape)).buffer);\n\n  const outputShapeBytes = new
Uint8Array(new Int32Array(outputShape).buffer);\n  const outStridesBytes =\n      new Uint8Array(new
Int32Array(util.computeStrides(outputShape)).buffer);\n\n  const outId = backend.dataIdMap.get(out.dataId).id;\n
const channelsLast = dataFormat === 'NHWC' ? 1 : 0;\n  wasmDepthToSpace(\n      xId, blockSize, channelsLast,
xStridesBytes, x.shape.length - 1,\n      outputShapeBytes, outStridesBytes, outputShape.length, outId);\n\n  return
out;\n}\n\nexport const depthToSpaceConfig: KernelConfig = {\n  kernelName: DepthToSpace,\n  backendName:
'wasm',\n  setupFunc: setup,\n  kernelFunc: depthToSpace as {} as KernelFunc\n};\n","/**\n * @license\n *
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\"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the
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 at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in
writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT
WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific
language governing permissions and\n * limitations under the License.\n *
==========================================================================\n
*/\n\nimport {backend_util, DepthwiseConv2dNative, DepthwiseConv2dNativeAttrs,
DepthwiseConv2dNativeInputs, KernelConfig, KernelFunc, Tensor4D} from '@tensorflow/tfjs-core';\n\nimport
{BackendWasm} from '../backend_wasm';\n\nlet wasmDepthwiseConv2d: (\n    xId: number, batchSize: number,
inputHeight: number, inputWidth: number,\n    filterId: number, filterHeight: number, filterWidth: number, padTop:
number,\n    padRight: number, padBottom: number, padLeft: number, isSamePad: number,\n    dilationHeight:
number, dilationWidth:
 number, strideHeight: number,\n    strideWidth: number, inputChannels: number, outputChannels: number,\n
outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n  wasmDepthwiseConv2d =\n
backend.wasm.cwrap(DepthwiseConv2dNative, null /* void */, [\n      'number',  // xId\n      'number',  //
batchSize\n      'number',  // inputHeight\n      'number',  // inputWidth\n      'number',  // filterId\n      'number',  //
filterHeight\n      'number',  // filterWidth\n      'number',  // padTop\n      'number',  // padRight\n      'number',  //
padBottom\n      'number',  // padLeft\n      'number',  // isSamePad\n      'number',  // dilationHeight\n
'number',  // dilationWidth\n      'number',  // strideHeight\n      'number',  // strideWidth\n      'number',  //
inputChannels\n      'number',  // outputChannels\n      'number',  // outId\n    ]);\n}\n\nfunction
depthwiseConv2d(args: {\n  inputs: DepthwiseConv2dNativeInputs,\n
 backend: BackendWasm,\n  attrs: DepthwiseConv2dNativeAttrs\n}) {\n  const {inputs, attrs, backend} = args;\n\n
const {x, filter} = inputs;\n  const xId = backend.dataIdMap.get(x.dataId).id;\n  const filterId =
backend.dataIdMap.get(filter.dataId).id;\n\n  const {strides, dilations, pad, dimRoundingMode} = attrs;\n\n  const
$dilations = dilations == null ? [1, 1] : dilations;\n\n  const convInfo = backend_util.computeConv2DInfo(\n      (x as
Tensor4D).shape, (filter as Tensor4D).shape, strides,\n      ($dilations as number | [number, number]), pad,
dimRoundingMode,\n      true /* depthwise */);\n\n  const filterHeight = convInfo.filterHeight;\n  const filterWidth =
convInfo.filterWidth;\n  const padTop = convInfo.padInfo.top;\n  const padRight = convInfo.padInfo.right;\n  const
padBottom = convInfo.padInfo.bottom;\n  const padLeft = convInfo.padInfo.left;\n  const dilationHeight =
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convInfo.dilationHeight;\n const dilationWidth = convInfo.dilationWidth;\n const strideHeight = convInfo.strideHeight;\n
  const strideWidth = convInfo.strideWidth;\n const inputChannels = convInfo.inChannels;\n const outputChannels = convInfo.outChannels;\n const isSamePad = convInfo.padInfo.type === 'SAME' ? 1 : 0;\n\n if (convInfo.dataFormat !== 'channelsLast') {\n   throw new Error(\n   `wasm backend DepthwiseConv2dNative does not support dataFormat:'` +\n   `${convInfo.dataFormat}'. Please use 'channelsLast'.`);\n }\n\n const out = backend.makeOutput(convInfo.outShape, 'float32');\n const outId = backend.dataIdMap.get(out.dataId).id;\n wasmDepthwiseConv2d(\n   xId, x.shape[0], x.shape[1], x.shape[2], filterId, filterHeight,\n   filterWidth, padTop, padRight, padBottom, padLeft, isSamePad,\n   dilationHeight, dilationWidth, strideHeight, strideWidth, inputChannels,\n   outputChannels, outId);\n return out;\n}\n\nexport const depthwiseConv2dNativeConfig: KernelConfig = {\n kernelName: DepthwiseConv2dNative,\n backendName: 'wasm',\n setupFunc: setup,\n
  kernelFunc: depthwiseConv2d as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2021 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
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*/\nimport {Elu, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\n\nexport const eluConfig: KernelConfig = createUnaryKernelConfig(Elu);\n","/**\n * @license\n *
 Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n
*/\nimport {Equal, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from './binary_kernel';\n\nconst supportsFullBroadcast = false;\nexport const equalConfig: KernelConfig =\n createBinaryKernelConfig(Equal, supportsFullBroadcast, 'bool');\n","/**\n * @license\n * Copyright
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*/\nimport {Exp, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\n\nexport const expConfig: KernelConfig = createUnaryKernelConfig(Exp, 'float32');\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache
 License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
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*/\n\nimport {ExpandDims, ExpandDimsAttrs, ExpandDimsInputs, KernelConfig, KernelFunc, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\nimport {reshape} from './Reshape';\n\nexport function expandDims(args: {\n inputs: ExpandDimsInputs,\n attrs: ExpandDimsAttrs,\n backend: BackendWasm\n}) {\n const {inputs, attrs, backend} = args;\n const {input} = inputs;\n const {dim} = attrs;\n\n const inputRank = input.shape.length;\n const newShape = input.shape.slice();\n let $dim = dim;\n if (dim < 0) {\n   // Negative value is counted from the tail of rank.\n util.assert(\n   -(inputRank + 1) <= dim,\n   () => `Axis must be in the interval [${- (inputRank + 1)}, ${\n    inputRank}]`);\n $dim = inputRank + dim + 1;\n }\n newShape.splice($dim, 0, 1);\n\n return reshape({inputs: {x: input}, backend, attrs: {shape: newShape}});\n}\n\nexport const expandDimsConfig: KernelConfig = {\n kernelName: ExpandDims,\n backendName: 'wasm',\n kernelFunc: expandDims as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==\n */\n\nimport {KernelConfig, KernelFunc} from '@tensorflow/tfjs-core';\nimport {Fill, FillAttrs} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nexport function fill(args: {attrs: FillAttrs, backend: BackendWasm}) {\n const {attrs: {shape, value, dtype}, backend} = args;\n const out = backend.makeOutput(shape, dtype);\n const outVals = backend.typedArrayFromHeap(out);\n outVals.fill(value as number);\n return out;\n}\n\nexport const fillConfig: KernelConfig = {\n kernelName: Fill,\n backendName: 'wasm',\n kernelFunc: fill as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==\n */\n\nimport {FlipLeftRight, FlipLeftRightInputs, KernelConfig, KernelFunc, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmFlipLeftRight: (\n   xId: number, batch: number, imageHeight: number, imageWidth: number,\n   numChannels: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmFlipLeftRight = backend.wasm.cwrap(FlipLeftRight, null /* void */, [\n   'number', // xId\n   'number', // batch\n   'number', // imageHeight\n   'number', // imageWidth\n   'number', // numChannels\n   'number', // outId\n]);\n}\n\nexport function flipLeftRight(\n   args: {inputs: FlipLeftRightInputs, backend: BackendWasm}): TensorInfo {\n const {inputs, backend} = args;\n const {image} = inputs;\n\n const out = backend.makeOutput(image.shape, image.dtype);\n const imageId = backend.dataIdMap.get(image.dataId).id;\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n const [batch, imageHeight, imageWidth, numChannels] = image.shape;\n\n wasmFlipLeftRight(\n   imageId, batch, imageHeight, imageWidth, numChannels, outId);\n return out;\n}\n\nexport const flipLeftRightConfig: KernelConfig = {\n kernelName: FlipLeftRight,\n backendName: 'wasm',\n kernelFunc: flipLeftRight as {} as KernelFunc,\n setupFunc: setup\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES

OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\nimport {Floor, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\nexport const floorConfig: KernelConfig = createUnaryKernelConfig(Floor);\n","/**\n * @license\n * Copyright
2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {FloorDiv, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from './binary_kernel';\n\nconst supportsFullBroadcast = false;\nexport const floorDivConfig: KernelConfig =\n createBinaryKernelConfig(FloorDiv, supportsFullBroadcast);\n","/**\n * @license\n * Copyright
2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {FusedBatchNorm, FusedBatchNormAttrs, FusedBatchNormInputs, KernelConfig, KernelFunc, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmBatchNorm: (\n xId: number, meanId: number, varianceId: number, offsetId: number,\n scaleId: number, varianceEpsilon: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n wasmBatchNorm = backend.wasm.cwrap(\n FusedBatchNorm, null /* void */,\n ['number', 'number', 'number', 'number', 'number', 'number', 'number']);\n}\n\nfunction fusedBatchNorm(args: {\n backend: BackendWasm,\n inputs: FusedBatchNormInputs,\n attrs: FusedBatchNormAttrs\n}): TensorInfo {\n const {backend, inputs, attrs} = args;\n const {varianceEpsilon} = attrs;\n const {x, mean, variance, offset, scale} = inputs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n const meanId = backend.dataIdMap.get(mean.dataId).id;\n const varianceId = backend.dataIdMap.get(variance.dataId).id;\n const offsetId = offset != null ? backend.dataIdMap.get(offset.dataId).id : 0;\n const scaleId = scale != null ? backend.dataIdMap.get(scale.dataId).id : 0;\n\n const out = backend.makeOutput(x.shape, x.dtype);\n // Short-circuit zero-sized tensors.\n if (util.sizeFromShape(x.shape) ===
0) {\n return out;\n }\n\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n wasmBatchNorm(\n xId, meanId, varianceId, offsetId, scaleId, varianceEpsilon, outId);\n return out;\n}\n\nexport const fusedBatchNormConfig: KernelConfig = {\n kernelName: FusedBatchNorm,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: fusedBatchNorm as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations
under the License.\n *
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*/\n\nimport {backend_util, FusedConv2D, FusedConv2DAttrs, FusedConv2DInputs, KernelConfig, KernelFunc,
Tensor4D} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport
{FusableActivation} from './types';\n\nlet wasmFusedConv2d:\n    (xId: number, batchSize: number, inputHeight:
number, inputWidth: number,\n     filterId: number, filterHeight: number, filterWidth: number,\n     biasId: number,
padTop: number, padRight: number, padBottom: number,\n     padLeft: number, isSamePad: number,
dilationHeight: number,\n     dilationWidth: number, strideHeight: number, strideWidth: number,\n
inputChannels: number, outputChannels: number, activation: number,\n     preluActivationWeightsId: number,
leakyreluAlpha: number, outId: number) =>\n         void;\n\nfunction setup(backend: BackendWasm) {\n
wasmFusedConv2d = backend.wasm.cwrap(FusedConv2D, null /*
 void */, [\n    'number',  // xId\n    'number',  // batchSize\n    'number',  // inputHeight\n    'number',  // inputWidth\n
'number',  // filterId\n    'number',  // filterHeight\n    'number',  // filterWidth\n    'number',  // biasId\n    'number',  //
padTop\n    'number',  // padRight\n    'number',  // padBottom\n    'number',  // padLeft\n    'number',  // isSamePad\n
 'number',  // dilationHeight\n    'number',  // dilationWidth\n    'number',  // strideHeight\n    'number',  //
strideWidth\n    'number',  // inputChannels\n    'number',  // outputChannels\n    'number',  // activation\n    'number',
// preluActivationWeightsId\n    'number',  // leakyreluAlpha\n    'number',  // outId\n  ]);\n}\n\nfunction
fusedConv2d(args: {\n  inputs: FusedConv2DInputs,\n  backend: BackendWasm,\n  attrs: FusedConv2DAttrs\n})
{\n  const {inputs, attrs, backend} = args;\n  const {x, filter, bias, preluActivationWeights} = inputs;\n  const {\n
strides,\n    pad,\n    dilations,\n
  dataFormat,\n    dimRoundingMode,\n    activation,\n    leakyreluAlpha\n  } = attrs;\n\n  const convInfo =
backend_util.computeConv2DInfo(\n      (x as Tensor4D).shape, (filter as Tensor4D).shape, strides, dilations,\n
pad, dimRoundingMode);\n\n  const fusedActivation =\n      FusableActivation[activation as {} as keyof typeof
FusableActivation];\n  if (fusedActivation == null) {\n    throw new Error(\n        `${activation} activation not yet
supported for FusedConv2D ` +\n        `in the wasm backend.`);\n  }\n\n  const xId =
backend.dataIdMap.get(x.dataId).id;\n  const filterId = backend.dataIdMap.get(filter.dataId).id;\n\n  const
outputChannels = convInfo.outChannels;\n\n  let biasId = 0;\n  if (bias != null) {\n    const biasData =
backend.dataIdMap.get(bias.dataId);\n    if (biasData.shape.length !== 1) {\n      throw new Error(\n
`FusedConv2D only supports rank-1 bias but got ` +\n          `rank ${biasData.shape.length}.`);\n    }\n    if
(biasData.shape[0] !== outputChannels)
 {\n      throw new Error(\n          `FusedConv2D bias shape (${biasData.shape}) does not ` +\n          `match the
number of output channels (${outputChannels})`);\n    }\n    biasId = biasData.id;\n  }\n\n  const filterHeight =
convInfo.filterHeight;\n  const filterWidth = convInfo.filterWidth;\n  const padTop = convInfo.padInfo.top;\n  const
padRight = convInfo.padInfo.right;\n  const padBottom = convInfo.padInfo.bottom;\n  const padLeft =
convInfo.padInfo.left;\n  const dilationHeight = convInfo.dilationHeight;\n  const dilationWidth =
convInfo.dilationWidth;\n  const strideHeight = convInfo.strideHeight;\n  const strideWidth =
convInfo.strideWidth;\n  const inputChannels = convInfo.inChannels;\n  const isSamePad = convInfo.padInfo.type
=== 'SAME' ? 1 : 0;\n  const batchSize = convInfo.batchSize;\n  const inHeight = convInfo.inHeight;\n  const
inWidth = convInfo.inWidth;\n\n  if (dataFormat !== 'NHWC') {\n    throw new Error(\n        `wasm backend
FusedConv2D does not
 support dataFormat:'` +\n        `${dataFormat}'. Please use 'NHWC'.`);\n  }\n\n  const out =
backend.makeOutput(convInfo.outShape, 'float32');\n  const outId = backend.dataIdMap.get(out.dataId).id;\n  const
preluActivationWeightsId = preluActivationWeights == null ?\n      0 :\n
backend.dataIdMap.get(preluActivationWeights.dataId).id;\n\n  wasmFusedConv2d(\n      xId, batchSize, inHeight,
inWidth, filterId, filterHeight, filterWidth,\n      biasId, padTop, padRight, padBottom, padLeft, isSamePad,
dilationHeight,\n      dilationWidth, strideHeight, strideWidth, inputChannels, outputChannels,\n      fusedActivation,
preluActivationWeightsId, leakyreluAlpha || 0, outId);\n\n  return out;\n}\n\nexport const fusedConv2DConfig:
KernelConfig = {\n  kernelName: FusedConv2D,\n  backendName: 'wasm',\n  setupFunc: setup,\n  kernelFunc:
fusedConv2d as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights
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 filterHeight: number, filterWidth: number,\n biasId: number, padTop: number, padRight: number, padBottom: number,\n padLeft: number, isSamePad: number, dilationHeight: number,\n dilationWidth: number, strideHeight: number, strideWidth: number,\n inputChannels: number, outputChannels: number, activation: number,\n preluActivationWeightsId: number, leakyreluAlpha: number, outId: number) =>\n void;\n\nfunction setup(backend: BackendWasm) {\n wasmFusedDepthwiseConv2d =\n backend.wasm.cwrap(FusedDepthwiseConv2D, null /* void */, [\n 'number', // xId\n 'number', // batchSize\n 'number', // inputHeight\n 'number', // inputWidth\n 'number', // filterId\n 'number', // filterHeight\n 'number', // filterWidth\n 'number', // biasId\n 'number', // padTop\n 'number', // padRight\n 'number', // padBottom\n 'number', // padLeft\n 'number', // isSamePad\n
 'number', // dilationHeight\n 'number', // dilationWidth\n 'number', // strideHeight\n 'number', // strideWidth\n 'number', // inputChannels\n 'number', // outputChannels\n 'number', // activation\n 'number', // preluActivationWeightsId\n 'number', // leakyreluAlpha\n 'number', // outId\n]);\n}\n\nfunction fusedDepthwiseConv2d(args: {\n inputs: FusedDepthwiseConv2DInputs,\n backend: BackendWasm,\n attrs: FusedDepthwiseConv2DAttrs\n}) {\n const {inputs, attrs, backend} = args;\n const {x, filter, bias, preluActivationWeights} = inputs;\n const {\n strides,\n pad,\n dilations,\n dataFormat,\n dimRoundingMode,\n activation,\n leakyreluAlpha\n } = attrs;\n\n const convInfo = backend_util.computeConv2DInfo(\n (x as Tensor4D).shape, (filter as Tensor4D).shape, strides, dilations,\n pad, dimRoundingMode, true /* depthwise */);\n\n const fusedActivation =\n FusableActivation[activation
 as {} as keyof typeof FusableActivation];\n if (fusedActivation == null) {\n throw new Error(\n `${activation} activation not yet supported for FusedDepthwiseConv2D ` +\n `in the wasm backend.`);\n }\n\n const xId = backend.dataIdMap.get(x.dataId).id;\n const filterId = backend.dataIdMap.get(filter.dataId).id;\n\n const outputChannels = convInfo.outChannels;\n\n let biasId = 0;\n if (bias != null) {\n const biasData = backend.dataIdMap.get(bias.dataId);\n if (biasData.shape.length !== 1) {\n throw new Error(\n `FusedDepthwiseConv2D only supports rank-1 bias but got ` +\n `rank ${biasData.shape.length}.`);\n }\n if (biasData.shape[0] !== outputChannels) {\n throw new Error(\n `FusedDepthwiseConv2D bias shape (${biasData.shape}) does not ` +\n `match the number of output channels (${outputChannels})`);\n }\n biasId = biasData.id;\n }\n\n const filterHeight = convInfo.filterHeight;\n
 const filterWidth = convInfo.filterWidth;\n const padTop = convInfo.padInfo.top;\n const padRight = convInfo.padInfo.right;\n const padBottom = convInfo.padInfo.bottom;\n const padLeft = convInfo.padInfo.left;\n const dilationHeight = convInfo.dilationHeight;\n const dilationWidth = convInfo.dilationWidth;\n const strideHeight = convInfo.strideHeight;\n const strideWidth = convInfo.strideWidth;\n const inputChannels = convInfo.inChannels;\n const isSamePad = convInfo.padInfo.type === 'SAME' ? 1 : 0;\n const batchSize = convInfo.batchSize;\n const inHeight = convInfo.inHeight;\n const inWidth = convInfo.inWidth;\n\n if (dataFormat !== 'NHWC') {\n throw new Error(\n `wasm backend FusedDepthwiseConv2D does not support dataFormat:` +\n `${dataFormat}'. Please use 'NHWC'.`);\n }\n\n const out = backend.makeOutput(convInfo.outShape, 'float32');\n const outId = backend.dataIdMap.get(out.dataId).id;\n const preluActivationWeightsId = preluActivationWeights

== null ?\n 0 :\n backend.dataIdMap.get(preluActivationWeights.dataId).id;\n\n wasmFusedDepthwiseConv2d(\n xId, batchSize, inHeight, inWidth, filterId, filterHeight, filterWidth,\n biasId, padTop, padRight, padBottom, padLeft, isSamePad, dilationHeight,\n dilationWidth, strideHeight, strideWidth, inputChannels, outputChannels,\n fusedActivation, preluActivationWeightsId, leakyreluAlpha || 0, outId);\n\n return out;\n}\n\nexport const fusedDepthwiseConv2DConfig: KernelConfig = {\n kernelName: FusedDepthwiseConv2D,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: fusedDepthwiseConv2d as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable
law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {gather_util, GatherNd, GatherNdInputs, KernelConfig, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {CppDType} from './types';\n\nlet wasmGatherNd: (\n xId: number, dtype: CppDType, indicesId: number, numSlices: number,\n sliceRank: number, sliceSize: number, strides: Uint8Array, outId: number) =>\n void;\n\nfunction setup(backend: BackendWasm): void {\n wasmGatherNd = backend.wasm.cwrap(GatherNd, null /*void*/, [\n 'number', // xId\n 'number', // dtype\n 'number', // indicesId\n 'number', // numSlices\n 'number', //
sliceRank\n 'number', // sliceSize\n 'array', // strides\n 'number' // outId\n]);\n}\n\nfunction gatherNd(args: {backend: BackendWasm, inputs: GatherNdInputs}):\n TensorInfo {\n const {backend, inputs} = args;\n const {params, indices} = inputs;\n\n const [resultShape, numSlices, sliceSize, strides] =\n gather_util.prepareAndValidate(params, indices);\n\n const out = backend.makeOutput(resultShape, params.dtype);\n if (numSlices === 0) {\n return out;\n }\n\n const indicesShape = indices.shape;\n const sliceRank = indicesShape[indicesShape.length - 1];\n\n const xData = backend.dataIdMap.get(params.dataId);\n const xId = xData.id;\n const indicesData = backend.dataIdMap.get(indices.dataId);\n const indicesId = indicesData.id;\n\n const stridesBytes = new Uint8Array(new Int32Array(strides).buffer);\n\n const outId = backend.dataIdMap.get(out.dataId).id;\n wasmGatherNd(\n xId, CppDType[params.dtype], indicesId, numSlices, sliceRank, sliceSize,\n
stridesBytes, outId);\n\n return out;\n}\n\nexport const gatherNdConfig: KernelConfig = {\n kernelName: GatherNd,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: gatherNd\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {backend_util, GatherV2, GatherV2Attrs, GatherV2Inputs, KernelConfig,
KernelFunc, Tensor, TensorInfo, TypedArray, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {reshape} from './Reshape';\nimport {CppDType} from './types';\n\nlet wasmGather: (\n xId: number, dtype: CppDType, xStrides: Uint8Array, stridesSize: number,\n indicesId: number, batchSize: number, outStrides: Uint8Array,\n outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n wasmGather = backend.wasm.cwrap('Gather', null /*void*/, [\n 'number', // xId\n 'number', // dtype\n 'array', // xStrides\n 'number', // stridesSize\n 'number', // indicesId\n 'number', // batchSize\n 'array', // outStrides\n 'number' // outId\n]);\n}\n\nfunction gatherV2(\n args: {backend: BackendWasm, inputs: GatherV2Inputs, attrs: GatherV2Attrs}):\n TensorInfo {\n const {backend, inputs, attrs} = args;\n const {x,

indices} = inputs;\n const {axis, batchDims} = attrs;\n\n // Throw error when any
 index is out of bound.\n const parsedAxis = util.parseAxisParam(axis, x.shape)[0];\n const indicesVals =
backend.readSync(indices.dataId) as TypedArray;\n const axisDim = x.shape[parsedAxis];\n for (let i = 0; i <
indicesVals.length; ++i) {\n   const index = indicesVals[i];\n   util.assert(\n   index <= axisDim - 1 && index >=
0,\n   () =>\n   `GatherV2: the index value ${index} is not in [0, ${axisDim - 1}]`);\n }\n\n const
shapeInfo = backend_util.segment_util.collectGatherOpShapeInfo(\n   x as Tensor, indices as Tensor, parsedAxis,
batchDims);\n\n const flattenX = reshape({\n   inputs: {x},\n   attrs: {\n   shape: [\n   shapeInfo.batchSize,
shapeInfo.outerSize, shapeInfo.dimSize,\n   shapeInfo.sliceSize\n   ]\n   },\n   backend\n });\n const
indicesSize = util.sizeFromShape(indices.shape);\n const flattenIndex = reshape({\n   inputs: {x: indices},\n   attrs:
{shape: [shapeInfo.batchSize, indicesSize / shapeInfo.batchSize]},\n
    backend\n });\n const flattenOutputShape = [\n   shapeInfo.batchSize, shapeInfo.outerSize, indicesSize /
shapeInfo.batchSize,\n   shapeInfo.sliceSize\n];\n\n const out = backend.makeOutput(flattenOutputShape,
x.dtype);\n if (util.sizeFromShape(x.shape) === 0) {\n   return out;\n }\n const stridesSize = flattenX.shape.length
- 1;\n\n const xData = backend.dataIdMap.get(flattenX.dataId);\n const xId = xData.id;\n\n const indicesData =
backend.dataIdMap.get(flattenIndex.dataId);\n const indicesId = indicesData.id;\n\n const outId =
backend.dataIdMap.get(out.dataId).id;\n\n const xStridesBytes = new Uint8Array(\n   new
Int32Array(util.computeStrides(flattenX.shape)).buffer);\n const outStridesBytes = new Uint8Array(\n   new
Int32Array(util.computeStrides(flattenOutputShape)).buffer);\n\n wasmGather(\n   xId, CppDType[x.dtype],
xStridesBytes, stridesSize, indicesId,\n   shapeInfo.batchSize, outStridesBytes, outId);\n\n
backend.disposeData(flattenX.dataId);\n
  backend.disposeData(flattenIndex.dataId);\n\n // reshape\n out.shape = shapeInfo.outputShape;\n return
out;\n}\n\nexport const gatherV2Config: KernelConfig = {\n kernelName: GatherV2,\n backendName: 'wasm',\n
setupFunc: setup,\n kernelFunc: gatherV2 as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google
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OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language
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==\n
 */\nimport {Greater, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from
'./binary_kernel';\n\nconst supportsFullBroadcast = false;\nexport const greaterConfig: KernelConfig =\n
createBinaryKernelConfig(Greater, supportsFullBroadcast, 'bool');\n","/**\n * @license\n * Copyright 2019 Google
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OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language
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==\n
 */\nimport {GreaterEqual, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig}
from './binary_kernel';\n\nconst supportsFullBroadcast = false;\nexport const greaterEqualConfig: KernelConfig =\n
 createBinaryKernelConfig(GreaterEqual, supportsFullBroadcast, 'bool');\n","/**\n * @license\n * Copyright 2019
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OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language

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==========\n
*/\n\nimport {KernelConfig, KernelFunc, LeakyRelu, LeakyReluAttrs, LeakyReluInputs, TensorInfo, util} from
'@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {CppDType} from
'./types';\n\nlet wasmFunc: (\n xId: number, dtype: number, leakyreluAlpha: number, outId: number) =>
void;\n\nfunction setupFunc(backend: BackendWasm): void {\n wasmFunc = backend.wasm.cwrap(LeakyRelu,
null /* void */, [\n 'number', // x_id\n 'number', // dtype\n 'number', // leakyrelu_alpha\n 'number', //
out_id\n]);\n}\n\nexport function leakyRelu(\n args:\n {inputs: LeakyReluInputs, attrs: LeakyReluAttrs,
backend: BackendWasm}):\n TensorInfo {\n const {inputs: {x}, attrs: {alpha}, backend} = args;\n\n const xId =
backend.dataIdMap.get(x.dataId).id;\n // According to TF API, LeakyRelu returns float32 when input is either
float32\n // or int32.\n const out = backend.makeOutput(x.shape, 'float32');\n\n if (util.sizeFromShape(x.shape)
 !== 0) {\n const outId = backend.dataIdMap.get(out.dataId).id;\n wasmFunc(xId, CppDType[x.dtype], alpha,
outId);\n }\n\n return out;\n}\n\nexport const leakyReluConfig: KernelConfig = {\n kernelName: LeakyRelu,\n
backendName: 'wasm',\n setupFunc,\n kernelFunc: leakyRelu as {} as KernelFunc,\n};\n","/**\n * @license\n *
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WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for
the specific language governing permissions and\n * limitations under the License.\n *
==========\n
*/\nimport {KernelConfig, Less} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from
'./binary_kernel';\nconst supportsFullBroadcast = false;\nexport const lessConfig: KernelConfig =\n
createBinaryKernelConfig(Less, supportsFullBroadcast, 'bool');\n","/**\n * @license\n * Copyright 2019 Google
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http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing,
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OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language
governing permissions and\n * limitations under the License.\n *
==========\n
*/\n\nimport {KernelConfig, LessEqual} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from
'./binary_kernel';\nconst supportsFullBroadcast = false;\nexport const lessEqualConfig: KernelConfig =\n
createBinaryKernelConfig(LessEqual, supportsFullBroadcast, 'bool');\n","/**\n * @license\n * Copyright 2019
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may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n *
http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing,
software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES
OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language
governing permissions and\n * limitations under the License.\n *
==========\n
*/\nimport {KernelConfig, Log} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from
'./unary_kernel';\nexport const logConfig: KernelConfig = createUnaryKernelConfig(Log);\n","/**\n * @license\n *
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WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for

the specific language governing permissions and\n * limitations under the License.\n *
==========\n
*/\nimport {KernelConfig, LogicalAnd}
from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from './binary_kernel';\nconst
supportsFullBroadcast = false;\nexport const logicalAndConfig: KernelConfig =\n
createBinaryKernelConfig(LogicalAnd, supportsFullBroadcast, 'bool');\n","/**\n * @license\n * Copyright 2019
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http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing,
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OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language
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==========\n
*/\n\nimport {backend_util,
KernelConfig, KernelFunc, Max, MaxAttrs, MaxInputs, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport
{BackendWasm} from '../backend_wasm';\n\nimport {permuteAxesAndTranspose} from './kernel_utils';\nimport
{CppDType} from './types';\n\nlet wasmMax: (xId: number, dtype: number, reduceSize: number, outId: number)
=>\n void;\n\nfunction setup(backend: BackendWasm): void {\n wasmMax = backend.wasm.cwrap(Max, null
/*void*/, [\n 'number', // x_id\n 'number', // dtype\n 'number', // reduce_size\n 'number', // out_id\n
]);\n}\n\nfunction max(args: {backend: BackendWasm, inputs: MaxInputs, attrs: MaxAttrs}):\n TensorInfo {\n
const {backend, inputs, attrs} = args;\n const {reductionIndices: axis, keepDims} = attrs;\n const {x} = inputs;\n
const xId = backend.dataIdMap.get(x.dataId).id;\n let inputId = xId;\n let input = x;\n\n const {transposed, axes,
originalAxes, inputWasTransposed} =\n permuteAxesAndTranspose(x, axis, backend);\n\n if
(inputWasTransposed)
{\n const transposedId = backend.dataIdMap.get(transposed.dataId).id;\n input = transposed;\n inputId =
transposedId;\n }\n\n const inputRank = input.shape.length;\n backend_util.assertAxesAreInnerMostDims('max',
axes, inputRank);\n const [outShape, reduceShape] =\n
backend_util.computeOutAndReduceShapes(input.shape, axes);\n const reduceSize =
util.sizeFromShape(reduceShape);\n\n const out = backend.makeOutput(outShape, x.dtype);\n if
(util.sizeFromShape(input.shape) !== 0) {\n const outId = backend.dataIdMap.get(out.dataId).id;\n
wasmMax(inputId, CppDType[x.dtype], reduceSize, outId);\n }\n\n if (inputWasTransposed) {\n // dispose of the
transposed tensor.\n backend.disposeData(transposed.dataId);\n }\n\n if (keepDims) {\n // reshape\n const
newShape = backend_util.expandShapeToKeepDim(out.shape, originalAxes);\n out.shape = newShape;\n }\n\n
return out;\n}\n\nexport const maxConfig: KernelConfig = {\n kernelName: Max,\n
backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: max as {} as KernelFunc\n};\n","/**\n * @license\n *
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==========\n
*/\nimport {KernelConfig, Maximum} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from
'./binary_kernel';\nconst supportsFullBroadcast = false;\nexport const maximumConfig:
KernelConfig =\n createBinaryKernelConfig(Maximum, supportsFullBroadcast);\n","/**\n * @license\n *
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agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {backend_util, KernelConfig, KernelFunc, MaxPool, MaxPoolAttrs, MaxPoolInputs, Tensor4D, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmMaxPool: (\n xId: number, batchSize: number, inputHeight: number, inputWidth: number,\n filterHeight: number, filterWidth: number, padTop: number, padRight: number,\n padBottom: number, padLeft: number, dilationHeight: number,\n dilationWidth: number, strideHeight: number, strideWidth: number,\n inputChannels: number, outputChannels: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmMaxPool = backend.wasm.cwrap(MaxPool, null /* void */, [\n 'number', // xId\n 'number', // batchSize\n 'number', // inputHeight\n 'number', // inputWidth\n 'number', // filterHeight\n 'number', // filterWidth\n 'number', // padTop\n 'number', // padRight\n 'number', // padBottom\n 'number', // padLeft\n 'number', // dilationHeight\n 'number', // dilationWidth\n 'number', // strideHeight\n 'number', // strideWidth\n 'number', // inputChannels\n 'number', // outputChannels\n 'number', // outId\n]);\n}\n\nfunction maxPool(\n args: {inputs: MaxPoolInputs, backend: BackendWasm, attrs: MaxPoolAttrs}) {\n const {inputs, attrs, backend} = args;\n\n const x = inputs.x as Tensor4D;\n const xId = backend.dataIdMap.get(x.dataId).id;\n\n // TF API supports int32 input. CPU and WebGL backend also support int32\n // input. WASM backend doesn't support it because it uses xnnpack which only\n // supports float32.\n //\n // Add the following assert only for the WASM backend instead of at core op\n // level.\n //\n // TODO: add support for int32 input.\n util.assert(\n x.dtype === 'float32',\n () =>\n `Error in MaxPool: only float32 input is supported. Got ${x.dtype}.`);\n\n const {filterSize, strides, pad, dimRoundingMode} = attrs;\n const convInfo = backend_util.computePool2DInfo(\n x.shape, filterSize, strides, 1 /* dilations */, pad, dimRoundingMode);\n\n const filterHeight = convInfo.filterHeight;\n const filterWidth = convInfo.filterWidth;\n const padTop = convInfo.padInfo.top;\n const padRight = convInfo.padInfo.right;\n const padBottom = convInfo.padInfo.bottom;\n const padLeft = convInfo.padInfo.left;\n const dilationHeight = convInfo.dilationHeight;\n const dilationWidth = convInfo.dilationWidth;\n const strideHeight = convInfo.strideHeight;\n const strideWidth = convInfo.strideWidth;\n const inputChannels = convInfo.inChannels;\n const outputChannels = convInfo.outChannels;\n\n if (convInfo.dataFormat !== 'channelsLast') {\n throw new Error(\n `wasm backend does not support dataFormat:` +\n `${convInfo.dataFormat}'. Please use 'channelsLast'.`);\n }\n\n const out = backend.makeOutput(convInfo.outShape, 'float32');\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n wasmMaxPool(\n xId, x.shape[0], x.shape[1], x.shape[2], filterHeight, filterWidth,\n padTop, padRight, padBottom, padLeft, dilationHeight, dilationWidth,\n strideHeight, strideWidth, inputChannels, outputChannels, outId);\n return out;\n}\n\nexport const maxPoolConfig: KernelConfig = {\n kernelName: MaxPool,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: maxPool as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {backend_util, KernelConfig, KernelFunc, Mean, MeanAttrs, MeanInputs, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\nimport {cast} from './Cast';\n\nimport {permuteAxesAndTranspose} from './kernel_utils';\n\nlet wasmMean: (xId: number, reduceSize: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n wasmMean =\n backend.wasm.cwrap(Mean, null /*void*/, ['number, number, number']);\n}\n\nexport function mean(\n args:

{backend: BackendWasm, inputs: MeanInputs, attrs: MeanAttrs}):\n TensorInfo {\n const {backend, inputs, attrs} = args;\n const {axis, keepDims} = attrs;\n const {x} = inputs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n let inputId = xId;\n let input = x;\n\n const {transposed, axes, originalAxes, inputWasTransposed} =\n   permuteAxesAndTranspose(x, axis, backend);\n\n let reductionAxes = axes;\n if (inputWasTransposed) {\n   const transposedId = backend.dataIdMap.get(transposed.dataId).id;\n   if (transposedId !== xId) {\n
      // transpose was not a no-op. We will need to dispose of this\n   // once we are done.\n   input = transposed;\n
    inputId = transposedId;\n   reductionAxes = backend_util.getInnerMostAxes(\n   reductionAxes.length, input.shape.length);\n   }\n }\n\n backend_util.assertAxesAreInnerMostDims(\n   'mean', reductionAxes, input.shape.length);\n const [outShape, reduceShape] =\n backend_util.computeOutAndReduceShapes(input.shape, reductionAxes);\n const reduceSize = util.sizeFromShape(reduceShape);\n let castedInput = input;\n if (input.dtype !== 'float32') {\n   castedInput =\n cast({backend, inputs: {x: input}, attrs: {dtype: 'float32'}});\n   inputId = backend.dataIdMap.get(castedInput.dataId).id;\n }\n\n const out = backend.makeOutput(outShape, 'float32');\n if (util.sizeFromShape(input.shape) !== 0) {\n   const outId = backend.dataIdMap.get(out.dataId).id;\n wasmMean(inputId, reduceSize, outId);\n }\n\n if (inputWasTransposed) {\n
    // dispose of the transposed tensor.\n   backend.disposeData(transposed.dataId);\n }\n\n if (keepDims) {\n   // reshape\n   const newShape = backend_util.expandShapeToKeepDim(out.shape, originalAxes);\n   out.shape = newShape;\n }\n\n if (input.dtype !== 'float32') {\n   backend.disposeData(castedInput.dataId);\n }\n\n return out;\n}\n\nexport const meanConfig: KernelConfig = {\n kernelName: Mean,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: mean as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF
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==\n *\n\nimport {backend_util, KernelConfig, KernelFunc, Min, MinAttrs, MinInputs, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {permuteAxesAndTranspose} from './kernel_utils';\nimport {CppDType} from './types';\n\nlet wasmMin: (xId: number, dtype: number, reduceSize: number, outId: number) =>\n void;\n\nfunction setup(backend: BackendWasm): void {\n wasmMin = backend.wasm.cwrap(Min, null /*void*/, [\n   'number', // x_id\n   'number', // dtype\n   'number', // reduce_size\n   'number', // out_id\n]);\n}\n\nfunction min(args: {backend: BackendWasm, inputs: MinInputs, attrs: MinAttrs}):\n TensorInfo {\n const {backend, inputs, attrs} = args;\n const {axis, keepDims} = attrs;\n const {x}
 = inputs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n let inputId = xId;\n let input = x;\n\n const {transposed, axes, originalAxes, inputWasTransposed} =\n   permuteAxesAndTranspose(x, axis, backend);\n\n if (inputWasTransposed) {\n   const transposedId = backend.dataIdMap.get(transposed.dataId).id;\n   if (transposedId !== xId) {\n   // transpose was not a no-op. We will need to dispose of this\n   // once we are done.\n   input = transposed;\n   inputId = transposedId;\n   }\n }\n\n const inputRank = input.shape.length;\n\n backend_util.assertAxesAreInnerMostDims('min', axes, inputRank);\n const [outShape, reduceShape] =\n backend_util.computeOutAndReduceShapes(input.shape, axes);\n const reduceSize = util.sizeFromShape(reduceShape);\n\n const out = backend.makeOutput(outShape, input.dtype);\n if (util.sizeFromShape(input.shape) !== 0) {\n   const outId = backend.dataIdMap.get(out.dataId).id;\n wasmMin(inputId, CppDType[x.dtype], reduceSize,

outId);\n }\n\n if (inputWasTransposed) {\n   // dispose of the transposed tensor.\n backend.disposeData(transposed.dataId);\n }\n\n if (keepDims) {\n   // reshape\n   const newShape = backend_util.expandShapeToKeepDim(out.shape, originalAxes);\n   out.shape = newShape;\n }\n\n return out;\n}\n\nexport const minConfig: KernelConfig = {\n kernelName: Min,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: min as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n
 * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\nimport {KernelConfig, Minimum} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from './binary_kernel';\nconst supportsFullBroadcast = false;\nexport const minimumConfig: KernelConfig =\n createBinaryKernelConfig(Minimum, supportsFullBroadcast);\n","/**\n * @license\n * Copyright 2021 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See
 the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {KernelConfig, KernelFunc, MirrorPad, MirrorPadAttrs, MirrorPadInputs} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {CppDType} from './types';\n\n// Must match enum in MirrorPad.cc\nenum MirrorPaddingMode {\n reflect = 0,\n symmetric = 1\n}\n\nlet wasmMirrorPad: (\n xId: number, xShapeBytes: Uint8Array, xShapeLength: number, xDtype: number,\n   prePaddingsBytes: Uint8Array, postPaddingsBytes: Uint8Array, mode: number,\n   outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmMirrorPad = backend.wasm.cwrap(MirrorPad, null /* void */, [\n 'number', // xId\n   'array',   // x.shape\n   'number', // x.shape.length\n   'number', // x.dtype\n   'array',   // pre-paddings\n   'array',   // post-paddings\n   'number',
 // mode\n   'number', // outId\n]);\n}\n\nfunction mirrorPad(args: {\n inputs: MirrorPadInputs,\n backend: BackendWasm,\n attrs: MirrorPadAttrs\n}) {\n const {inputs: {x}, backend, attrs: {paddings, mode}} = args;\n\n const outShape = paddings.map(\n   (p, i) => p[0] /* beforePad */ + x.shape[i] + p[1] /* afterPad */);\n const xId = backend.dataIdMap.get(x.dataId).id;\n const out = backend.makeOutput(outShape, x.dtype);\n const outId = backend.dataIdMap.get(out.dataId).id;\n const xShapeBytes = new Uint8Array(new Int32Array(x.shape).buffer);\n\n const prePaddingsFlat = paddings.map(padTuple => padTuple[0]);\n const postPaddingsFlat = paddings.map(padTuple => padTuple[1]);\n const prePaddingsBytes =\n   new Uint8Array(new Int32Array(prePaddingsFlat).buffer);\n const postPaddingsBytes =\n   new Uint8Array(new Int32Array(postPaddingsFlat).buffer);\n\n wasmMirrorPad(\n   xId, xShapeBytes, x.shape.length, CppDType[x.dtype], prePaddingsBytes,\n   postPaddingsBytes,
 MirrorPaddingMode[mode], outId);\n return out;\n}\n\nexport const mirrorPadConfig: KernelConfig = {\n kernelName: MirrorPad,\n backendName: 'wasm',\n kernelFunc: mirrorPad as {} as KernelFunc,\n setupFunc: setup\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the

License.\n *
==========\n
*/\n\nimport {KernelConfig, Multiply} from '@tensorflow/tfjs-core';\n\nimport
{createBinaryKernelConfig} from './binary_kernel';\n\nconst supportsFullBroadcast = true;\nexport const
multiplyConfig: KernelConfig =\n createBinaryKernelConfig(Multiply, supportsFullBroadcast);\n","/**\n *
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the specific language governing permissions and\n * limitations under the License.\n *
==========\n
*/\nimport {KernelConfig, Neg} from '@tensorflow/tfjs-core';\n\nimport
{createUnaryKernelConfig} from './unary_kernel';\nexport const negConfig: KernelConfig =
createUnaryKernelConfig(Neg);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n *
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OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language
governing permissions and\n * limitations under the License.\n *
==========\n
*/\n\nimport {BackendWasm} from '../backend_wasm';\n\n// Analogous to `struct Result` in
`non_max_suppression_impl.h`.\ninterface Result
{\n pSelectedIndices: number;\n selectedSize: number;\n pSelectedScores: number;\n pValidOutputs:
number;\n}\n/**\n * Parse the result of the c++ method, which has the shape equivalent to\n * `Result`.\n */\nexport
function parseResultStruct(\n backend: BackendWasm, resOffset: number): Result {\n const result = new
Int32Array(backend.wasm.HEAPU8.buffer, resOffset, 4);\n const pSelectedIndices = result[0];\n const
selectedSize = result[1];\n const pSelectedScores = result[2];\n const pValidOutputs = result[3];\n // Since the
result was allocated on the heap, we have to delete it.\n backend.wasm._free(resOffset);\n return
{pSelectedIndices, selectedSize, pSelectedScores, pValidOutputs};\n}\n","/**\n * @license\n * Copyright 2019
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the License.\n *
==========\n
*/\n\nimport {KernelConfig, KernelFunc, NonMaxSuppressionV3, NonMaxSuppressionV3Attrs,
NonMaxSuppressionV3Inputs, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from
'../backend_wasm';\n\nimport {parseResultStruct} from './NonMaxSuppression_util';\n\nlet wasmFunc: (\n
boxesId: number, scoresId: number, maxOutputSize: number,\n iouThreshold: number, scoreThreshold: number)
=> number;\n\nfunction setup(backend: BackendWasm): void {\n wasmFunc = backend.wasm.cwrap(\n
NonMaxSuppressionV3,\n 'number', // Result*\n [\n
'number', // boxesId\n 'number', // scoresId\n 'number', // maxOutputSize\n 'number', //
iouThreshold\n 'number', // scoreThreshold\n]);\n}\n\nfunction kernelFunc(args: {\n backend:
BackendWasm,\n inputs: NonMaxSuppressionV3Inputs,\n attrs: NonMaxSuppressionV3Attrs\n}): TensorInfo {\n

const {backend, inputs, attrs} = args;\n const {iouThreshold, maxOutputSize, scoreThreshold} = attrs;\n const {boxes, scores} = inputs;\n\n const boxesId = backend.dataIdMap.get(boxes.dataId).id;\n const scoresId = backend.dataIdMap.get(scores.dataId).id;\n\n const resOffset =\n   wasmFunc(boxesId, scoresId, maxOutputSize, iouThreshold, scoreThreshold);\n\n const {pSelectedIndices, selectedSize, pSelectedScores, pValidOutputs} =\n parseResultStruct(backend, resOffset);\n\n // Since we are not using scores for V3, we have to delete it from the heap.\n backend.wasm._free(pSelectedScores);\n backend.wasm._free(pValidOutputs);\n\n const selectedIndicesTensor
 =\n   backend.makeOutput([selectedSize], 'int32', pSelectedIndices);\n\n return selectedIndicesTensor;\n}\n\nexport const nonMaxSuppressionV3Config: KernelConfig = {\n kernelName: NonMaxSuppressionV3,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: kernelFunc as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {KernelConfig, KernelFunc, NonMaxSuppressionV4, NonMaxSuppressionV4Attrs, NonMaxSuppressionV4Inputs, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {parseResultStruct} from './NonMaxSuppression_util';\n\nlet wasmFunc: (\n boxesId: number, scoresId: number, maxOutputSize: number,\n   iouThreshold: number, scoreThreshold: number,\n padToMaxOutputSize: boolean) => number;\n\nfunction setup(backend: BackendWasm): void {\n wasmFunc = backend.wasm.cwrap(\n   NonMaxSuppressionV4,\n   'number', // Result*\n   [\n   'number', // boxesId\n 'number', // scoresId\n   'number', // maxOutputSize\n   'number', // iouThreshold\n   'number', // scoreThreshold\n   'bool',   // padToMaxOutputSize\n   ]);\n}\n\nfunction nonMaxSuppressionV4(args: {\n backend: BackendWasm,\n inputs: NonMaxSuppressionV4Inputs,\n attrs: NonMaxSuppressionV4Attrs\n}): TensorInfo[] {\n const {backend, inputs, attrs} = args;\n const {iouThreshold, maxOutputSize, scoreThreshold, padToMaxOutputSize} =\n   attrs;\n const {boxes, scores} = inputs;\n\n const boxesId = backend.dataIdMap.get(boxes.dataId).id;\n const scoresId = backend.dataIdMap.get(scores.dataId).id;\n\n const resOffset = wasmFunc(\n   boxesId, scoresId, maxOutputSize, iouThreshold, scoreThreshold,\n padToMaxOutputSize);\n\n const {pSelectedIndices, selectedSize, pSelectedScores, pValidOutputs} =\n parseResultStruct(backend, resOffset);\n\n // Since we are not using scores for V4, we have to delete it from the heap.\n backend.wasm._free(pSelectedScores);\n\n const selectedIndicesTensor =\n backend.makeOutput([selectedSize], 'int32', pSelectedIndices);\n\n const validOutputsTensor = backend.makeOutput([], 'int32', pValidOutputs);\n\n return [selectedIndicesTensor, validOutputsTensor];\n}\n\nexport const nonMaxSuppressionV4Config: KernelConfig = {\n kernelName: NonMaxSuppressionV4,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: nonMaxSuppressionV4 as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {KernelConfig, KernelFunc, NonMaxSuppressionV5, NonMaxSuppressionV5Attrs, NonMaxSuppressionV5Inputs, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport

{BackendWasm} from '../backend_wasm';\n\nimport {parseResultStruct} from './NonMaxSuppression_util';\n\nlet wasmFunc:\n (boxesId: number, scoresId: number, maxOutputSize: number,\n iouThreshold: number, scoreThreshold: number, softNmsSigma: number) =>\n number;\n\nfunction setup(backend: BackendWasm): void {\n wasmFunc = backend.wasm.cwrap(\n NonMaxSuppressionV5,\n 'number', // Result*\n [\n 'number', // boxesId\n 'number', // scoresId\n 'number', // maxOutputSize\n 'number', // iouThreshold\n 'number', // scoreThreshold\n 'number', // softNmsSigma\n]);\n}\n\nfunction kernelFunc(args: {\n backend: BackendWasm,\n inputs: NonMaxSuppressionV5Inputs,\n attrs: NonMaxSuppressionV5Attrs\n}): TensorInfo[] {\n const {backend, inputs, attrs} = args;\n const {iouThreshold, maxOutputSize, scoreThreshold, softNmsSigma} = attrs;\n const {boxes, scores} = inputs;\n\n const boxesId = backend.dataIdMap.get(boxes.dataId).id;\n
const scoresId = backend.dataIdMap.get(scores.dataId).id;\n\n const resOffset = wasmFunc(\n boxesId, scoresId, maxOutputSize, iouThreshold, scoreThreshold,\n softNmsSigma);\n\n const {pSelectedIndices, selectedSize, pSelectedScores, pValidOutputs} =\n parseResultStruct(backend, resOffset);\n\n // Since we are not using validOutputs for V5, we have to delete it from the\n // heap.\n backend.wasm._free(pValidOutputs);\n\n const selectedIndicesTensor =\n backend.makeOutput([selectedSize], 'int32', pSelectedIndices);\n const selectedScoresTensor =\n backend.makeOutput([selectedSize], 'float32', pSelectedScores);\n\n return [selectedIndicesTensor, selectedScoresTensor];\n}\n\nexport const nonMaxSuppressionV5Config: KernelConfig = {\n kernelName: NonMaxSuppressionV5,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: kernelFunc as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights
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==\n */\nimport {KernelConfig, NotEqual} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from './binary_kernel';\nconst supportsFullBroadcast = false;\nexport const notEqualConfig: KernelConfig =\n createBinaryKernelConfig(NotEqual, supportsFullBroadcast, 'bool');\n","/**\n * @license\n * Copyright 2020 Google LLC. All
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==\n */\n\nimport {KernelConfig, KernelFunc, OneHot, OneHotAttrs, OneHotInputs} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmOneHot: (\n indicesId: number, depth: number, onValue: number, offValue: number,\n outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmOneHot
= backend.wasm.cwrap(OneHot, null /* void */, [\n 'number', // indices_id\n 'number', // depth,\n 'number', // onValue\n 'number', // offValue\n 'number' // out_id\n]);\n}\n\nfunction oneHot(\n args: {inputs: OneHotInputs, attrs: OneHotAttrs, backend: BackendWasm}) {\n const {inputs, backend, attrs} = args;\n const {indices} = inputs;\n const {depth, onValue, offValue} = attrs;\n\n const out = backend.makeOutput([...indices.shape, depth], 'int32');\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n const indicesData = backend.dataIdMap.get(indices.dataId);\n const indicesId = indicesData.id;\n\n wasmOneHot(indicesId, depth, onValue, offValue, outId);\n\n return out;\n}\n\nexport const oneHotConfig:

KernelConfig = {\n kernelName: OneHot,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: oneHot as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version
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==========\n
*/\n\nimport {KernelConfig, KernelFunc, OnesLike, OnesLikeInputs} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nfunction onesLike(args: {inputs: OnesLikeInputs, backend: BackendWasm}) {\n const {inputs: {x}, backend} = args;\n const out = backend.makeOutput(x.shape, x.dtype);\n const outVals = backend.typedArrayFromHeap(out);\n outVals.fill(1);\n return
out;\n}\n\nexport const onesLikeConfig: KernelConfig = {\n kernelName: OnesLike,\n backendName: 'wasm',\n kernelFunc: onesLike as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n
*/\n\nimport {KernelConfig, KernelFunc, Pack, PackAttrs, PackInputs, TensorInfo, util} from '@tensorflow/tfjs-core';\nimport
{BackendWasm} from '../backend_wasm';\n\nimport {concat} from './Concat';\nimport {expandDims} from './ExpandDims';\n\nexport function pack(\n   args: {inputs: PackInputs, backend: BackendWasm, attrs: PackAttrs}):\n   TensorInfo {\n const {inputs, backend, attrs} = args;\n const {axis} = attrs;\n\n if (inputs.length === 1) {\n   return expandDims(\n   {inputs: {input: inputs[0]}, backend, attrs: {dim: axis}});\n }\n\n const shape = inputs[0].shape;\n const dtype = inputs[0].dtype;\n\n inputs.forEach(t => {\n   util.assertShapesMatch(\n   shape, t.shape,\n   'All tensors passed to stack must have matching shapes');\n   util.assert(\n   dtype === t.dtype,\n   () => 'All tensors passed to stack must have matching dtypes');\n });\n\n const intermediateTensorInfos: TensorInfo[] = [];\n const expandedTensors = inputs.map(t => {\n   const expandedT =\n   expandDims({inputs: {input: t}, backend, attrs: {dim: axis}});\n   intermediateTensorInfos.push(expandedT);\n   return expandedT;\n });\n\n const result = concat({inputs: expandedTensors, backend, attrs: {axis}});\n\n intermediateTensorInfos.forEach(t => backend.disposeData(t.dataId));\n\n return result;\n}\n\nexport const packConfig: KernelConfig = {\n kernelName: Pack,\n backendName: 'wasm',\n kernelFunc: pack as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n
* ==========\n
*/\n\nimport {KernelConfig, KernelFunc, PadV2, PadV2Attrs, PadV2Inputs, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {fill} from './Fill';\n\nimport {CppDType} from './types';\n\nlet wasmPadV2: (\n   xId: number, xShapeBytes: Uint8Array, xShapeLength: number, xDtype: number,\n   prePaddingsBytes: Uint8Array, postPaddingsBytes: Uint8Array,\n   constantValue: number, outId:

number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmPadV2 = backend.wasm.cwrap(PadV2, null /* void */, [\n   'number', // xId\n   'array',   // x.shape\n   'number', // x.shape.length\n   'number', // x.dtype\n   'array',   // pre-paddings\n   'array',   // post-paddings\n   'number', // constantValue\n   'number', // outId\n]);\n}\n\nfunction pad(\n   args: {inputs: PadV2Inputs, backend: BackendWasm, attrs: PadV2Attrs}) {\n const {inputs: {x}, backend,
 attrs: {paddings, constantValue}} = args;\n\n const outShape = paddings.map(\n   (p, i) => p[0] /* beforePad */ + x.shape[i] + p[1] /* afterPad */);\n\n if (util.sizeFromShape(x.shape) === 0) {\n   // Short-circuit the computation, since x doesn't have value, only\n   // the shape is used to compute output shape to pad.\n   return fill({\n backend,\n   attrs: {shape: outShape, value: constantValue, dtype: x.dtype}\n   });\n }\n\n const xId = backend.dataIdMap.get(x.dataId).id;\n const out = backend.makeOutput(outShape, x.dtype);\n const outTensorData = backend.dataIdMap.get(out.dataId);\n const outId = outTensorData.id;\n\n const xShapeBytes = new Uint8Array(new Int32Array(x.shape).buffer);\n\n const prePaddingsFlat = paddings.map(padTuple => padTuple[0]);\n const postPaddingsFlat = paddings.map(padTuple => padTuple[1]);\n const prePaddingsBytes =\n   new Uint8Array(new Int32Array(prePaddingsFlat).buffer);\n const postPaddingsBytes =\n   new Uint8Array(new
 Int32Array(postPaddingsFlat).buffer);\n\n wasmPadV2(\n   xId, xShapeBytes, x.shape.length, CppDType[x.dtype], prePaddingsBytes,\n   postPaddingsBytes, constantValue, outId);\n return out;\n}\n\nexport const padV2Config: KernelConfig = {\n kernelName: PadV2,\n backendName: 'wasm',\n kernelFunc: pad as {} as KernelFunc,\n setupFunc: setup\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n
 * ==\n */\nimport {KernelConfig, Pow} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from './binary_kernel';\nconst supportsFullBroadcast = false;\nexport const powConfig: KernelConfig =\n createBinaryKernelConfig(Pow, supportsFullBroadcast);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
 ==\n */\n\nimport {KernelConfig, KernelFunc, Prelu, PreluInputs} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {cast} from './Cast';\n\nlet wasmPrelu: (xId: number, weightsId: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmPrelu = backend.wasm.cwrap(Prelu, null /* void */, [\n   'number', // x_id\n   'number', // weights_id\n   'number'   // out_id\n]);\n}\n\nfunction prelu(args: {inputs: PreluInputs, backend: BackendWasm}) {\n const {inputs, backend} = args;\n const {x, alpha} = inputs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n const weightsId = backend.dataIdMap.get(alpha.dataId).id;\n\n let inputId = xId;\n const input = x;\n let castedInput = input;\n if (input.dtype !== 'float32') {\n   castedInput = cast({backend, inputs: {x}, attrs: {dtype: 'float32'}});\n   inputId = backend.dataIdMap.get(castedInput.dataId).id;\n }\n\n
  const out = backend.makeOutput(x.shape, 'float32');\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n wasmPrelu(inputId, weightsId, outId);\n\n if (input.dtype !== 'float32') {\n   backend.disposeData(castedInput.dataId);\n }\n return out;\n}\n\nexport const preluConfig: KernelConfig = {\n

kernelName: Prelu,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: prelu as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing
 permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {backend_util, KernelConfig, KernelFunc, Prod, ProdAttrs, ProdInputs, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {permuteAxesAndTranspose} from './kernel_utils';\n\nimport {CppDType} from './types';\n\nlet wasmProd: (\n xId: number, reduceSize: number,\n   dtype: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n wasmProd = backend.wasm.cwrap(Prod, null /*void*/, [\n   'number',\n   'number',\n   'number',\n   'number'\n]);\n}\n\nfunction prod(args: {\n backend: BackendWasm,\n inputs: ProdInputs,\n attrs: ProdAttrs\n}): TensorInfo {\n const {backend, inputs, attrs} = args;\n const {axis, keepDims} = attrs;\n const {x} = inputs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n let inputId = xId;\n let input = x;\n\n const
 {transposed, axes, originalAxes, inputWasTransposed} =\n   permuteAxesAndTranspose(x, axis, backend);\n\n let reductionAxes = axes;\n if (inputWasTransposed) {\n   const transposedId = backend.dataIdMap.get(transposed.dataId).id;\n   if (transposedId !== xId) {\n   // transpose was not a no-op. We will need to dispose of this\n   // once we are done.\n   input = transposed;\n   inputId = transposedId;\n   reductionAxes = backend_util.getInnerMostAxes(\n   reductionAxes.length, input.shape.length);\n   }\n }\n\n backend_util.assertAxesAreInnerMostDims(\n   'prod', reductionAxes, input.shape.length);\n const [outShape, reduceShape] =\n   backend_util.computeOutAndReduceShapes(input.shape, reductionAxes);\n const reduceSize = util.sizeFromShape(reduceShape);\n\n const out = backend.makeOutput(outShape, input.dtype);\n if (util.sizeFromShape(input.shape) !== 0) {\n   const outId = backend.dataIdMap.get(out.dataId).id;\n   wasmProd(inputId, reduceSize,
 CppDType[out.dtype], outId);\n }\n\n if (inputWasTransposed) {\n   // dispose of the transposed tensor.\n   backend.disposeData(transposed.dataId);\n }\n\n if (keepDims) {\n   // reshape\n   const newShape = backend_util.expandShapeToKeepDim(out.shape, originalAxes);\n   out.shape = newShape;\n }\n\n return out;\n}\n\nexport const prodConfig: KernelConfig = {\n kernelName: Prod,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: prod as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either
 express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {KernelConfig, KernelFunc, Range, RangeAttrs, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\nimport {rangeImplCPU} from '../kernel_utils/shared';\n\nexport const range =\n   (args: {backend: BackendWasm, attrs: RangeAttrs}): TensorInfo => {\n   const {backend, attrs} = args;\n   const {start, stop, step, dtype} = attrs;\n   const values = rangeImplCPU(start, stop, step, dtype);\n\n const out = backend.makeOutput([values.length], dtype);\n   const outVals = backend.typedArrayFromHeap(out);\n   outVals.set(values);\n   return out;\n   };\n\nexport const rangeConfig: KernelConfig = {\n kernelName: Range,\n backendName: 'wasm',\n kernelFunc: range as {} as KernelFunc\n};\n","/**\n * @license\n *

Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\nimport { util } from '@tensorflow/tfjs-core';\nexport function rangeImpl(start, stop, step, dtype) {\n const sameStartStop = start === stop;\n const increasingRangeNegativeStep = start < stop && step < 0;\n const decreasingRangePositiveStep = stop < start && step > 1;\n if (sameStartStop || increasingRangeNegativeStep ||\n decreasingRangePositiveStep) {\n return util.makeZerosTypedArray(0, dtype);\n }\n const numElements = Math.abs(Math.ceil((stop - start) / step));\n const values = util.makeZerosTypedArray(numElements, dtype);\n if (stop < start && step === 1) {\n // Auto adjust the step's sign if it hasn't been set\n // (or was set to 1)\n step = -1;\n }\n values[0] = start;\n for (let i = 1; i < values.length; i++) {\n values[i] = values[i - 1] + step;\n }\n return values;\n}\n//# sourceMappingURL=data:application/json; base64,eyJ2ZXJzaW9uIjozLCJmaWxlIjoiUmFuZ2VfaW1wbC5qcyIsInNvdXJjZVJvb3QiOiIiLCJzb3VyY2VzIjpbIi4uLy4uLy4uLy4uLy4uLy4uL3RmanMtYmFja2VuZC1jcHUvc3JjL3tlcm5lbHMvUmFuZ2VfaW1wbC50cyJdLCJuYW1lcyI6W10sIm1hcHBpbmdzIjoiQUFBQTs7Ozs7Ozs7Ozs7O0dBZUc7QUFFSCxPQUFPLEVBQUMsSUFBSSxFQUFDLE1BQU0sc0JBQXNCLENBQUM7QUFFMUMsTUFBTSxVQUFVLFNBQVMsQ0FBQyxLQUFhLEVBQUUsSUFBWSxFQUFFLElBQVksRUFBRSxLQUFlO0lBQ3pFLE1BQU0sYUFBYSxHQUFHLEtBQUssS0FBSyxJQUFJLENBQUM7SUFDckMsTUFBTSwwQkFBMEIsR0FBRyxLQUFLLEdBQUcsSUFBSSxJQUFJLEdBQUcsQ0FBQyxDQUFDO0lBQ3hELE1BQU0sMEJBQTBCLEdBQUcsSUFBSSxHQUFHLEtBQUssSUFBSSxJQUFJLEdBQUcsQ0FBQyxDQUFDO0lBQzVELElBQUksQ0FBQyxhQUFhO1FBQUUsMEJBQTBCO1FBQUUsMEJBQTBCLENBQUM7UUFDekUsT0FBTyxJQUFJLENBQUMsb0JBQW9CLENBQUMsQ0FBQyxFQUFFLEtBQUssQ0FBQyxDQUFDO0tBQzVDO0lBQ0QsTUFBTSxXQUFXLEdBQUcsSUFBSSxDQUFDLEdBQUcsQ0FBQyxJQUFJLENBQUMsSUFBSSxDQUFDLENBQUMsSUFBSSxHQUFHLEtBQUssQ0FBQyxHQUFHLElBQUksQ0FBQyxDQUFDLENBQUM7SUFDOUQsTUFBTSxNQUFNLEdBQUcsSUFBSSxDQUFDLG9CQUFvQixDQUFDLFdBQVcsRUFBRSxLQUFLLENBQUMsQ0FBQztJQUM3RCxJQUFJLElBQUksR0FBRyxLQUFLLElBQUksSUFBSSxLQUFLLENBQUMsRUFBRTtRQUM5QiwwQ0FBMEM7UUFDMUMsMkJBQTJCO1FBQzNCLElBQUksR0FBRyxDQUFDLENBQUMsQ0FBQztLQUNYO0lBQ0QsTUFBTSxDQUFDLENBQUMsQ0FBQyxHQUFHLEtBQUssQ0FBQztJQUNsQixLQUFLLElBQUksQ0FBQyxHQUFHLENBQUMsRUFBRSxDQUFDLEdBQUcsTUFBTSxDQUFDLE1BQU0sRUFBRSxDQUFDLEVBQUUsRUFBRTtRQUN0QyxNQUFNLENBQUMsQ0FBQyxDQUFDLEdBQUcsTUFBTSxDQUFDLENBQUMsR0FBRyxDQUFDLENBQUMsR0FBRyxJQUFJLENBQUM7S0FDbEM7SUFDRCxPQUFPLE1BQU0sQ0FBQztBQUNoQixDQUFDIn0=

xcbiAgICBkdHlwZTogJ2Zsb2F0MzInfCdpbnQzMicpOiBEYXRhVHlwZU1hcFsnZmxvYXQzMicgfCAnaW50MzInXSB7XG4gIGNvbnN0IHNhbWVTdGFydFN0b3AgPSBzdGFydCA9PT0gc3RvcDtcbiAgY29uc3QgaW5jcmVhc2luZ1JhbmdlTmVnYXRpdmVTdGVwID0gc3RhcnQgPCBzdG9wICYmIHN0ZXAgPCAwO1xuICBjb25zdCBkZWNyZWFzaW5nUmFuZ2VQb3NpdGl2ZVN0ZXAgPSBzdGFydCA+IHN0b3AgJiYgc3RlcCA+IDA7XG4gIGlmICghc2FtZVN0YXJ0U3RvcCAmJiAhaW5jcmVhc2luZ1JhbmdlTmVnYXRpdmVTdGVwICYmXG4gICAgICAhZGVjcmVhc2luZ1JhbmdlUG9zaXRpdmVTdGVwKSB7XG4gICAgdGhyb3cgbmV3IEVycm9yKFxuICAgICAgICAnQ2Fubm90IGZvcmdldCBhIHJhbmdlIHRoYXQgZG9lcyBub3QgbWFrZSBwcm9ncmVzcyBpbiBpdHMgbm9uLXplcm8gc3RlcC4nKTtcbiAgfVxuXG4gIGNvbnN0IHZhbHMgPSBbXTtcbiAgZm9yIChsZXQgaSA9IHN0YXJ0OyBzYW1lU3RhcnRTdG9wID8gaSA9PT0gc3RvcCA6IGkgPCBzdG9wOyBpICs9IHN0ZXApIHtcbiAgICB2YWxzLnB1c2goaSk7XG4gIH1cbiAgcmV0dXJuIHZhbHM7XG59XG4iLCIvKipcbiAqIEBsaWNlbnNlXG4gKiBDb3B5cmlnaHQgMjAxOSBHb29nbGUgTExDLiBBbGwgUmlnaHRzIFJlc2VydmVkLlxuICogTGljZW5zZWQgdW5kZXIgdGhlIEFwYWNoZSBMaWNlbnNlLCBWZXJzaW9uIDIuMCAodGhlIFwiTGljZW5zZVwiKTtcbiAqIHlvdSBtYXkgbm90IHVzZSB0aGlzIGZpbGUgZXhjZXB0IGluIGNvbXBsaWFuY2Ugd2l0aCB0aGUgTGljZW5zZS5cbiAqIFlvdSBtYXkgb2J0YWluIGEgY29weSBvZiB0aGUgTGljZW5zZSBhdFxuICpcbiAqIGh0dHA6Ly93d3cuYXBhY2hlLm9yZy9saWNlbnNlcy9MSUNFTlNFLTIuMFxuICpcbiAqIFVubGVzcyByZXF1aXJlZCBieSBhcHBsaWNhYmxlIGxhdyBvciBhZ3JlZWQgdG8gaW4gd3JpdGluZywgc29mdHdhcmVcbiAqIGRpc3RyaWJ1dGVkIHVuZGVyIHRoZSBMaWNlbnNlIGlzIGRpc3RyaWJ1dGVkIG9uIGFuIFwiQVMgSVNcIiBCQVNJUyxcbiAqIFdJVEhPVVQgV0FSUkFOVElFUyBPUiBDT05ESVRJT05TIE9GIEFOWSBLSU5ELCBlaXRoZXIgZXhwcmVzcyBvciBpbXBsaWVkLlxuICogU2VlIHRoZSBMaWNlbnNlIGZvciB0aGUgc3BlY2lmaWMgbGFuZ3VhZ2UgZ292ZXJuaW5nIHBlcm1pc3Npb25zIGFuZFxuICogbGltaXRhdGlvbnMgdW5kZXIgdGhlIExpY2Vuc2UuXG4gKlxuICogPT09PT09PT09P

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==========\n
*/\n\nimport {KernelConfig, KernelFunc, ResizeBilinear, ResizeBilinearAttrs, ResizeBilinearInputs, TensorInfo,
util} from '@tensorflow/tfjs-core';\n\nimport
{BackendWasm} from '../backend_wasm';\n\nimport {cast} from './Cast';\n\nlet wasmResizeBilinear: (\n xId:
number, batch: number, oldHeight: number, oldWidth: number,\n numChannels: number, newHeight: number,
newWidth: number,\n alignCorners: number, halfPixelCenters: number, outId: number) => void;\n\nfunction
setup(backend: BackendWasm): void {\n wasmResizeBilinear = backend.wasm.cwrap(ResizeBilinear, null
/*void*/, [\n 'number', // xId\n 'number', // batch\n 'number', // oldHeight\n 'number', // oldWidth\n
'number', // numChannels\n 'number', // newHeight\n 'number', // newWidth\n 'number', // alignCorners\n
'number', // halfPixelCenters\n 'number' // outId\n]);\n}\n\nfunction resizeBilinear(args: {\n backend:
BackendWasm,\n inputs: ResizeBilinearInputs,\n attrs: ResizeBilinearAttrs\n}): TensorInfo {\n const {backend,
inputs, attrs} = args;\n\n const {images} = inputs;\n const {alignCorners, halfPixelCenters,
size} = attrs;\n const [newHeight, newWidth] = size;\n\n const [batch, oldHeight, oldWidth, numChannels] =
images.shape;\n const outShape = [batch, newHeight, newWidth, numChannels];\n\n let xData =
backend.dataIdMap.get(images.dataId);\n let castedData;\n if (xData.dtype !== 'float32') {\n castedData =\n
cast({backend, inputs: {x: images}, attrs: {dtype: 'float32'}});\n xData =
backend.dataIdMap.get(castedData.dataId);\n }\n const xId = xData.id;\n\n const out =
backend.makeOutput(outShape, 'float32');\n if (util.sizeFromShape(images.shape) === 0) {\n return out;\n }\n
const outId = backend.dataIdMap.get(out.dataId).id;\n\n wasmResizeBilinear(\n xId, batch, oldHeight,
oldWidth, numChannels, newHeight, newWidth,\n alignCorners ? 1 : 0, halfPixelCenters ? 1 : 0, outId);\n\n if
(castedData != null) {\n backend.disposeData(castedData.dataId);\n }\n\n return out;\n}\n\nexport const
resizeBilinearConfig: KernelConfig = {\n kernelName: ResizeBilinear,\n
backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: resizeBilinear as {} as KernelFunc\n};\n","/**\n *
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==========\n
*/\n\nimport {KernelConfig, KernelFunc, Reverse, ReverseAttrs, ReverseInputs, TensorInfo, util} from
'@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport
{identity} from './Identity';\nimport {reshape} from './Reshape';\n\nlet wasmReverse: (\n xId: number, axes:
Uint8Array, axesLength: number, outShape: Uint8Array,\n outShapeLength: number, outId: number) =>
void;\n\nfunction setup(backend: BackendWasm) {\n wasmReverse = backend.wasm.cwrap(Reverse, null, [\n
'number', // x_id\n 'array', // axes\n 'number', // axes_length\n 'array', // out_shape\n 'number', //
out_shape_length\n 'number' // out_id\n]);\n}\n\nexport function reverse(\n args: {inputs: ReverseInputs,
backend: BackendWasm, attrs: ReverseAttrs}):\n TensorInfo {\n const {inputs, backend, attrs} = args;\n const
{x} = inputs;\n const {dims} = attrs;\n\n const axes = util.parseAxisParam(dims, x.shape);\n\n if (x.shape.length
=== 0) {\n return identity({inputs: {x}, backend});\n }\n\n const out = backend.makeOutput(x.shape, x.dtype);\n
const xId = backend.dataIdMap.get(x.dataId).id;\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n
const axesBytes = new Uint8Array(new Int32Array(axes).buffer);\n const outShapeBytes = new Uint8Array(new
Int32Array(x.shape).buffer);\n\n wasmReverse(\n xId, axesBytes, axes.length, outShapeBytes, x.shape.length,
outId);\n\n const reshaped =\n reshape({inputs: {x: out}, attrs: {shape: x.shape}, backend});\n\n
backend.disposeData(out.dataId);\n return reshaped;\n}\n\nexport const reverseConfig: KernelConfig = {\n
kernelName: Reverse,\n backendName: 'wasm',\n kernelFunc: reverse as {} as KernelFunc,\n setupFunc:
setup\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the

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* ==\n
*/\n\nimport {KernelConfig, KernelFunc, scatter_util, ScatterNd, ScatterNdAttrs, ScatterNdInputs, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {CppDType} from './types';\n\nlet wasmScatterNd: (\n indicesId: number, updatesId: number, dtype: CppDType, sliceRank: number,\n numUpdates: number, sliceSize: number, strides: Uint8Array,\n outputSize: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n wasmScatterNd = backend.wasm.cwrap(ScatterNd, null /*void*/, [\n 'number', // indicesId\n 'number', // updatesId\n 'number', // dtype\n 'number', // sliceRank\n 'number', // numUpdates\n 'number', // sliceSize\n 'array', // strides\n 'number', // outputSize\n 'number' // outId\n]);\n}\n\nfunction scatterNd(\n args:\n {backend: BackendWasm, inputs: ScatterNdInputs,
attrs: ScatterNdAttrs}):\n TensorInfo {\n const {backend, inputs, attrs} = args;\n const {indices, updates} = inputs;\n const {shape} = attrs;\n\n const out = backend.makeOutput(shape, updates.dtype);\n if (util.sizeFromShape(shape) === 0) {\n return out;\n }\n\n const {sliceRank, numUpdates, sliceSize, strides, outputSize} =\n scatter_util.calculateShapes(updates, indices, shape);\n\n const indicesData = backend.dataIdMap.get(indices.dataId);\n const indicesId = indicesData.id;\n\n const updatesData = backend.dataIdMap.get(updates.dataId);\n const updatesId = updatesData.id;\n\n const stridesBytes = new Uint8Array(new Int32Array(strides).buffer);\n\n const outId = backend.dataIdMap.get(out.dataId).id;\n wasmScatterNd(\n indicesId, updatesId, CppDType[updates.dtype], sliceRank, numUpdates,\n sliceSize, stridesBytes, outputSize, outId);\n\n return out;\n}\n\nexport const scatterNdConfig: KernelConfig = {\n kernelName: ScatterNd,\n backendName: 'wasm',\n
setupFunc: setup,\n kernelFunc: scatterNd as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n
*/\n\nimport {KernelConfig, KernelFunc, Select, SelectInputs, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmSelect: (\n conditionId: number, tId: number,
eId: number, offset: number,\n outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmSelect = backend.wasm.cwrap('SelectV2', null, [\n 'number', // conditionId\n 'number', // tId\n 'number', // eId\n 'number', // offset\n 'number', // outId\n]);\n}\n\nfunction select(args: {inputs: SelectInputs, backend: BackendWasm}) {\n const {inputs, backend} = args;\n const {condition, t, e} = inputs;\n\n const conditionId = backend.dataIdMap.get(condition.dataId).id;\n const tId = backend.dataIdMap.get(t.dataId).id;\n const eId = backend.dataIdMap.get(e.dataId).id;\n const out = backend.makeOutput(t.shape, t.dtype);\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n const cRank = condition.shape.length;\n const tRank = t.shape.length;\n\n const offset = cRank === 0 || cRank > 1 || tRank === 1 ?\n 1 :\n util.sizeFromShape(t.shape.slice(1));\n\n wasmSelect(conditionId, tId, eId, offset, outId);\n return out;\n}\n\nexport const
selectConfig: KernelConfig = {\n kernelName: Select,\n backendName: 'wasm',\n kernelFunc: select as {} as KernelFunc,\n setupFunc: setup\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n

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from '../backend_wasm';\n\nlet wasmFunc: (xId: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n wasmFunc = backend.wasm.cwrap(Sigmoid, null /* void */, ['number', 'number']);\n}\n\nfunction sigmoid(args: {backend: BackendWasm, inputs: SigmoidInputs}):\n TensorInfo {\n const {backend, inputs: {x}} = args;\n const xId = backend.dataIdMap.get(x.dataId).id;\n const out = backend.makeOutput(x.shape, x.dtype);\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n // Short-circuit zero-sized tensors.\n if (util.sizeFromShape(out.shape) === 0) {\n return out;\n }\n\n wasmFunc(xId, outId);\n return out;\n}\n\nexport const sigmoidConfig: KernelConfig = {\n kernelName: 'Sigmoid',\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: sigmoid as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file
except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\nimport {KernelConfig, Sin} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\nexport const sinConfig: KernelConfig = createUnaryKernelConfig(Sin);\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n
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inputs: SoftmaxInputs, attrs: SoftmaxAttrs}):\n TensorInfo {\n const {backend, inputs: {logits}, attrs: {dim}} = args;\n const xId = backend.dataIdMap.get(logits.dataId).id;\n const out = backend.makeOutput(logits.shape, logits.dtype);\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n const channels = logits.shape[dim];\n const batch = util.sizeFromShape(logits.shape) / channels;\n\n // Short-circuit zero-sized tensors.\n if (util.sizeFromShape(out.shape) === 0) {\n return out;\n }\n\n wasmFunc(xId, outId, channels, batch);\n return out;\n}\n\nexport const softmaxConfig: KernelConfig = {\n kernelName: Softmax,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: softmax as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2021 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not

use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n===\n*/\n\nimport {backend_util, KernelConfig, KernelFunc, ReshapeAttrs, ReshapeInputs, SpaceToBatchND, SpaceToBatchNDAttrs, SpaceToBatchNDInputs, TensorInfo, TransposeAttrs, TransposeInputs, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {padV2Config} from './PadV2';\nimport {reshape} from './Reshape';\nimport {transpose} from './Transpose';\n\nfunction spaceToBatchND(args: {\n inputs: SpaceToBatchNDInputs,\n backend: BackendWasm,\n attrs: SpaceToBatchNDAttrs\n}) {\n const {inputs,
 backend, attrs} = args;\n const {x} = inputs;\n const {blockShape, paddings} = attrs;\n\n const prod = util.sizeFromShape(blockShape);\n\n const completePaddings: Array<[number, number]> = [[0, 0]];\n completePaddings.push(...(paddings as Array<[number, number]>));\n\n for (let i = 1 + blockShape.length; i < x.shape.length; ++i) {\n   completePaddings.push([0, 0]);\n }\n\n const paddedX = padV2Config.kernelFunc({\n inputs: {x},\n   backend,\n   attrs: {paddings: completePaddings, constantValue: 0}\n }) as TensorInfo;\n\n const reshapedPaddedShape =\n   backend_util.getReshaped(paddedX.shape, blockShape, prod, false);\n\n const permutedReshapedPaddedPermutation = backend_util.getPermuted(\n   reshapedPaddedShape.length, blockShape.length, false);\n\n const flattenShape =\n   backend_util.getReshapedPermuted(paddedX.shape, blockShape, prod, false);\n\n const reshapeInputs: ReshapeInputs = {x: paddedX};\n const reshapeAttrs: ReshapeAttrs = {shape: reshapedPaddedShape};\n
  const paddedXReshaped =\n   reshape({inputs: reshapeInputs, backend, attrs: reshapeAttrs});\n\n const transposeInputs: TransposeInputs = {x: paddedXReshaped};\n const transposeAttrs:\n   TransposeAttrs = {perm: permutedReshapedPaddedPermutation};\n const paddedXT =\n   transpose({inputs: transposeInputs, backend, attrs: transposeAttrs});\n\n const resultReshapeInputs: ReshapeInputs = {x: paddedXT};\n const resultReshapeAttrs: ReshapeAttrs = {shape: flattenShape};\n const result = reshape(\n   {inputs: resultReshapeInputs, backend, attrs: resultReshapeAttrs});\n\n backend.disposeData(paddedX.dataId);\n backend.disposeData(paddedXReshaped.dataId);\n backend.disposeData(paddedXT.dataId);\n\n return result;\n}\n\nexport const spaceToBatchNDConfig: KernelConfig = {\n kernelName: SpaceToBatchND,\n backendName: 'wasm',\n kernelFunc: spaceToBatchND as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed
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 {inputs, attrs, backend} = args;\n const {x} = inputs;\n const {numOrSizeSplits, axis} = attrs;\n\n const $axis = util.parseAxisParam(axis, x.shape)[0];\n\n const splitSizes = backend_util.prepareSplitSize(x, numOrSizeSplits, $axis);\n const begin = new Array(x.shape.length).fill(0);\n const size = x.shape.slice();\n return splitSizes.map(s => {\n   const xSliceSize = [...size];\n   xSliceSize[$axis] = s;\n   const xSlice =\n   slice({inputs: {x}, attrs: {begin, size: xSliceSize}, backend});\n   begin[$axis] += s;\n   return xSlice;\n });\n}\n\nexport const

splitVConfig: KernelConfig = {\n kernelName: SplitV,\n backendName: 'wasm',\n kernelFunc: splitV as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n==========\n*/\n\nimport {KernelConfig, Sqrt} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\nexport const sqrtConfig: KernelConfig = createUnaryKernelConfig(Sqrt);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n==========\n*/\nimport {KernelConfig, Square} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\nexport const squareConfig: KernelConfig = createUnaryKernelConfig(Square);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n==========\n*/\nimport {KernelConfig, SquaredDifference} from '@tensorflow/tfjs-core';\nimport {createBinaryKernelConfig} from './binary_kernel';\nconst supportsFullBroadcast = true;\nexport const squaredDifferenceConfig: KernelConfig =\n   createBinaryKernelConfig(SquaredDifference, supportsFullBroadcast);\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n==========\n*/\n\nimport {KernelConfig, KernelFunc, Step, StepAttrs, StepInputs, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {CppDType} from './types';\n\nlet wasmStep: (xId: number, alpha: number, dtype: number, outId: number) =>\n   void;\n\nfunction setup(backend: BackendWasm): void {\n wasmStep = backend.wasm.cwrap(Step, null /*void*/, [\n   'number', // x_id\n   'number', // alpha\n   'number', // dtype\n   'number', // out_id\n]);\n}\n\nfunction step(\n   args: {backend: BackendWasm, inputs: StepInputs, attrs: StepAttrs}):\n   TensorInfo {\n const {backend, inputs, attrs} = args;\n const {alpha} = attrs;\n const {x} = inputs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n\n const out = backend.makeOutput(x.shape, x.dtype);\n const outId = backend.dataIdMap.get(out.dataId).id;\n wasmStep(xId, alpha, CppDType[x.dtype], outId);\n return

out;\n}\n\nexport const stepConfig: KernelConfig = {\n kernelName: Step,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: step as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2021 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under
 the License.\n *
==\n
*/\n\nimport {KernelConfig, KernelFunc, slice_util, StridedSlice, StridedSliceAttrs, StridedSliceInputs, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\nimport {reshape} from './Reshape';\nimport {slice} from './Slice';\n\nlet wasmStridedSlice: (\n   xId: number, xStridesBytes: Uint8Array, xRank: number,\n   beginBytes: Uint8Array, endBytes: Uint8Array, stridesBytes: Uint8Array,\n   outShapeBytes: Uint8Array, outStridesBytes: Uint8Array,\n   outShapeLength: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n wasmStridedSlice = backend.wasm.cwrap(StridedSlice, null /*void*/, [\n   'number', // xId\n   'array',   // xStrides\n   'number', // xRank\n   'array',   // beginBytes\n   'array',   // endBytes\n   'array',   // stridesBytes\n   'array',   // outShapeBytes\n   'array',   // outStridesBytes\n
    'number', // outShapeLength\n   'number', // outId\n]);\n}\n\nexport function stridedSlice(args: {\n backend: BackendWasm,\n inputs: StridedSliceInputs,\n attrs: StridedSliceAttrs\n}): TensorInfo {\n const {backend, inputs, attrs} = args;\n const {x} = inputs;\n\n const {\n   begin,\n   end,\n   strides,\n   beginMask,\n   endMask,\n   ellipsisMask,\n   newAxisMask,\n   shrinkAxisMask\n } = attrs;\n\n const {\n   finalShapeSparse,\n   finalShape,\n   isIdentity,\n   sliceDim0,\n   isSimpleSlice,\n   begin: $begin,\n   end: $end,\n   strides: $strides\n } =\n   slice_util.sliceInfo(\n   x.shape, begin, end, strides, beginMask, endMask, ellipsisMask,\n   newAxisMask, shrinkAxisMask);\n\n let result;\n\n if (isIdentity) {\n   // Optimization #1, slice is a no-op plus reshape\n   result = reshape({inputs: {x}, backend, attrs: {shape: finalShape}});\n } else if (sliceDim0 || isSimpleSlice) {\n   // Optimization #2, slice is memory contiguous
 (only occurs in dim 0)\n   util.assert(\n   x.shape.length >= 1,\n   () => `Input must have rank at least 1, got: ${x.shape.length}`);\n\n   const size = slice_util.computeOutShape($begin, $end, $strides);\n   // To tolerate begin[0] > end[0] (a 0-output slice), we min(begin, end).\n   const sliced = slice({inputs: {x}, backend, attrs: {begin: $begin, size}});\n   result =\n   reshape({inputs: {x: sliced}, backend, attrs: {shape: finalShape}});\n   backend.disposeData(sliced.dataId);\n } else {\n   const out = backend.makeOutput(finalShapeSparse, 'float32');\n\n   const xId = backend.dataIdMap.get(x.dataId).id;\n   const xStridesBytes =\n   new Uint8Array(new Int32Array(util.computeStrides(x.shape)).buffer);\n   const beginBytes = new Uint8Array(new Int32Array($begin).buffer);\n   const endBytes = new Uint8Array(new Int32Array($end).buffer);\n   const stridesBytes = new Uint8Array(new Int32Array($strides).buffer);\n\n   const outputShapeBytes
 =\n   new Uint8Array(new Int32Array(finalShapeSparse).buffer);\n   const outStridesBytes = new Uint8Array(\n   new Int32Array(util.computeStrides(finalShapeSparse)).buffer);\n   const outId = backend.dataIdMap.get(out.dataId).id;\n\n   wasmStridedSlice(\n   xId, xStridesBytes, x.shape.length, beginBytes, endBytes, stridesBytes,\n   outputShapeBytes, outStridesBytes, finalShapeSparse.length, outId);\n\n   result = reshape({inputs: {x: out}, backend, attrs: {shape: finalShape}});\n\n   backend.disposeData(out.dataId);\n }\n\n return result;\n}\n\nexport const stridedSliceConfig: KernelConfig = {\n kernelName: StridedSlice,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: stridedSlice as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License
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WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==========\n */\nimport {KernelConfig, Sub} from '@tensorflow/tfjs-core';\nimport {createBinaryKernelConfig} from './binary_kernel';\nconst supportsFullBroadcast = true;\nexport const subConfig: KernelConfig =\n createBinaryKernelConfig(Sub, supportsFullBroadcast);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==========\n */\n\nimport {backend_util, KernelConfig, KernelFunc, Sum, SumAttrs, SumInputs, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {permuteAxesAndTranspose} from './kernel_utils';\nimport {CppDType} from './types';\n\nlet wasmSum: (xId: number, reduceSize: number, dtype: number, outId: number) =>\n void;\n\nfunction setup(backend: BackendWasm): void {\n wasmSum = backend.wasm.cwrap(Sum, null /*void*/, [\n 'number', // input_id\n 'number', // reduce_size\n 'number', // dtype\n 'number', // out_id\n]);\n}\n\nfunction sum(args: {backend: BackendWasm, inputs: SumInputs, attrs: SumAttrs}):\n TensorInfo {\n const {backend, inputs, attrs} = args;\n const {axis, keepDims} = attrs;\n const {x} = inputs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n let inputId = xId;\n let input = x;\n\n const {transposed, axes, originalAxes, inputWasTransposed} =\n permuteAxesAndTranspose(x, axis, backend);\n\n let reductionAxes = axes;\n if (inputWasTransposed) {\n const transposedId = backend.dataIdMap.get(transposed.dataId).id;\n if (transposedId !== xId) {\n // transpose was not a no-op. We will need to dispose of this\n // once we are done.\n input = transposed;\n inputId = transposedId;\n reductionAxes = backend_util.getInnerMostAxes(\n reductionAxes.length, input.shape.length);\n }\n }\n\n backend_util.assertAxesAreInnerMostDims(\n 'sum', reductionAxes, input.shape.length);\n const [outShape, reduceShape] =\n backend_util.computeOutAndReduceShapes(input.shape, reductionAxes);\n const reduceSize = util.sizeFromShape(reduceShape);\n\n const out = backend.makeOutput(outShape, input.dtype);\n if (util.sizeFromShape(input.shape) !== 0) {\n const outId = backend.dataIdMap.get(out.dataId).id;\n wasmSum(inputId, reduceSize, CppDType[out.dtype], outId);\n }\n\n if (inputWasTransposed) {\n // dispose of the transposed tensor.\n backend.disposeData(transposed.dataId);\n }\n\n if (keepDims) {\n // reshape\n const newShape = backend_util.expandShapeToKeepDim(out.shape, originalAxes);\n out.shape = newShape;\n }\n\n return out;\n}\n\nexport const sumConfig: KernelConfig = {\n kernelName: Sum,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: sum as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2021 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==========\n */\nimport {KernelConfig, Tan} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\nexport const tanConfig: KernelConfig = createUnaryKernelConfig(Tan);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the

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*/\nimport {KernelConfig, Tanh} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\nexport const tanhConfig: KernelConfig = createUnaryKernelConfig(Tanh);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable
law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
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/\n\nimport {KernelConfig, KernelFunc, Tile, TileAttrs, TileInputs} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {CppDType} from './types';\n\nlet wasmTile: (\n xId: number, xShape: Uint8Array, xShapeSize: number, newShape: Uint8Array,\n newShapeSize: number, dtype: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmTile = backend.wasm.cwrap(Tile, null / void */, [\n 'number', // x_id\n 'array', // x_shape\n 'number', // x_shape.length\n 'array', // new_shape\n 'number', // new_shape.length\n 'number' // out_id\n]);\n}\n\nfunction tile(\n args: {inputs: TileInputs, backend: BackendWasm, attrs: TileAttrs}) {\n const {inputs, backend, attrs} = args;\n const {x} = inputs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n const {reps} = attrs;\n\n const newShape: number[] = new Array(x.shape.length);\n for (let i = 0; i < newShape.length; i++) {\n newShape[i] = x.shape[i] * reps[i];\n }\n const xShapeBytes = new Uint8Array(new Int32Array(x.shape).buffer);\n const newShapeBytes = new Uint8Array(new Int32Array(newShape).buffer);\n\n const out = backend.makeOutput(newShape, x.dtype);\n const outId = backend.dataIdMap.get(out.dataId).id;\n wasmTile(\n xId, xShapeBytes, x.shape.length, newShapeBytes, newShape.length,\n CppDType[out.dtype], outId);\n return out;\n}\n\nexport const tileConfig: KernelConfig = {\n kernelName: Tile,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: tile as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google
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*/\n\nimport {KernelConfig, KernelFunc, TensorInfo, TopK, TopKAttrs, TopKInputs} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\nimport {CppDType} from './types';\n\nlet wasmTopK: (\n xId: number, xShapeBytes: Uint8Array, xShapeLength: number,\n xDtype: CppDType, k: number, sorted: boolean,
outValuesId: number,\n outIndicesId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmTopK = backend.wasm.cwrap(TopK, null /* void */, [\n 'number', // xId\n 'array', // x.shape\n 'number', // x.shape.length\n 'number', // x.dtype\n 'number', // k\n 'bool', // sorted\n 'number', // outValuesId\n 'number', // outIndicesId\n]);\n}\n\nexport const topk:\n (args: {inputs: TopKInputs, backend: BackendWasm, attrs: TopKAttrs}) =>\n TensorInfo[] | TensorInfo = ({inputs, backend, attrs}) => {\n const {x} = inputs;\n const {k, sorted} = attrs;\n\n const xId = backend.dataIdMap.get(x.dataId).id;\n const xShapeBytes

= new Uint8Array(new Int32Array(x.shape).buffer);\n const outputShape = x.shape.slice();\n outputShape[outputShape.length - 1] = k;\n const outValues = backend.makeOutput(outputShape, x.dtype);\n const outValuesId = backend.dataIdMap.get(outValues.dataId).id;\n const outIndices = backend.makeOutput(outputShape, 'int32');\n const outIndicesId = backend.dataIdMap.get(outIndices.dataId).id;\n\n wasmTopK(\n xId, xShapeBytes, x.shape.length, CppDType[x.dtype], k, sorted,\n outValuesId, outIndicesId);\n\n return [outValues, outIndices];\n };\n\nexport const topKConfig: KernelConfig = {\n kernelName: TopK,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: topk as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2021 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==\n */\n\nimport {KernelConfig, KernelFunc, TensorInfo, Transform, TransformAttrs, TransformInputs, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmTransform: (\n imageId: number, transformsId: number, isBatchTransform: boolean,\n batch: number, outHeight: number, outWidth: number, numChannels: number,\n imageWidth: number, imageHeight: number, strides: Uint8Array,\n stridesLength: number, interpolationModeId: number, fillModeId: number,\n fillValue: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n wasmTransform = backend.wasm.cwrap(Transform, null /*void*/, [\n 'number', // imageId\n 'number', // transformsId\n 'bool', // isBatchTransform\n 'number', // batch\n 'number', // outHeight\n 'number', // outWidth\n 'number', // numChannels\n 'number', // imageWidth\n 'number', // imageHeight\n 'array', // strides\n 'number', // stridesLength\n 'number', // interpolationModeId\n 'number', // fillModeId\n 'number', // fillValue\n 'number' // outId\n]);\n}\n\nfunction transform(\n args:\n {backend: BackendWasm, inputs: TransformInputs, attrs: TransformAttrs}):\n TensorInfo {\n const {backend, inputs, attrs} = args;\n const {image, transforms} = inputs;\n const {interpolation, fillMode, fillValue, outputShape} = attrs;\n\n const [batch, imageHeight, imageWidth, numChannels] = image.shape;\n const [outHeight, outWidth] =\n outputShape != null ? outputShape : [imageHeight, imageWidth];\n const outShape =\n [batch, outHeight, outWidth,\n numChannels] as [number, number, number, number];\n const strides =\n new Uint8Array(new Int32Array(util.computeStrides(image.shape)).buffer);\n\n const out = backend.makeOutput(outShape, image.dtype);\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n const imageData = backend.dataIdMap.get(image.dataId);\n const imageId = imageData.id;\n\n const transformsData = backend.dataIdMap.get(transforms.dataId);\n const transformsId = transformsData.id;\n\n const interpolationModeId = interpolation === 'nearest' ? 1 : 2;\n let fillModeId;\n switch (fillMode) {\n case 'constant':\n fillModeId = 1;\n break;\n case 'reflect':\n fillModeId = 2;\n break;\n case 'wrap':\n fillModeId = 3;\n break;\n case 'nearest':\n fillModeId = 4;\n break;\n default:\n fillModeId = 1;\n break;\n }\n\n wasmTransform(\n imageId, transformsId, (transforms.shape[0] > 1), batch, outHeight,\n outWidth, numChannels, imageWidth, imageHeight, strides,\n image.shape.length - 1, interpolationModeId, fillModeId, fillValue,\n outId);\n\n return out;\n}\n\nexport const transformConfig: KernelConfig = {\n kernelName: Transform,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: transform as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language

governing permissions and\n * limitations under the License.\n *
==========\n
*/\n\nimport {KernelConfig, KernelFunc, TensorInfo, Unpack, UnpackAttrs, UnpackInputs}
from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {slice} from
'./Slice';\n\nfunction unpack(\n args: {inputs: UnpackInputs, backend: BackendWasm, attrs: UnpackAttrs}):\n
TensorInfo[] {\n const {inputs, backend, attrs} = args;\n const {value} = inputs;\n let {axis} = attrs;\n\n if (axis <
0) {\n axis += value.shape.length;\n }\n\n const numOutputs = value.shape[axis];\n const rank =
value.shape.length;\n const outShape: number[] = new Array(rank - 1);\n let outIndex = 0;\n for (let i = 0; i < rank;
i++) {\n if (i !== axis) {\n outShape[outIndex++] = value.shape[i];\n }\n }\n const outs: TensorInfo[] = new
Array(numOutputs);\n const begin = new Array(rank).fill(0);\n const size = value.shape.slice();\n size[axis] = 1;\n
for (let i = 0; i < outs.length; i++) {\n begin[axis] = i;\n outs[i] = slice({inputs: {x: value}, attrs: {begin, size},
backend});\n }\n return outs.map(({dataId, dtype}) => ({dataId,
dtype, shape: outShape}));\n}\n\nexport const unpackConfig: KernelConfig = {\n kernelName: Unpack,\n
backendName: 'wasm',\n kernelFunc: unpack as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2020
Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you
may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n *
http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing,
software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES
OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language
governing permissions and\n * limitations under the License.\n *
==========\n
*/\n\nimport {KernelConfig, KernelFunc, ZerosLike, ZerosLikeInputs} from '@tensorflow/tfjs-core';\n\nimport
{BackendWasm} from '../backend_wasm';\n\nfunction zerosLike(args: {inputs: ZerosLikeInputs, backend:
BackendWasm}) {\n const {inputs: {x}, backend} = args;\n const out = backend.makeOutput(x.shape, x.dtype);\n
const outVals = backend.typedArrayFromHeap(out);\n outVals.fill(0);\n return out;\n}\n\nexport const
zerosLikeConfig: KernelConfig = {\n kernelName: ZerosLike,\n backendName: 'wasm',\n kernelFunc: zerosLike
as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed
under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the
License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n *
Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed
on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or
implied.\n * See the License
for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n//
We explicitly import the modular kernels so they get registered in the\n// global registry when we compile the
library. A modular build would replace\n// the contents of this file and import only the kernels that are
needed.\nimport {KernelConfig, registerKernel} from '@tensorflow/tfjs-core';\n\nimport {fusedMatMulConfig}
from './kernels/_FusedMatMul';\nimport {absConfig} from './kernels/Abs';\nimport {addConfig} from
'./kernels/Add';\nimport {addNConfig} from './kernels/AddN';\nimport {allConfig} from './kernels/All';\nimport
{anyConfig} from './kernels/Any';\nimport {argMaxConfig} from './kernels/ArgMax';\nimport {avgPoolConfig}
from './kernels/AvgPool';\nimport {batchMatMulConfig} from './kernels/BatchMatMul';\nimport
{batchToSpaceNDConfig} from './kernels/BatchToSpaceND';\nimport {castConfig} from './kernels/Cast';\nimport
{ceilConfig} from './kernels/Ceil';\nimport {clipByValueConfig} from './kernels/ClipByValue';\nimport
{concatConfig} from './kernels/Concat';\nimport {conv2DConfig} from './kernels/Conv2D';\nimport
{conv2DBackpropInputConfig} from './kernels/Conv2DBackpropInput';\nimport {cosConfig} from
'./kernels/Cos';\nimport {coshConfig} from './kernels/Cosh';\nimport {cropAndResizeConfig} from
'./kernels/CropAndResize';\nimport {cumsumConfig} from './kernels/Cumsum';\nimport {depthToSpaceConfig}
from './kernels/DepthToSpace';\nimport {depthwiseConv2dNativeConfig} from

'./kernels/DepthwiseConv2dNative';\nimport {eluConfig} from './kernels/Elu';\nimport {equalConfig} from
'./kernels/Equal';\nimport {expConfig} from './kernels/Exp';\nimport {expandDimsConfig} from
'./kernels/ExpandDims';\nimport {fillConfig} from './kernels/Fill';\nimport {flipLeftRightConfig} from
'./kernels/FlipLeftRight';\nimport {floorConfig} from './kernels/Floor';\nimport {floorDivConfig} from
'./kernels/FloorDiv';\nimport
{fusedBatchNormConfig} from './kernels/FusedBatchNorm';\nimport {fusedConv2DConfig} from
'./kernels/FusedConv2D';\nimport {fusedDepthwiseConv2DConfig} from
'./kernels/FusedDepthwiseConv2D';\nimport {gatherNdConfig} from './kernels/GatherNd';\nimport
{gatherV2Config} from './kernels/GatherV2';\nimport {greaterConfig} from './kernels/Greater';\nimport
{greaterEqualConfig} from './kernels/GreaterEqual';\nimport {identityConfig} from './kernels/Identity';\nimport
{leakyReluConfig} from './kernels/LeakyRelu';\nimport {lessConfig} from './kernels/Less';\nimport
{lessEqualConfig} from './kernels/LessEqual';\nimport {logConfig} from './kernels/Log';\nimport
{logicalAndConfig} from './kernels/LogicalAnd';\nimport {maxConfig} from './kernels/Max';\nimport
{maximumConfig} from './kernels/Maximum';\nimport {maxPoolConfig} from './kernels/MaxPool';\nimport
{meanConfig} from './kernels/Mean';\nimport {minConfig} from './kernels/Min';\nimport {minimumConfig} from
'./kernels/Minimum';\nimport
{mirrorPadConfig} from './kernels/MirrorPad';\nimport {multiplyConfig} from './kernels/Multiply';\nimport
{negConfig} from './kernels/Neg';\nimport {nonMaxSuppressionV3Config} from
'./kernels/NonMaxSuppressionV3';\nimport {nonMaxSuppressionV4Config} from
'./kernels/NonMaxSuppressionV4';\nimport {nonMaxSuppressionV5Config} from
'./kernels/NonMaxSuppressionV5';\nimport {notEqualConfig} from './kernels/NotEqual';\nimport {oneHotConfig}
from './kernels/OneHot';\nimport {onesLikeConfig} from './kernels/OnesLike';\nimport {packConfig} from
'./kernels/Pack';\nimport {padV2Config} from './kernels/PadV2';\nimport {powConfig} from
'./kernels/Pow';\nimport {preluConfig} from './kernels/Prelu';\nimport {prodConfig} from './kernels/Prod';\nimport
{rangeConfig} from './kernels/Range';\nimport {realDivConfig} from './kernels/RealDiv';\nimport {reluConfig}
from './kernels/Relu';\nimport {relu6Config} from './kernels/Relu6';\nimport {reshapeConfig} from
'./kernels/Reshape';\nimport {resizeBilinearConfig}
from './kernels/ResizeBilinear';\nimport {reverseConfig} from './kernels/Reverse';\nimport
{rotateWithOffsetConfig} from './kernels/RotateWithOffset';\nimport {roundConfig} from
'./kernels/Round';\nimport {rsqrtConfig} from './kernels/Rsqrt';\nimport {scatterNdConfig} from
'./kernels/ScatterNd';\nimport {selectConfig} from './kernels/Select';\nimport {sigmoidConfig} from
'./kernels/Sigmoid';\nimport {sinConfig} from './kernels/Sin';\nimport {sliceConfig} from './kernels/Slice';\nimport
{softmaxConfig} from './kernels/Softmax';\nimport {spaceToBatchNDConfig} from
'./kernels/SpaceToBatchND';\nimport {splitVConfig} from './kernels/SplitV';\nimport {sqrtConfig} from
'./kernels/Sqrt';\nimport {squareConfig} from './kernels/Square';\nimport {squaredDifferenceConfig} from
'./kernels/SquaredDifference';\nimport {stepConfig} from './kernels/Step';\nimport {stridedSliceConfig} from
'./kernels/StridedSlice';\nimport {subConfig} from './kernels/Sub';\nimport {sumConfig} from
'./kernels/Sum';\nimport
{tanConfig} from './kernels/Tan';\nimport {tanhConfig} from './kernels/Tanh';\nimport {tileConfig} from
'./kernels/Tile';\nimport {topKConfig} from './kernels/TopK';\nimport {transformConfig} from
'./kernels/Transform';\nimport {transposeConfig} from './kernels/Transpose';\nimport {unpackConfig} from
'./kernels/Unpack';\nimport {zerosLikeConfig} from './kernels/ZerosLike';\n\n// List all kernel configs here\nconst
kernelConfigs: KernelConfig[] = [\n absConfig,\n addConfig,\n addNConfig,\n allConfig,\n anyConfig,\n
argMaxConfig,\n avgPoolConfig,\n batchMatMulConfig,\n batchToSpaceNDConfig,\n castConfig,\n
ceilConfig,\n clipByValueConfig,\n concatConfig,\n conv2DConfig,\n conv2DBackpropInputConfig,\n
cosConfig,\n coshConfig,\n cropAndResizeConfig,\n cumsumConfig,\n depthToSpaceConfig,\n
depthwiseConv2dNativeConfig,\n eluConfig,\n equalConfig,\n expConfig,\n expandDimsConfig,\n fillConfig,\n
flipLeftRightConfig,\n floorConfig,\n floorDivConfig,\n

fusedMatMulConfig,\n fusedBatchNormConfig,\n fusedConv2DConfig,\n fusedDepthwiseConv2DConfig,\n gatherNdConfig,\n gatherV2Config,\n greaterConfig,\n greaterEqualConfig,\n identityConfig,\n leakyReluConfig,\n lessConfig,\n lessEqualConfig,\n logConfig,\n logicalAndConfig,\n maxConfig,\n maximumConfig,\n maxPoolConfig,\n meanConfig,\n minConfig,\n minimumConfig,\n mirrorPadConfig,\n multiplyConfig,\n negConfig,\n nonMaxSuppressionV3Config,\n nonMaxSuppressionV4Config,\n nonMaxSuppressionV5Config,\n notEqualConfig,\n oneHotConfig,\n onesLikeConfig,\n packConfig,\n padV2Config,\n powConfig,\n preluConfig,\n prodConfig,\n rangeConfig,\n realDivConfig,\n reluConfig,\n relu6Config,\n reshapeConfig,\n resizeBilinearConfig,\n reverseConfig,\n rotateWithOffsetConfig,\n rsqrtConfig,\n roundConfig,\n scatterNdConfig,\n selectConfig,\n sigmoidConfig,\n sinConfig,\n sliceConfig,\n softmaxConfig,\n spaceToBatchNDConfig,\n splitVConfig,\n sqrtConfig,\n squareConfig,\n squaredDifferenceConfig,\n stepConfig,\n stridedSliceConfig,\n subConfig,\n sumConfig,\n tanConfig,\n tanhConfig,\n tileConfig,\n topKConfig,\n transformConfig,\n transposeConfig,\n unpackConfig,\n zerosLikeConfig\n];\n\nfor (const kernelConfig of kernelConfigs) {\n registerKernel(kernelConfig);\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {env} from '@tensorflow/tfjs-core';\n\nconst ENV = env();\n\n/**\n * True if SIMD is supported.\n */\n// From: https://github.com/GoogleChromeLabs/wasm-feature-detect\nENV.registerFlag(\n // This typed array passed in to WebAssembly.validate is WebAssembly binary\n // code. In this case it is a small program that contains SIMD\n // instructions.\n 'WASM_HAS_SIMD_SUPPORT', async () => WebAssembly.validate(new Uint8Array([\n 0, 97, 115, 109, 1, 0, 0, 0, 1, 4, 1, 96, 0, 0, 3,\n 2, 1, 0, 10, 9, 1, 7, 0, 65, 0, 253, 15, 26, 11\n])));\n\n/**\n * True if threads are supported.\n */\n// From: https://github.com/GoogleChromeLabs/wasm-feature-detect\nENV.registerFlag('WASM_HAS_MULTITHREAD_SUPPORT', async () => {\n // TODO(annxingyuan): Enable node support once this is resolved:\n // https://github.com/tensorflow/tfjs/issues/3830\n if (ENV.get('IS_NODE')) {\n return false;\n }\n\n try {\n // Test for transferability of SABs (needed for Firefox)\n // https://groups.google.com/forum/#!msg/mozilla.dev.platform/IHkBZlHETpA/dwsMNchWEQAJ\n new MessageChannel().port1.postMessage(new SharedArrayBuffer(1));\n // This typed array is a WebAssembly program containing threaded\n // instructions.\n return WebAssembly.validate(new Uint8Array([\n 0, 97, 115, 109, 1, 0, 0, 0, 1, 4, 1, 96, 0, 0, 3, 2, 1, 0, 5,\n 4, 1, 3, 1, 1, 10, 11, 1, 9, 0, 65, 0, 254, 16, 2, 0, 26, 11\n]));\n } catch (e) {\n return false;\n }\n});\n","\nvar WasmBackendModuleThreadedSimd = (function() {\n var _scriptDir = typeof document !== 'undefined' && document.currentScript ? document.currentScript.src : undefined;\n if (typeof __filename !== 'undefined') _scriptDir = _scriptDir || __filename;\n return (\nfunction(WasmBackendModuleThreadedSimd) {\n WasmBackendModuleThreadedSimd = WasmBackendModuleThreadedSimd || {};\n\nfunction GROWABLE_HEAP_I8(){if(wasmMemory.buffer!=buffer){updateGlobalBufferAndViews(wasmMemory.buffer)}return HEAP8}function GROWABLE_HEAP_U8(){if(wasmMemory.buffer!=buffer){updateGlobalBufferAndViews(wasmMemory.buffer)}return HEAPU8}function GROWABLE_HEAP_I32(){if(wasmMemory.buffer!=buffer){updateGlobalBufferAndViews(wasmMemory.buffer)}return HEAP32}function GROWABLE_HEAP_U32(){if(wasmMemory.buffer!=buffer){updateGlobalBufferAndViews(wasmMemory.buffer)}return HEAPU32}function

GROWABLE_HEAP_F64(){if(wasmMemory.buffer!=buffer){updateGlobalBufferAndViews(wasmMemory.buffer)}return HEAPF64}var Module=typeof WasmBackendModuleThreadedSimd!==\"undefined\"?WasmBackendModuleThreadedSimd:{};var readyPromiseResolve,readyPromiseReject;Module[\"ready\"]=new Promise(function(resolve,reject){readyPromiseResolve=resolve;readyPromiseReject=reject});var moduleOverrides={};var key;for(key in Module){if(Module.hasOwnProperty(key)){moduleOverrides[key]=Module[key]}}var arguments_=[];var thisProgram=\"./this.program\";var quit_=function(status,toThrow){throw toThrow};var ENVIRONMENT_IS_WEB=false;var ENVIRONMENT_IS_WORKER=false;var ENVIRONMENT_IS_NODE=false;var ENVIRONMENT_IS_SHELL=false;ENVIRONMENT_IS_WEB=typeof window===\"object\";ENVIRONMENT_IS_WORKER=typeof importScripts===\"function\";ENVIRONMENT_IS_NODE=typeof process===\"object\"&&typeof process.versions===\"object\"&&typeof process.versions.node===\"string\";ENVIRONMENT_IS_SHELL=!ENVIRONMENT_IS_WEB&&!ENVIRONMENT_IS_NODE&&!ENVIRONMENT_IS_WORKER;var ENVIRONMENT_IS_PTHREAD=Module[\"ENVIRONMENT_IS_PTHREAD\"]||false;if(ENVIRONMENT_IS_PTHREAD){buffer=Module[\"buffer\"]}var scriptDirectory=\"\";function locateFile(path){if(Module[\"locateFile\"]){return Module[\"locateFile\"](path,scriptDirectory)}return scriptDirectory+path}var read_,readAsync,readBinary,setWindowTitle;var nodeFS;var nodePath;if(ENVIRONMENT_IS_NODE){if(ENVIRONMENT_IS_WORKER){scriptDirectory=require(\"path\").dirname(scriptDirectory)+\"/\"}else{scriptDirectory=__dirname+\"/\"}read_=function shell_read(filename,binary){if(!nodeFS)nodeFS=require(\"fs\");if(!nodePath)nodePath=require(\"path\");filename=nodePath[\"normalize\"](filename);return nodeFS[\"readFileSync\"](filename,binary?null:\"utf8\")};readBinary=function readBinary(filename){var ret=read_(filename,true);if(!ret.buffer){ret=new Uint8Array(ret)}assert(ret.buffer);return ret};if(process[\"argv\"].length>1){thisProgram=process[\"argv\"][1].replace(/\\\\/g,\"/\")}arguments_=process[\"argv\"].slice(2);process[\"on\"](\"uncaughtException\",function(ex){if(!(ex instanceof ExitStatus)){throw ex}});process[\"on\"](\"unhandledRejection\",abort);quit_=function(status){process[\"exit\"](status)};Module[\"inspect\"]=function(){return\"[Emscripten Module object]\"};var nodeWorkerThreads;try{nodeWorkerThreads=require(\"worker_threads\")}catch(e){console.error('The \"worker_threads\" module is not supported in this node.js build - perhaps a newer version is needed?');throw e}global.Worker=nodeWorkerThreads.Worker}else if(ENVIRONMENT_IS_SHELL){if(typeof read!=\"undefined\"){read_=function shell_read(f){return read(f)}}readBinary=function readBinary(f){var data;if(typeof readbuffer===\"function\"){return new Uint8Array(readbuffer(f))}data=read(f,\"binary\");assert(typeof data===\"object\");return data};if(typeof scriptArgs!=\"undefined\"){arguments_=scriptArgs}else if(typeof arguments!=\"undefined\"){arguments_=arguments}if(typeof quit===\"function\"){quit_=function(status){quit(status)}}if(typeof print!==\"undefined\"){if(typeof console===\"undefined\")console={};console.log=print;console.warn=console.error=typeof printErr!==\"undefined\"?printErr:print}}else if(ENVIRONMENT_IS_WEB||ENVIRONMENT_IS_WORKER){if(ENVIRONMENT_IS_WORKER){scriptDirectory=self.location.href}else if(typeof document!==\"undefined\"&&document.currentScript){scriptDirectory=document.currentScript.src}if(typeof _scriptDir !== \"undefined\" && _scriptDir){scriptDirectory=_scriptDir}if(scriptDirectory.indexOf(\"blob:\")!==0){scriptDirectory=scriptDirectory.substr(0,scriptDirectory.lastIndexOf(\"/\")+1)}else{scriptDirectory=\"\"}if(ENVIRONMENT_IS_NODE){read_=function

shell_read(filename,binary){if(!nodeFS)nodeFS=require(\"fs\");if(!nodePath)nodePath=require(\"path\");filename=nodePath[\"normalize\"](filename);return nodeFS[\"readFileSync\"](filename,binary?null:\"utf8\")};readBinary=function readBinary(filename){var ret=read_(filename,true);if(!ret.buffer){ret=new Uint8Array(ret)}assert(ret.buffer);return ret}}else{read_=function(url){var xhr=new XMLHttpRequest;xhr.open(\"GET\",url,false);xhr.send(null);return xhr.responseText};if(ENVIRONMENT_IS_WORKER){readBinary=function(url){var xhr=new XMLHttpRequest;xhr.open(\"GET\",url,false);xhr.responseType=\"arraybuffer\";xhr.send(null);return new Uint8Array(xhr.response)}}readAsync=function(url,onload,onerror){var xhr=new XMLHttpRequest;xhr.open(\"GET\",url,true);xhr.responseType=\"arraybuffer\";xhr.onload=function(){if(xhr.status==200||xhr.status==0&&xhr.response){onload(xhr.response);return}onerror()};xhr.onerror=onerror;xhr.send(null)}}setWindowTitle=function(title){document.title=title}}else{}if(ENVIRONMENT_IS_NODE){if(typeof performance===\"undefined\"){global.performance=require(\"perf_hooks\").performance}}var out=Module[\"print\"]||console.log.bind(console);var err=Module[\"printErr\"]||console.warn.bind(console);for(key in moduleOverrides){if(moduleOverrides.hasOwnProperty(key)){Module[key]=moduleOverrides[key]}}moduleOverrides=null;if(Module[\"arguments\"])arguments_=Module[\"arguments\"];if(Module[\"thisProgram\"])thisProgram=Module[\"thisProgram\"];if(Module[\"quit\"])quit_=Module[\"quit\"];function warnOnce(text){if(!warnOnce.shown)warnOnce.shown={};if(!warnOnce.shown[text]){warnOnce.shown[text]=1;err(text)}}var Atomics_load=Atomics.load;var Atomics_store=Atomics.store;var Atomics_compareExchange=Atomics.compareExchange;var wasmBinary;if(Module[\"wasmBinary\"])wasmBinary=Module[\"wasmBinary\"];var noExitRuntime=Module[\"noExitRuntime\"]||true;if(typeof WebAssembly!==\"object\"){abort(\"no native wasm support detected\")}var wasmMemory;var wasmModule;var ABORT=false;var EXITSTATUS;function assert(condition,text){if(!condition){abort(\"Assertion failed: \"+text)}}function getCFunc(ident){var func=Module[\"_\"+ident];assert(func,\"Cannot call unknown function \"+ident+\", make sure it is exported\");return func}function ccall(ident,returnType,argTypes,args,opts){var toC={\"string\":function(str){var ret=0;if(str!==null&&str!==undefined&&str!==0){var len=(str.length<<2)+1;ret=stackAlloc(len);stringToUTF8(str,ret,len)}return ret},\"array\":function(arr){var ret=stackAlloc(arr.length);writeArrayToMemory(arr,ret);return ret}};function convertReturnValue(ret){if(returnType===\"string\")return UTF8ToString(ret);if(returnType===\"boolean\")return Boolean(ret);return ret}var func=getCFunc(ident);var cArgs=[];var stack=0;if(args){for(var i=0;i<args.length;i++){var converter=toC[argTypes[i]];if(converter){if(stack===0)stack=stackSave();cArgs[i]=converter(args[i])}else{cArgs[i]=args[i]}}}var ret=func.apply(null,cArgs);ret=convertReturnValue(ret);if(stack!==0)stackRestore(stack);return ret}function cwrap(ident,returnType,argTypes,opts){argTypes=argTypes||[];var numericArgs=argTypes.every(function(type){return type===\"number\"});var numericRet=returnType!==\"string\";if(numericRet&&numericArgs&&!opts){return getCFunc(ident)}return function(){return ccall(ident,returnType,argTypes,arguments,opts)}}function UTF8ArrayToString(heap,idx,maxBytesToRead){var endIdx=idx+maxBytesToRead;var str=\"\";while(!(idx>=endIdx)){var u0=heap[idx++];if(!u0)return str;if(!(u0&128)){str+=String.fromCharCode(u0);continue}var u1=heap[idx++]&63;if((u0&224)==192){str+=String.fromCharCode((u0&31)<<6|u1);continue}var u2=heap[idx++]&63;if((u0&240)==224){u0=(u0&15)<<12|u1<<6|u2}else{u0=(u0&7)<<18|u1<<12|u2<<6|heap[idx++]&63}if(u0<65536){str+=String.fromCharCode(u0)}else{var ch=u0-65536;str+=String.fromCharCode(55296|ch>>10,56320|ch&1023)}}return str}function UTF8ToString(ptr,maxBytesToRead){return

ptr?UTF8ArrayToString(GROWABLE_HEAP_U8(),ptr,maxBytesToRead):\"\"}function stringToUTF8Array(str,heap,outIdx,maxBytesToWrite){if(!(maxBytesToWrite>0))return 0;var startIdx=outIdx;var endIdx=outIdx+maxBytesToWrite-1;for(var i=0;i<str.length;++i){var u=str.charCodeAt(i);if(u>=55296&&u<=57343){var u1=str.charCodeAt(++i);u=65536+((u&1023)<<10)|u1&1023}if(u<=127){if(outIdx>=endIdx)break;heap[outIdx++]=u}else if(u<=2047){if(outIdx+1>=endIdx)break;heap[outIdx++]=192|u>>6;heap[outIdx++]=128|u&63}else if(u<=65535){if(outIdx+2>=endIdx)break;heap[outIdx++]=224|u>>12;heap[outIdx++]=128|u>>6&63;heap[outIdx++]=128|u&63}else{if(outIdx+3>=endIdx)break;heap[outIdx++]=240|u>>18;heap[outIdx++]=128|u>>12&63;heap[outIdx++]=128|u>>6&63;heap[outIdx++]=128|u&63}}heap[outIdx]=0;return outIdx-startIdx}function stringToUTF8(str,outPtr,maxBytesToWrite){return stringToUTF8Array(str,GROWABLE_HEAP_U8(),outPtr,maxBytesToWrite)}function lengthBytesUTF8(str){var len=0;for(var i=0;i<str.length;++i){var u=str.charCodeAt(i);if(u>=55296&&u<=57343)u=65536+((u&1023)<<10)|str.charCodeAt(++i)&1023;if(u<=127)++len;else if(u<=2047)len+=2;else if(u<=65535)len+=3;else len+=4}return len}function writeArrayToMemory(array,buffer){GROWABLE_HEAP_I8().set(array,buffer)}function alignUp(x,multiple){if(x%multiple>0){x+=multiple-x%multiple}return x}var buffer,HEAP8,HEAPU8,HEAP16,HEAPU16,HEAP32,HEAPU32,HEAPF32,HEAPF64;function updateGlobalBufferAndViews(buf){buffer=buf;Module[\"HEAP8\"]=HEAP8=new Int8Array(buf);Module[\"HEAP16\"]=HEAP16=new Int16Array(buf);Module[\"HEAP32\"]=HEAP32=new Int32Array(buf);Module[\"HEAPU8\"]=HEAPU8=new Uint8Array(buf);Module[\"HEAPU16\"]=HEAPU16=new Uint16Array(buf);Module[\"HEAPU32\"]=HEAPU32=new Uint32Array(buf);Module[\"HEAPF32\"]=HEAPF32=new Float32Array(buf);Module[\"HEAPF64\"]=HEAPF64=new Float64Array(buf)}var INITIAL_MEMORY=Module[\"INITIAL_MEMORY\"]||16777216;if(ENVIRONMENT_IS_PTHREAD){wasmMemory=Module[\"wasmMemory\"];buffer=Module[\"buffer\"]}else{if(Module[\"wasmMemory\"]){wasmMemory=Module[\"wasmMemory\"]}else{wasmMemory=new WebAssembly.Memory({\"initial\":INITIAL_MEMORY/65536,\"maximum\":2147483648/65536,\"shared\":true});if(!(wasmMemory.buffer instanceof SharedArrayBuffer)){err(\"requested a shared WebAssembly.Memory but the returned buffer is not a SharedArrayBuffer, indicating that while the browser has SharedArrayBuffer it does not have WebAssembly threads support - you may need to set a flag\");if(ENVIRONMENT_IS_NODE){console.log(\"(on node you may need: --experimental-wasm-threads --experimental-wasm-bulk-memory and also use a recent version)\")}throw Error(\"bad memory\")}}}if(wasmMemory){buffer=wasmMemory.buffer}INITIAL_MEMORY=buffer.byteLength;updateGlobalBufferAndViews(buffer);var wasmTable;var __ATPRERUN__=[];var __ATINIT__=[];var __ATMAIN__=[];var __ATEXIT__=[];var __ATPOSTRUN__=[];var runtimeInitialized=false;var runtimeExited=false;if(!ENVIRONMENT_IS_PTHREAD)__ATINIT__.push({func:function(){___wasm_call_ctors()}});function preRun(){if(ENVIRONMENT_IS_PTHREAD)return;if(Module[\"preRun\"]){if(typeof Module[\"preRun\"]==\"function\")Module[\"preRun\"]=[Module[\"preRun\"]];while(Module[\"preRun\"].length){addOnPreRun(Module[\"preRun\"].shift())}}callRuntimeCallbacks(__ATPRERUN__)}function initRuntime(){runtimeInitialized=true;if(ENVIRONMENT_IS_PTHREAD)return;callRuntimeCallbacks(__ATINIT__)}function preMain(){if(ENVIRONMENT_IS_PTHREAD)return;callRuntimeCallbacks(__ATMAIN__)}function exitRuntime(){if(ENVIRONMENT_IS_PTHREAD)return;runtimeExited=true}function postRun(){if(ENVIRONMENT_IS_PTHREAD)return;if(Module[\"postRun\"]){if(typeof Module[\"postRun\"]==\"function\")Module[\"postRun\"]=[Module[\"postRun\"]];while(Module[\"postRun\"].length){addOnPostRun(Module[\"postRun\"].shift())}}callRuntimeCallbacks(__ATPOSTRUN__)}function addOnPreRun(cb){__ATPRERUN__.unshift(cb)}function addOnPostRun(cb){__ATPOSTRUN__.unshift(cb)}var

runDependencies=0;var runDependencyWatcher=null;var dependenciesFulfilled=null;function addRunDependency(id){assert(!ENVIRONMENT_IS_PTHREAD,\"addRunDependency cannot be used in a pthread worker\");runDependencies++;if(Module[\"monitorRunDependencies\"]){Module[\"monitorRunDependencies\"](runDependencies)}}function removeRunDependency(id){runDependencies--;if(Module[\"monitorRunDependencies\"]){Module[\"monitorRunDependencies\"](runDependencies)}if(runDependencies==0){if(runDependencyWatcher!==null){clearInterval(runDependencyWatcher);runDependencyWatcher=null}if(dependenciesFulfilled){var callback=dependenciesFulfilled;dependenciesFulfilled=null;callback()}}}Module[\"preloadedImages\"]={};Module[\"preloadedAudios\"]={};function abort(what){if(Module[\"onAbort\"]){Module[\"onAbort\"](what)}if(ENVIRONMENT_IS_PTHREAD)console.error(\"Pthread aborting at \"+(new Error).stack);what+=\"\";err(what);ABORT=true;EXITSTATUS=1;what=\"abort(\"+what+\"). Build with -sASSERTIONS=1 for more info.\";var e=new WebAssembly.RuntimeError(what);readyPromiseReject(e);throw e}function hasPrefix(str,prefix){return String.prototype.startsWith?str.startsWith(prefix):str.indexOf(prefix)===0}var dataURIPrefix=\"data:application/octet-stream; base64,\";function isDataURI(filename){return hasPrefix(filename,dataURIPrefix)}var fileURIPrefix=\"file://\";function isFileURI(filename){return hasPrefix(filename,fileURIPrefix)}var wasmBinaryFile=\"tfjs-backend-wasm-threaded-simd.wasm\";if(!isDataURI(wasmBinaryFile)){wasmBinaryFile=locateFile(wasmBinaryFile)}function getBinary(file){try{if(file==wasmBinaryFile&&wasmBinary){return new Uint8Array(wasmBinary)}if(readBinary){return readBinary(file)}else{throw\"both async and sync fetching of the wasm failed\"}}catch(err){abort(err)}}function getBinaryPromise(){if(!wasmBinary&&(ENVIRONMENT_IS_WEB||ENVIRONMENT_IS_WORKER)){if(typeof fetch===\"function\"&&!isFileURI(wasmBinaryFile)){return fetch(wasmBinaryFile,{credentials:\"same-origin\"}).then(function(response){if(!response[\"ok\"]){throw\"failed to load wasm binary file at '\"+wasmBinaryFile+\"'\"}return response[\"arrayBuffer\"]()}).catch(function(){return getBinary(wasmBinaryFile)})}else{if(readAsync){return new Promise(function(resolve,reject){readAsync(wasmBinaryFile,function(response){resolve(new Uint8Array(response))},reject)})}}}return Promise.resolve().then(function(){return getBinary(wasmBinaryFile)})}function createWasm(){var info={\"a\":asmLibraryArg};function receiveInstance(instance,module){var exports=instance.exports;Module[\"asm\"]=exports;wasmTable=Module[\"asm\"][\"I\"];wasmModule=module;if(!ENVIRONMENT_IS_PTHREAD){var numWorkersToLoad=PThread.unusedWorkers.length;PThread.unusedWorkers.forEach(function(w){PThread.loadWasmModuleToWorker(w,function(){if(!--numWorkersToLoad)removeRunDependency(\"wasm-instantiate\")})})}if(!ENVIRONMENT_IS_PTHREAD){addRunDependency(\"wasm-instantiate\")}function receiveInstantiatedSource(output){receiveInstance(output[\"instance\"],output[\"module\"])}function instantiateArrayBuffer(receiver){return getBinaryPromise().then(function(binary){return WebAssembly.instantiate(binary,info)}).then(receiver,function(reason){err(\"failed to asynchronously prepare wasm: \"+reason);abort(reason)})}function instantiateAsync(){if(!wasmBinary&&typeof WebAssembly.instantiateStreaming===\"function\"&&!isDataURI(wasmBinaryFile)&&!isFileURI(wasmBinaryFile)&&typeof fetch===\"function\"){return fetch(wasmBinaryFile,{credentials:\"same-origin\"}).then(function(response){var result=WebAssembly.instantiateStreaming(response,info);return result.then(receiveInstantiatedSource,function(reason){err(\"wasm streaming compile failed: \"+reason);err(\"falling back to ArrayBuffer instantiation\");return instantiateArrayBuffer(receiveInstantiatedSource)})})}else{return instantiateArrayBuffer(receiveInstantiatedSource)}}if(Module[\"instantiateWasm\"]){try{var exports=Module[\"instantiateWasm\"](info,receiveInstance);return exports}catch(e){err(\"Module.instantiateWasm

callback failed with error: \"+e);return false}}instantiateAsync().catch(readyPromiseReject);return{}}var ASM_CONSTS={10520:function(){throw\"Canceled!\"},10538:function($0,$1){setTimeout(function(){__emscripten_do_dispatch_to_thread($0,$1)},0)}};function initPthreadsJS(){PThread.initRuntime()}function callRuntimeCallbacks(callbacks){while(callbacks.length>0){var callback=callbacks.shift();if(typeof callback==\"function\"){callback(Module);continue}var func=callback.func;if(typeof func===\"number\"){if(callback.arg===undefined){wasmTable.get(func)()}else{wasmTable.get(func)(callback.arg)}}else{func(callback.arg===undefined?null:callback.arg)}}}var ERRNO_CODES={EPERM:63,ENOENT:44,ESRCH:71,EINTR:27,EIO:29,ENXIO:60,E2BIG:1,ENOEXEC:45,EBADF:8,ECHILD:12,EAGAIN:6,EWOULDBLOCK:6,ENOMEM:48,EACCES:2,EFAULT:21,ENOTBLK:105,EBUSY:10,EEXIST:20,EXDEV:75,ENODEV:43,ENOTDIR:54,EISDIR:31,EINVAL:28,ENFILE:41,EMFILE:33,ENOTTY:59,ETXTBSY:74,EFBIG:22,ENOSPC:51,ESPIPE:70,EROFS:69,EMLINK:34,EPIPE:64,EDOM:18,ERANGE:68,ENOMSG:49,EIDRM:24,ECHRNG:106,EL2NSYNC:156,EL3HLT:107,EL3RST:108,ELNRNG:109,EUNATCH:110,ENOCSI:111,EL2HLT:112,EDEADLK:16,ENOLCK:46,EBADE:113,EBADR:114,EXFULL:115,ENOANO:104,EBADRQC:103,EBADSLT:102,EDEADLOCK:16,EBFONT:101,ENOSTR:100,ENODATA:116,ETIME:117,ENOSR:118,ENONET:119,ENOPKG:120,EREMOTE:121,ENOLINK:47,EADV:122,ESRMNT:123,ECOMM:124,EPROTO:65,EMULTIHOP:36,EDOTDOT:125,EBADMSG:9,ENOTUNIQ:126,EBADFD:127,EREMCHG:128,ELIBACC:129,ELIBBAD:130,ELIBSCN:131,ELIBMAX:132,ELIBEXEC:133,ENOSYS:52,ENOTEMPTY:55,ENAMETOOLONG:37,ELOOP:32,EOPNOTSUPP:138,EPFNOSUPPORT:139,ECONNRESET:15,ENOBUFS:42,EAFNOSUPPORT:5,EPROTOTYPE:67,ENOTSOCK:57,ENOPROTOOPT:50,ESHUTDOWN:140,ECONNREFUSED:14,EADDRINUSE:3,ECONNABORTED:13,ENETUNREACH:40,ENETDOWN:38,ETIMEDOUT:73,EHOSTDOWN:142,EHOSTUNREACH:23,EINPROGRESS:26,EALREADY:7,EDESTADDRREQ:17,EMSGSIZE:35,EPROTONOSUPPORT:66,ESOCKTNOSUPPORT:137,EADDRNOTAVAIL:4,ENETRESET:39,EISCONN:30,ENOTCONN:53,ETOOMANYREFS:141,EUSERS:136,EDQUOT:19,ESTALE:72,ENOTSUP:138,ENOMEDIUM:148,EILSEQ:25,EOVERFLOW:61,ECANCELED:11,ENOTRECOVERABLE:56,EOWNERDEAD:62,ESTRPIPE:135};function _emscripten_futex_wake(addr,count){if(addr<=0||addr>GROWABLE_HEAP_I8().length||addr&3!=0||count<0)return-28;if(count==0)return 0;if(count>=2147483647)count=Infinity;var mainThreadWaitAddress=Atomics.load(GROWABLE_HEAP_I32(),__emscripten_main_thread_futex>>2);var mainThreadWoken=0;if(mainThreadWaitAddress==addr){var loadedAddr=Atomics.compareExchange(GROWABLE_HEAP_I32(),__emscripten_main_thread_futex>>2,mainThreadWaitAddress,0);if(loadedAddr==mainThreadWaitAddress){--count;mainThreadWoken=1;if(count<=0)return 1}}var ret=Atomics.notify(GROWABLE_HEAP_I32(),addr>>2,count);if(ret>=0)return ret+mainThreadWoken;throw\"Atomics.notify returned an unexpected value \"+ret}Module[\"_emscripten_futex_wake\"]=_emscripten_futex_wake;function killThread(pthread_ptr){if(ENVIRONMENT_IS_PTHREAD)throw\"Internal Error! killThread() can only ever be called from main application thread!\";if(!pthread_ptr)throw\"Internal Error! Null pthread_ptr in killThread!\";GROWABLE_HEAP_I32()[pthread_ptr+12>>2]=0;var pthread=PThread.pthreads[pthread_ptr];pthread.worker.terminate();PThread.freeThreadData(pthread);PThread.runningWorkers.splice(PThread.runningWorkers.indexOf(pthread.worker),1);pthread.worker.pthread=undefined}function cancelThread(pthread_ptr){if(ENVIRONMENT_IS_PTHREAD)throw\"Internal Error! cancelThread() can only ever be called from main application thread!\";if(!pthread_ptr)throw\"Internal Error! Null pthread_ptr in cancelThread!\";var pthread=PThread.pthreads[pthread_ptr];pthread.worker.postMessage({\"cmd\":\"cancel\"})}function cleanupThread(pthread_ptr){if(ENVIRONMENT_IS_PTHREAD)throw\"Internal Error! cleanupThread() can only ever be called from main application thread!\";if(!pthread_ptr)throw\"Internal Error! Null pthread_ptr in cleanupThread!\";var pthread=PThread.pthreads[pthread_ptr];if(pthread){GROWABLE_HEAP_I32()[pthread_ptr+12>>2]=0;var worker=pthread.worker;PThread.returnWorkerToPool(worker)}}var

PThread={unusedWorkers:[],runningWorkers:[],initMainThreadBlock:function(){var
pthreadPoolSize=8;for(var
i=0;i<pthreadPoolSize;++i){PThread.allocateUnusedWorker()}},initRuntime:function(){var
tb=_malloc(228);for(var
i=0;i<228/4;++i)GROWABLE_HEAP_U32()[tb/4+i]=0;GROWABLE_HEAP_I32()[tb+12>>2]=tb;var
headPtr=tb+152;GROWABLE_HEAP_I32()[headPtr>>2]=headPtr;var tlsMemory=_malloc(512);for(var
i=0;i<128;++i)GROWABLE_HEAP_U32()[tlsMemory/4+i]=0;Atomics.store(GROWABLE_HEAP_U32(),tb+100
>>2,tlsMemory);Atomics.store(GROWABLE_HEAP_U32(),tb+40>>2,tb);__emscripten_thread_init(tb,!ENVIRON
MENT_IS_WORKER,1);_emscripten_register_main_browser_thread_id(tb)},initWorker:function(){},pthreads:{},t
hreadExitHandlers:[],setThreadStatus:function(){},runExitHandlers:function(){while(PThread.threadExitHandlers.l
ength>0){PThread.threadExitHandlers.pop()()}if(ENVIRONMENT_IS_PTHREAD&&_pthread_self())___pthread
_tsd_run_dtors()},runExitHandlersAndDeinitThread:function(tb,exitCode){Atomics.store(GROWABLE_HEAP_U
32(),tb+56>>2,1);Atomics.store(GROWABLE_HEAP_U32(),tb+60>>2,0);PThread.runExitHandlers();Atomics.stor
e(GROWABLE_HEAP_U32(),tb+4>>2,exitCode);Atomics.store(GROWABLE_HEAP_U32(),tb+0>>2,1);_emscri
pten_futex_wake(tb+0,2147483647);__emscripten_thread_init(0,0,0)},threadExit:function(exitCode){var
tb=_pthread_self();if(tb){PThread.runExitHandlersAndDeinitThread(tb,exitCode);if(ENVIRONMENT_IS_PTHRE
AD){postMessage({\"cmd\":\"exit\"})}}},threadCancel:function(){PThread.runExitHandlersAndDeinitThread(_pthr
ead_self(),-1);postMessage({\"cmd\":\"cancelDone\"})},terminateAllThreads:function(){for(var t in
PThread.pthreads){var
pthread=PThread.pthreads[t];if(pthread&&pthread.worker){PThread.returnWorkerToPool(pthread.worker)}}PThre
ad.pthreads={};for(var i=0;i<PThread.unusedWorkers.length;++i){var
worker=PThread.unusedWorkers[i];worker.terminate()}PThread.unusedWorkers=[];for(var
i=0;i<PThread.runningWorkers.length;++i){var worker=PThread.runningWorkers[i];var
pthread=worker.pthread;PThread.freeThreadData(pthread);worker.terminate()}PThread.runningWorkers=[]},freeTh
readData:function(pthread){if(!pthread)return;if(pthread.threadInfoStruct){var
tlsMemory=GROWABLE_HEAP_I32()[pthread.threadInfoStruct+100>>2];GROWABLE_HEAP_I32()[pthread.thr
eadInfoStruct+100>>2]=0;_free(tlsMemory);_free(pthread.threadInfoStruct)}pthread.threadInfoStruct=0;if(pthread.
allocatedOwnStack&&pthread.stackBase)_free(pthread.stackBase);pthread.stackBase=0;if(pthread.worker)pthread.
worker.pthread=null},returnWorkerToPool:function(worker){PThread.runWithoutMainThreadQueuedCalls(functio
n(){delete
PThread.pthreads[worker.pthread.threadInfoStruct];PThread.unusedWorkers.push(worker);PThread.runningWorker
s.splice(PThread.runningWorkers.indexOf(worker),1);PThread.freeThreadData(worker.pthread);worker.pthread=un
defined})},runWithoutMainThreadQueuedCalls:function(func){GROWABLE_HEAP_I32()[__emscripten_allow_m
ain_runtime_queued_calls>>2]=0;try{func()}finally{GROWABLE_HEAP_I32()[__emscripten_allow_main_runti
me_queued_calls>>2]=1}},receiveObjectTransfer:function(data){},loadWasmModuleToWorker:function(worker,o
nFinishedLoading){worker.onmessage=function(e){var
d=e[\"data\"];var
cmd=d[\"cmd\"];if(worker.pthread)PThread.currentProxiedOperationCallerThread=worker.pthread.threadInfoStruct;
if(d[\"targetThread\"]&&d[\"targetThread\"]!=_pthread_self()){var
thread=PThread.pthreads[d.targetThread];if(thread){thread.worker.postMessage(e.data,d[\"transferList\"])}else{con
sole.error('Internal error! Worker sent a message \"'+cmd+'\" to target pthread '+d[\"targetThread\"]+\", but that
thread no longer
exists!\")}PThread.currentProxiedOperationCallerThread=undefined;return}if(cmd===\"processQueuedMainThread
Work\"){_emscripten_main_thread_process_queued_calls()}else
if(cmd===\"spawnThread\"){spawnThread(e.data)}else
if(cmd===\"cleanupThread\"){cleanupThread(d[\"thread\"])}else
if(cmd===\"killThread\"){killThread(d[\"thread\"])}else
if(cmd===\"cancelThread\"){cancelThread(d[\"thread\"])}else

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if(cmd===\"loaded\"){worker.loaded=true;if(onFinishedLoading)onFinishedLoading(worker);if(worker.runPthread){worker.runPthread();delete
 worker.runPthread}}else if(cmd===\"print\"){out(\"Thread \"+d[\"threadId\"]+\": \"+d[\"text\"])}else if(cmd===\"printErr\"){err(\"Thread \"+d[\"threadId\"]+\": \"+d[\"text\"])}else if(cmd===\"alert\"){alert(\"Thread \"+d[\"threadId\"]+\": \"+d[\"text\"])}else if(cmd===\"exit\"){var detached=worker.pthread&&Atomics.load(GROWABLE_HEAP_U32(),worker.pthread.threadInfoStruct+64>>2);if(detached){PThread.returnWorkerToPool(worker)}}else if(cmd===\"exitProcess\"){try{exit(d[\"returnCode\"])}catch(e){if(e instanceof ExitStatus)return;throw e}}else if(cmd===\"cancelDone\"){PThread.returnWorkerToPool(worker)}else if(cmd===\"objectTransfer\"){PThread.receiveObjectTransfer(e.data)}else if(e.data.target===\"setimmediate\"){worker.postMessage(e.data)}else{err(\"worker sent an unknown command \"+cmd)}PThread.currentProxiedOperationCallerThread=undefined};worker.onerror=function(e){err(\"pthread sent an error! \"+e.filename+\":\"+e.lineno+\": \"+e.message)};if(ENVIRONMENT_IS_NODE){worker.on(\"message\",function(data){worker.onmessage({data:data})});worker.on(\"error\",function(data){worker.onerror(data)});worker.on(\"exit\",function(data){})}worker.postMessage({\"cmd\":\"load\",\"urlOrBlob\":Module[\"mainScriptUrlOrBlob\"]||_scriptDir,\"wasmMemory\":wasmMemory,\"wasmModule\":wasmModule})},allocateUnusedWorker:function(){var
 pthreadMainJs=locateFile(\"tfjs-backend-wasm-threaded-simd.worker.js\");PThread.unusedWorkers.push(new Worker(pthreadMainJs))},getNewWorker:function(){if(PThread.unusedWorkers.length==0){PThread.allocateUnusedWorker();PThread.loadWasmModuleToWorker(PThread.unusedWorkers[0])}if(PThread.unusedWorkers.length>0)return PThread.unusedWorkers.pop();else return null},busySpinWait:function(msecs){var t=performance.now()+msecs;while(performance.now()<t){}}};function establishStackSpace(stackTop,stackMax){_emscripten_stack_set_limits(stackTop,stackMax);stackRestore(stackTop)}Module[\"establishStackSpace\"]=establishStackSpace;function
 getNoExitRuntime(){return noExitRuntime}Module[\"getNoExitRuntime\"]=getNoExitRuntime;function invokeEntryPoint(ptr,arg){return wasmTable.get(ptr)(arg)}Module[\"invokeEntryPoint\"]=invokeEntryPoint;function ___assert_fail(condition,filename,line,func){abort(\"Assertion failed: \"+UTF8ToString(condition)+\", at: \"+[filename?UTF8ToString(filename):\"unknown filename\",line,func?UTF8ToString(func):\"unknown function\"])}function ___call_main(argc,argv){var returnCode=_main(argc,argv)}var _emscripten_get_now;if(ENVIRONMENT_IS_NODE){_emscripten_get_now=function(){var t=process[\"hrtime\"]();return t[0]*1e3+t[1]/1e6}}else if(ENVIRONMENT_IS_PTHREAD){_emscripten_get_now=function(){return performance.now()-Module[\"__performance_now_clock_drift\"]}}else if(typeof dateNow!==\"undefined\"){_emscripten_get_now=dateNow}else _emscripten_get_now=function(){return performance.now()};function setErrNo(value){GROWABLE_HEAP_I32()[___errno_location()>>2]=value;return value}function _atexit(func,arg){if(ENVIRONMENT_IS_PTHREAD)return
 _emscripten_proxy_to_main_thread_js(1,1,func,arg)}function __emscripten_notify_thread_queue(targetThreadId,mainThreadId){if(targetThreadId==mainThreadId){postMessage({\"cmd\":\"processQueuedMainThreadWork\"})}else if(ENVIRONMENT_IS_PTHREAD){postMessage({\"targetThread\":targetThreadId,\"cmd\":\"processThreadQueue\"})}else{var pthread=PThread.pthreads[targetThreadId];var worker=pthread&&pthread.worker;if(!worker){return}worker.postMessage({\"cmd\":\"processThreadQueue\"})}return 1}function _abort(){abort()}function _emscripten_asm_const_int(code,sigPtr,argbuf){var args=readAsmConstArgs(sigPtr,argbuf);return ASM_CONSTS[code].apply(null,args)}function _emscripten_conditional_set_current_thread_status(expectedStatus,newStatus){}function _emscripten_futex_wait(addr,val,timeout){if(addr<=0||addr>GROWABLE_HEAP_I8().length||addr&3!=0)return-28;if(!ENVIRONMENT_IS_WEB){var
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ret=Atomics.wait(GROWABLE_HEAP_I32(),addr>>2,val,timeout);if(ret===\"timed-out\")return-73;if(ret===\"not-equal\")return-6;if(ret===\"ok\")return 0;throw\"Atomics.wait returned an unexpected value \"+ret}else{if(Atomics.load(GROWABLE_HEAP_I32(),addr>>2)!=val){return-6}var tNow=performance.now();var tEnd=tNow+timeout;var lastAddr=Atomics.exchange(GROWABLE_HEAP_I32(),__emscripten_main_thread_futex>>2,addr);while(1){tNow=performance.now();if(tNow>tEnd){lastAddr=Atomics.exchange(GROWABLE_HEAP_I32(),__emscripten_main_thread_futex>>2,0);return-73}lastAddr=Atomics.exchange(GROWABLE_HEAP_I32(),__emscripten_main_thread_futex>>2,0);if(lastAddr==0){break}_emscripten_main_thread_process_queued_calls();if(Atomics.load(GROWABLE_HEAP_I32(),addr>>2)!=val){return-6}lastAddr=Atomics.exchange(GROWABLE_HEAP_I32(),__emscripten_main_thread_futex>>2,addr)}return 0}}function _emscripten_memcpy_big(dest,src,num){GROWABLE_HEAP_U8().copyWithin(dest,src,src+num)}function _emscripten_num_logical_cores(){if(ENVIRONMENT_IS_NODE)return require(\"os\").cpus().length;return navigator[\"hardwareConcurrency\"]}function _emscripten_proxy_to_main_thread_js(index,sync){var numCallArgs=arguments.length-2;var stack=stackSave();var serializedNumCallArgs=numCallArgs;var args=stackAlloc(serializedNumCallArgs*8);var b=args>>3;for(var i=0;i<numCallArgs;i++){var arg=arguments[2+i];GROWABLE_HEAP_F64()[b+i]=arg}var ret=_emscripten_run_in_main_runtime_thread_js(index,serializedNumCallArgs,args,sync);stackRestore(stack);return ret}var _emscripten_receive_on_main_thread_js_callArgs=[];var readAsmConstArgsArray=[];function readAsmConstArgs(sigPtr,buf){readAsmConstArgsArray.length=0;var ch;buf>>=2;while(ch=GROWABLE_HEAP_U8()[sigPtr++]){var double=ch<105;if(double&&buf&1)buf++;readAsmConstArgsArray.push(double?GROWABLE_HEAP_F64()[buf++>>1]:GROWABLE_HEAP_I32()[buf]);++buf}return readAsmConstArgsArray}function _emscripten_receive_on_main_thread_js(index,numCallArgs,args){_emscripten_receive_on_main_thread_js_callArgs.length=numCallArgs;var b=args>>3;for(var i=0;i<numCallArgs;i++){_emscripten_receive_on_main_thread_js_callArgs[i]=GROWABLE_HEAP_F64()[b+i]}var isEmAsmConst=index<0;var func=!isEmAsmConst?proxiedFunctionTable[index]:ASM_CONSTS[-index-1];return func.apply(null,_emscripten_receive_on_main_thread_js_callArgs)}function _emscripten_get_heap_size(){return GROWABLE_HEAP_U8().length}function emscripten_realloc_buffer(size){try{wasmMemory.grow(size-buffer.byteLength+65535>>>16);updateGlobalBufferAndViews(wasmMemory.buffer);return 1}catch(e){}}function _emscripten_resize_heap(requestedSize){var oldSize=_emscripten_get_heap_size();if(requestedSize<=oldSize){return false}var maxHeapSize=2147483648;if(requestedSize>maxHeapSize){return false}for(var cutDown=1;cutDown<=4;cutDown*=2){var overGrownHeapSize=oldSize*(1+.2/cutDown);overGrownHeapSize=Math.min(overGrownHeapSize,requestedSize+100663296);var newSize=Math.min(maxHeapSize,alignUp(Math.max(requestedSize,overGrownHeapSize),65536));var replacement=emscripten_realloc_buffer(newSize);if(replacement){return true}}return false}var JSEvents={inEventHandler:0,removeAllEventListeners:function(){for(var i=JSEvents.eventHandlers.length-1;i>=0;--i){JSEvents._removeHandler(i)}JSEvents.eventHandlers=[];JSEvents.deferredCalls=[]},registerRemoveEventListeners:function(){if(!JSEvents.removeEventListenersRegistered){__ATEXIT__.push(JSEvents.removeAllEventListeners);JSEvents.removeEventListenersRegistered=true}},deferredCalls:[],deferCall:function(targetFunction,precedence,argsList){function arraysHaveEqualContent(arrA,arrB){if(arrA.length!=arrB.length)return false;for(var i in

arrA){if(arrA[i]!=arrB[i])return false}return true}for(var i in JSEvents.deferredCalls){var call=JSEvents.deferredCalls[i];if(call.targetFunction==targetFunction&&arraysHaveEqualContent(call.argsList,argsList)){return}}JSEvents.deferredCalls.push({targetFunction:targetFunction,precedence:precedence,argsList:argsList});JSEvents.deferredCalls.sort(function(x,y){return x.precedence<y.precedence})},removeDeferredCalls:function(targetFunction){for(var i=0;i<JSEvents.deferredCalls.length;++i){if(JSEvents.deferredCalls[i].targetFunction==targetFunction){JSEvents.deferredCalls.splice(i,1);--i}}},canPerformEventHandlerRequests:function(){return JSEvents.inEventHandler&&JSEvents.currentEventHandler.allowsDeferredCalls},runDeferredCalls:function(){if(!JSEvents.canPerformEventHandlerRequests()){return}for(var i=0;i<JSEvents.deferredCalls.length;++i){var call=JSEvents.deferredCalls[i];JSEvents.deferredCalls.splice(i,1);--i;call.targetFunction.apply(null,call.argsList)}},eventHandlers:[],removeAllHandlersOnTarget:function(target,eventTypeString){for(var i=0;i<JSEvents.eventHandlers.length;++i){if(JSEvents.eventHandlers[i].target==target&&(!eventTypeString||eventTypeString==JSEvents.eventHandlers[i].eventTypeString)){JSEvents._removeHandler(i--)}}},_removeHandler:function(i){var h=JSEvents.eventHandlers[i];h.target.removeEventListener(h.eventTypeString,h.eventListenerFunc,h.useCapture);JSEvents.eventHandlers.splice(i,1)},registerOrRemoveHandler:function(eventHandler){var jsEventHandler=function jsEventHandler(event){++JSEvents.inEventHandler;JSEvents.currentEventHandler=eventHandler;JSEvents.runDeferredCalls();eventHandler.handlerFunc(event);JSEvents.runDeferredCalls();--JSEvents.inEventHandler};if(eventHandler.callbackfunc){eventHandler.eventListenerFunc=jsEventHandler;eventHandler.target.addEventListener(eventHandler.eventTypeString,jsEventHandler,eventHandler.useCapture);JSEvents.eventHandlers.push(eventHandler);JSEvents.registerRemoveEventListeners()}else{for(var i=0;i<JSEvents.eventHandlers.length;++i){if(JSEvents.eventHandlers[i].target==eventHandler.target&&JSEvents.eventHandlers[i].eventTypeString==eventHandler.eventTypeString){JSEvents._removeHandler(i--)}}}},queueEventHandlerOnThread_iiii:function(targetThread,eventHandlerFunc,eventTypeId,eventData,userData){var stackTop=stackSave();var varargs=stackAlloc(12);GROWABLE_HEAP_I32()[varargs>>2]=eventTypeId;GROWABLE_HEAP_I32()[varargs+4>>2]=eventData;GROWABLE_HEAP_I32()[varargs+8>>2]=userData;__emscripten_call_on_thread(0,targetThread,637534208,eventHandlerFunc,eventData,varargs);stackRestore(stackTop)},getTargetThreadForEventCallback:function(targetThread){switch(targetThread){case 1:return 0;case 2:return PThread.currentProxiedOperationCallerThread;default:return targetThread}},getNodeNameForTarget:function(target){if(!target)return\"\";if(target==window)return\"#window\";if(target==screen)return\"#screen\";return target&&target.nodeName?target.nodeName:\"\"},fullscreenEnabled:function(){return document.fullscreenEnabled||document.webkitFullscreenEnabled}};function stringToNewUTF8(jsString){var length=lengthBytesUTF8(jsString)+1;var cString=_malloc(length);stringToUTF8(jsString,cString,length);return cString}function _emscripten_set_offscreencanvas_size_on_target_thread_js(targetThread,targetCanvas,width,height){var stackTop=stackSave();var varargs=stackAlloc(12);var targetCanvasPtr=0;if(targetCanvas){targetCanvasPtr=stringToNewUTF8(targetCanvas)}GROWABLE_HEAP_I32()[varargs>>2]=targetCanvasPtr;GROWABLE_HEAP_I32()[varargs+4>>2]=width;GROWABLE_HEAP_I32()[varargs+8>>2]=height;__emscripten_call_on_thread(0,targetThread,657457152,0,targetCanvasPtr,varargs);stackRestore(stackTop)}function _emscripten_set_offscreencanvas_size_on_target_thread(targetThread,targetCanvas,width,height){targetCanvas=targetCanvas?UTF8ToString(targetCanvas):\"\";_emscripten_set_offscreencanvas_size_on_target_thread_js(targetThread,targetCanvas,width,height)}function maybeCStringToJsString(cString){return cString>2?UTF8ToString(cString):cString}var specialHTMLTargets=[0,typeof

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document!==\"undefined\"?document:0,typeof window!==\"undefined\"?window:0];function
findEventTarget(target){target=maybeCStringToJsString(target);var
domElement=specialHTMLTargets[target]||(typeof
document!==\"undefined\"?document.querySelector(target):undefined);return domElement}function
findCanvasEventTarget(target){return findEventTarget(target)}function
_emscripten_set_canvas_element_size_calling_thread(target,width,height){var
 canvas=findCanvasEventTarget(target);if(!canvas)return-
4;if(canvas.canvasSharedPtr){GROWABLE_HEAP_I32()[canvas.canvasSharedPtr>>2]=width;GROWABLE_HEA
P_I32()[canvas.canvasSharedPtr+4>>2]=height}if(canvas.offscreenCanvas||!canvas.controlTransferredOffscreen){if
(canvas.offscreenCanvas)canvas=canvas.offscreenCanvas;var
autoResizeViewport=false;if(canvas.GLctxObject&&canvas.GLctxObject.GLctx){var
prevViewport=canvas.GLctxObject.GLctx.getParameter(2978);autoResizeViewport=prevViewport[0]===0&&prev
Viewport[1]===0&&prevViewport[2]===canvas.width&&prevViewport[3]===canvas.height}canvas.width=width;
canvas.height=height;if(autoResizeViewport){canvas.GLctxObject.GLctx.viewport(0,0,width,height)}}else
if(canvas.canvasSharedPtr){var
targetThread=GROWABLE_HEAP_I32()[canvas.canvasSharedPtr+8>>2];_emscripten_set_offscreencanvas_size_o
n_target_thread(targetThread,target,width,height);return 1}else{return-4}return 0}function
_emscripten_set_canvas_element_size_main_thread(target,width,height){if(ENVIRONMENT_IS_PTHREAD)retur
n
 _emscripten_proxy_to_main_thread_js(2,1,target,width,height);return
_emscripten_set_canvas_element_size_calling_thread(target,width,height)}function
_emscripten_set_canvas_element_size(target,width,height){var
canvas=findCanvasEventTarget(target);if(canvas){return
_emscripten_set_canvas_element_size_calling_thread(target,width,height)}else{return
_emscripten_set_canvas_element_size_main_thread(target,width,height)}}function
_emscripten_set_current_thread_status(newStatus){}function
_emscripten_set_thread_name(threadId,name){}function __webgl_enable_ANGLE_instanced_arrays(ctx){var
ext=ctx.getExtension(\"ANGLE_instanced_arrays\");if(ext){ctx[\"vertexAttribDivisor\"]=function(index,divisor){ex
t[\"vertexAttribDivisorANGLE\"](index,divisor)};ctx[\"drawArraysInstanced\"]=function(mode,first,count,primcou
nt){ext[\"drawArraysInstancedANGLE\"](mode,first,count,primcount)};ctx[\"drawElementsInstanced\"]=function(
mode,count,type,indices,primcount){ext[\"drawElementsInstancedANGLE\"](mode,count,type,indices,primcount)};
return
 1}}function __webgl_enable_OES_vertex_array_object(ctx){var
ext=ctx.getExtension(\"OES_vertex_array_object\");if(ext){ctx[\"createVertexArray\"]=function(){return
ext[\"createVertexArrayOES\"]()};ctx[\"deleteVertexArray\"]=function(vao){ext[\"deleteVertexArrayOES\"](vao)};
ctx[\"bindVertexArray\"]=function(vao){ext[\"bindVertexArrayOES\"](vao)};ctx[\"isVertexArray\"]=function(vao)
{return ext[\"isVertexArrayOES\"](vao)};return 1}}function __webgl_enable_WEBGL_draw_buffers(ctx){var
ext=ctx.getExtension(\"WEBGL_draw_buffers\");if(ext){ctx[\"drawBuffers\"]=function(n,bufs){ext[\"drawBuffers
WEBGL\"](n,bufs)};return 1}}function
__webgl_enable_WEBGL_multi_draw(ctx){return!!(ctx.multiDrawWebgl=ctx.getExtension(\"WEBGL_multi_dra
w\"))}var
GL={counter:1,buffers:[],programs:[],framebuffers:[],renderbuffers:[],textures:[],uniforms:[],shaders:[],vaos:[],cont
exts:{},offscreenCanvases:{},timerQueriesEXT:[],programInfos:{},stringCache:{},unpackAlignment:4,recordError:
function
 recordError(errorCode){if(!GL.lastError){GL.lastError=errorCode}},getNewId:function(table){var
ret=GL.counter++;for(var i=table.length;i<ret;i++){table[i]=null}return
ret},getSource:function(shader,count,string,length){var source=\"\";for(var i=0;i<count;++i){var
len=length?GROWABLE_HEAP_I32()[length+i*4>>2]:-
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1;source+=UTF8ToString(GROWABLE_HEAP_I32()[string+i*4>>2],len<0?undefined:len)}return source},createContext:function(canvas,webGLContextAttributes){var ctx=canvas.getContext(\"webgl\",webGLContextAttributes);if(!ctx)return 0;var handle=GL.registerContext(ctx,webGLContextAttributes);return handle},registerContext:function(ctx,webGLContextAttributes){var handle=_malloc(8);GROWABLE_HEAP_I32()[handle+4>>2]=_pthread_self();var context={handle:handle,attributes:webGLContextAttributes,version:webGLContextAttributes.majorVersion,GLctx:ctx};if(ctx.canvas)ctx.canvas.GLctxObject=context;GL.contexts[handle]=context;if(typeof webGLContextAttributes.enableExtensionsByDefault===\"undefined\"||webGLContextAttributes.enableExtensionsByDefault){GL.initExtensions(context)}return handle},makeContextCurrent:function(contextHandle){GL.currentContext=GL.contexts[contextHandle];Module.ctx=GLctx=GL.currentContext&&GL.currentContext.GLctx;return!(contextHandle&&!GLctx)},getContext:function(contextHandle){return GL.contexts[contextHandle]},deleteContext:function(contextHandle){if(GL.currentContext===GL.contexts[contextHandle])GL.currentContext=null;if(typeof JSEvents===\"object\")JSEvents.removeAllHandlersOnTarget(GL.contexts[contextHandle].GLctx.canvas);if(GL.contexts[contextHandle]&&GL.contexts[contextHandle].GLctx.canvas)GL.contexts[contextHandle].GLctx.canvas.GLctxObject=undefined;_free(GL.contexts[contextHandle].handle);GL.contexts[contextHandle]=null},initExtensions:function(context){if(!context)context=GL.currentContext;if(context.initExtensionsDone)return;context.initExtensionsDone=true;var GLctx=context.GLctx;__webgl_enable_ANGLE_instanced_arrays(GLctx);__webgl_enable_OES_vertex_array_object(GLctx);__webgl_enable_WEBGL_draw_buffers(GLctx);GLctx.disjointTimerQueryExt=GLctx.getExtension(\"EXT_disjoint_timer_query\");__webgl_enable_WEBGL_multi_draw(GLctx);var exts=GLctx.getSupportedExtensions()||[];exts.forEach(function(ext){if(ext.indexOf(\"lose_context\")<0&&ext.indexOf(\"debug\")<0){GLctx.getExtension(ext)}})},populateUniformTable:function(program){var p=GL.programs[program];var ptable=GL.programInfos[program]={uniforms:{},maxUniformLength:0,maxAttributeLength:-1,maxUniformBlockNameLength:-1};var utable=ptable.uniforms;var numUniforms=GLctx.getProgramParameter(p,35718);for(var i=0;i<numUniforms;++i){var u=GLctx.getActiveUniform(p,i);var name=u.name;ptable.maxUniformLength=Math.max(ptable.maxUniformLength,name.length+1);if(name.slice(-1)==\"]\"){name=name.slice(0,name.lastIndexOf(\"[\"))}var loc=GLctx.getUniformLocation(p,name);if(loc){var id=GL.getNewId(GL.uniforms);utable[name]=[u.size,id];GL.uniforms[id]=loc;for(var j=1;j<u.size;++j){var n=name+\"[\"+j+\"]\";loc=GLctx.getUniformLocation(p,n);id=GL.getNewId(GL.uniforms);GL.uniforms[id]=loc}}}}};var __emscripten_webgl_power_preferences=[\"default\",\"low-power\",\"high-performance\"];function _emscripten_webgl_do_create_context(target,attributes){var a=attributes>>2;var powerPreference=GROWABLE_HEAP_I32()[a+(24>>2)];var contextAttributes={\"alpha\":!!GROWABLE_HEAP_I32()[a+(0>>2)],\"depth\":!!GROWABLE_HEAP_I32()[a+(4>>2)],\"stencil\":!!GROWABLE_HEAP_I32()[a+(8>>2)],\"antialias\":!!GROWABLE_HEAP_I32()[a+(12>>2)],\"premultipliedAlpha\":!!GROWABLE_HEAP_I32()[a+(16>>2)],\"preserveDrawingBuffer\":!!GROWABLE_HEAP_I32()[a+(20>>2)],\"powerPreference\":__emscripten_webgl_power_preferences[powerPreference],\"failIfMajorPerformanceCaveat\":!!GROWABLE_HEAP_I32()[a+(28>>2)],majorVersion:GROWABLE_HEAP_I32()[a+(32>>2)],minorVersion:GROWABLE_HEAP_I32()[a+(36>>2)],enableExtensionsByDefault:GROWABLE_HEAP_I32()[a+(40>>2)],explicitSwapControl:GROWABLE_HEAP_I32()[a+(44>>2)],proxyContextToMainThread:GROWABLE_HEAP_I32()[a+(48>>2)],renderViaOffscreenBackBuffer:GROWABLE_HEAP_I32()[a+(52>>2)]};var canvas=findCanvasEventTarget(target);if(!canvas){return 0}if(contextAttributes.explicitSwapControl){return 0}var contextHandle=GL.createContext(canvas,contextAttributes);return contextHandle}function

_emscripten_webgl_create_context(a0,a1){return _emscripten_webgl_do_create_context(a0,a1)}var SYSCALLS={mappings:{},buffers:[null,[],[]],printChar:function(stream,curr){var buffer=SYSCALLS.buffers[stream];if(curr===0||curr===10){(stream===1?out:err)(UTF8ArrayToString(buffer,0));buffer.length=0}else{buffer.push(curr)}},varargs:undefined,get:function(){SYSCALLS.varargs+=4;var ret=GROWABLE_HEAP_I32()[SYSCALLS.varargs-4>>2];return ret},getStr:function(ptr){var ret=UTF8ToString(ptr);return ret},get64:function(low,high){return low}};function _fd_close(fd){if(ENVIRONMENT_IS_PTHREAD)return _emscripten_proxy_to_main_thread_js(3,1,fd);return 0}function _fd_seek(fd,offset_low,offset_high,whence,newOffset){if(ENVIRONMENT_IS_PTHREAD)return _emscripten_proxy_to_main_thread_js(4,1,fd,offset_low,offset_high,whence,newOffset)}function _fd_write(fd,iov,iovcnt,pnum){if(ENVIRONMENT_IS_PTHREAD)return _emscripten_proxy_to_main_thread_js(5,1,fd,iov,iovcnt,pnum);var num=0;for(var i=0;i<iovcnt;i++){var ptr=GROWABLE_HEAP_I32()[iov+i*8>>2];var len=GROWABLE_HEAP_I32()[iov+(i*8+4)>>2];for(var j=0;j<len;j++){SYSCALLS.printChar(fd,GROWABLE_HEAP_U8()[ptr+j])}num+=len}GROWABLE_HEAP_I32()[pnum>>2]=num;return 0}function _pthread_cleanup_pop(execute){var routine=PThread.threadExitHandlers.pop();if(execute)routine()}function _pthread_cleanup_push(routine,arg){PThread.threadExitHandlers.push(function(){wasmTable.get(routine)(arg)})}function spawnThread(threadParams){if(ENVIRONMENT_IS_PTHREAD)throw\"Internal Error! spawnThread() can only ever be called from main application thread!\";var worker=PThread.getNewWorker();if(worker.pthread!==undefined)throw\"Internal error!\";if(!threadParams.pthread_ptr)throw\"Internal error, no pthread ptr!\";PThread.runningWorkers.push(worker);var tlsMemory=_malloc(128*4);for(var i=0;i<128;++i){GROWABLE_HEAP_I32()[tlsMemory+i*4>>2]=0}var stackHigh=threadParams.stackBase+threadParams.stackSize;var pthread=PThread.pthreads[threadParams.pthread_ptr]={worker:worker,stackBase:threadParams.stackBase,stackSize:threadParams.stackSize,allocatedOwnStack:threadParams.allocatedOwnStack,threadInfoStruct:threadParams.pthread_ptr};var tis=pthread.threadInfoStruct>>2;Atomics.store(GROWABLE_HEAP_U32(),tis+(64>>2),threadParams.detached);Atomics.store(GROWABLE_HEAP_U32(),tis+(100>>2),tlsMemory);Atomics.store(GROWABLE_HEAP_U32(),tis+(40>>2),pthread.threadInfoStruct);Atomics.store(GROWABLE_HEAP_U32(),tis+(80>>2),threadParams.stackSize);Atomics.store(GROWABLE_HEAP_U32(),tis+(76>>2),stackHigh);Atomics.store(GROWABLE_HEAP_U32(),tis+(104>>2),threadParams.stackSize);Atomics.store(GROWABLE_HEAP_U32(),tis+(104+8>>2),stackHigh);Atomics.store(GROWABLE_HEAP_U32(),tis+(104+12>>2),threadParams.detached);var global_libc=_emscripten_get_global_libc();var global_locale=global_libc+40;Atomics.store(GROWABLE_HEAP_U32(),tis+(172>>2),global_locale);worker.pthread=pthread;var msg={\"cmd\":\"run\",\"start_routine\":threadParams.startRoutine,\"arg\":threadParams.arg,\"threadInfoStruct\":threadParams.pthread_ptr,\"stackBase\":threadParams.stackBase,\"stackSize\":threadParams.stackSize};worker.runPthread=function(){msg.time=performance.now();worker.postMessage(msg,threadParams.transferList)};if(worker.loaded){worker.runPthread();delete worker.runPthread}}function _pthread_create(pthread_ptr,attr,start_routine,arg){if(typeof SharedArrayBuffer===\"undefined\"){err(\"Current environment does not support SharedArrayBuffer, pthreads are not available!\");return 6}if(!pthread_ptr){err(\"pthread_create called with a null thread pointer!\");return 28}var transferList=[];var error=0;if(ENVIRONMENT_IS_PTHREAD&&(transferList.length===0||error)){return _emscripten_sync_run_in_main_thread_4(687865856,pthread_ptr,attr,start_routine,arg)}if(error)return error;var stackSize=0;var stackBase=0;var detached=0;if(attr&&attr!=-1){stackSize=GROWABLE_HEAP_I32()[attr>>2];stackSize+=81920;stackBase=GROWABLE_HEAP_I32()[attr+8>>2];detached=GROWABLE_HEAP_I32()[attr+12>>2]!==0}else{stackSize=2097152}var allocatedOwnStack=stackBase==0;if(allocatedOwnStack){stackBase=_memalign(16,stackSize)}else{stackBase-

=stackSize;assert(stackBase>0)}var threadInfoStruct=_malloc(228);for(var i=0;i<228>>2;++i)GROWABLE_HEAP_U32()[(threadInfoStruct>>2)+i]=0;GROWABLE_HEAP_I32()[pthread_ptr>>2]=threadInfoStruct;GROWABLE_HEAP_I32()[threadInfoStruct+12>>2]=threadInfoStruct;var headPtr=threadInfoStruct+152;GROWABLE_HEAP_I32()[headPtr>>2]=headPtr;var threadParams={stackBase:stackBase,stackSize:stackSize,allocatedOwnStack:allocatedOwnStack,detached:detached,startRoutine:start_routine,pthread_ptr:threadInfoStruct,arg:arg,transferList:transferList};if(ENVIRONMENT_IS_PTHREAD){threadParams.cmd=\"spawnThread\";postMessage(threadParams,transferList)}else{spawnThread(threadParams)}return 0}function __pthread_testcancel_js(){if(!ENVIRONMENT_IS_PTHREAD)return;var tb=_pthread_self();if(!tb)return;var cancelDisabled=Atomics.load(GROWABLE_HEAP_U32(),tb+56>>2);if(cancelDisabled)return;var canceled=Atomics.load(GROWABLE_HEAP_U32(),tb+0>>2);if(canceled==2)throw\"Canceled!\"}function _emscripten_check_blocking_allowed(){if(ENVIRONMENT_IS_NODE)return;if(ENVIRONMENT_IS_WORKER)return;warnOnce(\"Blocking on the main thread is very dangerous, see https://emscripten.org/docs/porting/pthreads.html#blocking-on-the-main-browser-thread\")}function __emscripten_do_pthread_join(thread,status,block){if(!thread){err(\"pthread_join attempted on a null thread pointer!\");return ERRNO_CODES.ESRCH}if(ENVIRONMENT_IS_PTHREAD&&_pthread_self()==thread){err(\"PThread \"+thread+\" is attempting to join to itself!\");return ERRNO_CODES.EDEADLK}else if(!ENVIRONMENT_IS_PTHREAD&&_emscripten_main_browser_thread_id()==thread){err(\"Main thread \"+thread+\" is attempting to join to itself!\");return ERRNO_CODES.EDEADLK}var self=GROWABLE_HEAP_I32()[thread+12>>2];if(self!==thread){err(\"pthread_join attempted on thread \"+thread+\", which does not point to a valid thread, or does not exist anymore!\");return ERRNO_CODES.ESRCH}var detached=Atomics.load(GROWABLE_HEAP_U32(),thread+64>>2);if(detached){err(\"Attempted to join thread \"+thread+\", which was already detached!\");return ERRNO_CODES.EINVAL}if(block){_emscripten_check_blocking_allowed()}for(;;){var threadStatus=Atomics.load(GROWABLE_HEAP_U32(),thread+0>>2);if(threadStatus==1){var threadExitCode=Atomics.load(GROWABLE_HEAP_U32(),thread+4>>2);if(status)GROWABLE_HEAP_I32()[status>>2]=threadExitCode;Atomics.store(GROWABLE_HEAP_U32(),thread+64>>2,1);if(!ENVIRONMENT_IS_PTHREAD)cleanupThread(thread);else postMessage({\"cmd\":\"cleanupThread\",\"thread\":thread});return 0}if(!block){return ERRNO_CODES.EBUSY}__pthread_testcancel_js();if(!ENVIRONMENT_IS_PTHREAD)_emscripten_main_thread_process_queued_calls();_emscripten_futex_wait(thread+0,threadStatus,ENVIRONMENT_IS_PTHREAD?100:1)}}function _pthread_join(thread,status){return __emscripten_do_pthread_join(thread,status,true)}function _sysconf(name){if(ENVIRONMENT_IS_PTHREAD)return _emscripten_proxy_to_main_thread_js(6,1,name);switch(name){case 30:return 16384;case 85:var maxHeapSize=2147483648;return maxHeapSize/16384;case 132:case 133:case 12:case 137:case 138:case 15:case 235:case 16:case 17:case 18:case 19:case 20:case 149:case 13:case 10:case 236:case 153:case 9:case 21:case 22:case 159:case 154:case 14:case 77:case 78:case 139:case 82:case 68:case 67:case 164:case 11:case 29:case 47:case 48:case 95:case 52:case 51:case 46:return 200809;case 27:case 246:case 127:case 128:case 23:case 24:case 160:case 161:case 181:case 182:case 242:case 183:case 184:case 243:case 244:case 245:case 165:case 178:case 179:case 49:case 50:case 168:case 169:case 175:case 170:case 171:case 172:case 97:case 76:case 32:case 173:case 35:case 80:case 81:case 79:return-1;case 176:case 177:case 7:case 155:case 8:case 157:case 125:case 126:case 92:case 93:case 129:case 130:case 131:case 94:case 91:return 1;case 74:case 60:case 69:case 70:case 4:return 1024;case 31:case 42:case 72:return 32;case 87:case 26:case 33:return 2147483647;case 34:case 1:return 47839;case 38:case 36:return 99;case 43:case 37:return 2048;case 0:return 2097152;case 3:return

65536;case 28:return 32768;case 44:return 32767;case 75:return 16384;case 39:return 1e3;case 89:return 700;case 71:return 256;case 40:return 255;case 2:return 100;case 180:return 64;case 25:return 20;case 5:return 16;case 6:return 6;case 73:return 4;case 84:{if(typeof navigator===\"object\")return navigator[\"hardwareConcurrency\"]||1;return 1}}setErrNo(28);return-1}if(!ENVIRONMENT_IS_PTHREAD)PThread.initMainThreadBlock();var GLctx;var proxiedFunctionTable=[null,_atexit,_emscripten_set_canvas_element_size_main_thread,_fd_close,_fd_seek,_fd_write,_sysconf];var asmLibraryArg={\"e\":___assert_fail,\"r\":___call_main,\"x\":__emscripten_notify_thread_queue,\"b\":_abort,\"y\":_emscripten_asm_const_int,\"j\":_emscripten_conditional_set_current_thread_status,\"d\":_emscripten_futex_wait,\"c\":_emscripten_futex_wake,\"f\":_emscripten_get_now,\"p\":_emscripten_memcpy_big,\"A\":_emscripten_num_logical_cores,\"u\":_emscripten_receive_on_main_thread_js,\"q\":_emscripten_resize_heap,\"v\":_emscripten_set_canvas_element_size,\"i\":_emscripten_set_current_thread_status,\"s\":_emscripten_set_thread_name,\"w\":_emscripten_webgl_create_context,\"l\":_fd_close,\"n\":_fd_seek,\"g\":_fd_write,\"o\":initPthreadsJS,\"a\":wasmMemory||Module[\"wasmMemory\"],\"z\":_pthread_cleanup_pop,\"k\":_pthread_cleanup_push,\"h\":_pthread_create,\"m\":_pthread_join,\"t\":_sysconf};var asm=createWasm();var ___wasm_call_ctors=Module[\"___wasm_call_ctors\"]=function(){return(___wasm_call_ctors=Module[\"___wasm_call_ctors\"]=Module[\"asm\"][\"B\"]).apply(null,arguments)};var _init=Module[\"_init\"]=function(){return(_init=Module[\"_init\"]=Module[\"asm\"][\"C\"]).apply(null,arguments)};var _init_with_threads_count=Module[\"_init_with_threads_count\"]=function(){return(_init_with_threads_count=Module[\"_init_with_threads_count\"]=Module[\"asm\"][\"D\"]).apply(null,arguments)};var _get_threads_count=Module[\"_get_threads_count\"]=function(){return(_get_threads_count=Module[\"_get_threads_count\"]=Module[\"asm\"][\"E\"]).apply(null,arguments)};var _register_tensor=Module[\"_register_tensor\"]=function(){return(_register_tensor=Module[\"_register_tensor\"]=Module[\"asm\"][\"F\"]).apply(null,arguments)};var _dispose_data=Module[\"_dispose_data\"]=function(){return(_dispose_data=Module[\"_dispose_data\"]=Module[\"asm\"][\"G\"]).apply(null,arguments)};var _dispose=Module[\"_dispose\"]=function(){return(_dispose=Module[\"_dispose\"]=Module[\"asm\"][\"H\"]).apply(null,arguments)};var _Abs=Module[\"_Abs\"]=function(){return(_Abs=Module[\"_Abs\"]=Module[\"asm\"][\"J\"]).apply(null,arguments)};var _Add=Module[\"_Add\"]=function(){return(_Add=Module[\"_Add\"]=Module[\"asm\"][\"K\"]).apply(null,arguments)};var _AddN=Module[\"_AddN\"]=function(){return(_AddN=Module[\"_AddN\"]=Module[\"asm\"][\"L\"]).apply(null,arguments)};var _All=Module[\"_All\"]=function(){return(_All=Module[\"_All\"]=Module[\"asm\"][\"M\"]).apply(null,arguments)};var _Any=Module[\"_Any\"]=function(){return(_Any=Module[\"_Any\"]=Module[\"asm\"][\"N\"]).apply(null,arguments)};var _ArgMax=Module[\"_ArgMax\"]=function(){return(_ArgMax=Module[\"_ArgMax\"]=Module[\"asm\"][\"O\"]).apply(null,arguments)};var _AvgPool=Module[\"_AvgPool\"]=function(){return(_AvgPool=Module[\"_AvgPool\"]=Module[\"asm\"][\"P\"]).apply(null,arguments)};var _BatchMatMul=Module[\"_BatchMatMul\"]=function(){return(_BatchMatMul=Module[\"_BatchMatMul\"]=Module[\"asm\"][\"Q\"]).apply(null,arguments)};var _Ceil=Module[\"_Ceil\"]=function(){return(_Ceil=Module[\"_Ceil\"]=Module[\"asm\"][\"R\"]).apply(null,arguments)};var

_ClipByValue=Module[\"_ClipByValue\"]=function(){return(_ClipByValue=Module[\"_ClipByValue\"]=Module[\"asm\"][\"S\"]).apply(null,arguments)};var
_Conv2D=Module[\"_Conv2D\"]=function(){return(_Conv2D=Module[\"_Conv2D\"]=Module[\"asm\"][\"T\"]).apply(null,arguments)};var
_Conv2DBackpropInput=Module[\"_Conv2DBackpropInput\"]=function(){return(_Conv2DBackpropInput=Module[\"_Conv2DBackpropInput\"]=Module[\"asm\"][\"U\"]).apply(null,arguments)};var
_Cos=Module[\"_Cos\"]=function(){return(_Cos=Module[\"_Cos\"]=Module[\"asm\"][\"V\"]).apply(null,arguments)};var
_Cosh=Module[\"_Cosh\"]=function(){return(_Cosh=Module[\"_Cosh\"]=Module[\"asm\"][\"W\"]).apply(null,arguments)};var
_CropAndResize=Module[\"_CropAndResize\"]=function(){return(_CropAndResize=Module[\"_CropAndResize\"]=Module[\"asm\"][\"X\"]).apply(null,arguments)};var
_Cumsum=Module[\"_Cumsum\"]=function(){return(_Cumsum=Module[\"_Cumsum\"]=Module[\"asm\"][\"Y\"]).apply(null,arguments)};var
_DepthToSpace=Module[\"_DepthToSpace\"]=function(){return(_DepthToSpace=Module[\"_DepthToSpace\"]=Module[\"asm\"][\"Z\"]).apply(null,arguments)};var
_DepthwiseConv2dNative=Module[\"_DepthwiseConv2dNative\"]=function(){return(_DepthwiseConv2dNative=Module[\"_DepthwiseConv2dNative\"]=Module[\"asm\"][\"_\"]).apply(null,arguments)};var
_Elu=Module[\"_Elu\"]=function(){return(_Elu=Module[\"_Elu\"]=Module[\"asm\"][\"$\"]).apply(null,arguments)};var
_Equal=Module[\"_Equal\"]=function(){return(_Equal=Module[\"_Equal\"]=Module[\"asm\"][\"aa\"]).apply(null,arguments)};var
_Exp=Module[\"_Exp\"]=function(){return(_Exp=Module[\"_Exp\"]=Module[\"asm\"][\"ba\"]).apply(null,arguments)};var
_FlipLeftRight=Module[\"_FlipLeftRight\"]=function(){return(_FlipLeftRight=Module[\"_FlipLeftRight\"]=Module[\"asm\"][\"ca\"]).apply(null,arguments)};var
_Floor=Module[\"_Floor\"]=function(){return(_Floor=Module[\"_Floor\"]=Module[\"asm\"][\"da\"]).apply(null,arguments)};var
_FloorDiv=Module[\"_FloorDiv\"]=function(){return(_FloorDiv=Module[\"_FloorDiv\"]=Module[\"asm\"][\"ea\"]).apply(null,arguments)};var
_FusedBatchNorm=Module[\"_FusedBatchNorm\"]=function(){return(_FusedBatchNorm=Module[\"_FusedBatchNorm\"]=Module[\"asm\"][\"fa\"]).apply(null,arguments)};var
_FusedConv2D=Module[\"_FusedConv2D\"]=function(){return(_FusedConv2D=Module[\"_FusedConv2D\"]=Module[\"asm\"][\"ga\"]).apply(null,arguments)};var
_FusedDepthwiseConv2D=Module[\"_FusedDepthwiseConv2D\"]=function(){return(_FusedDepthwiseConv2D=Module[\"_FusedDepthwiseConv2D\"]=Module[\"asm\"][\"ha\"]).apply(null,arguments)};var
_Gather=Module[\"_Gather\"]=function(){return(_Gather=Module[\"_Gather\"]=Module[\"asm\"][\"ia\"]).apply(null,arguments)};var
_GatherNd=Module[\"_GatherNd\"]=function(){return(_GatherNd=Module[\"_GatherNd\"]=Module[\"asm\"][\"ja\"]).apply(null,arguments)};var
_Greater=Module[\"_Greater\"]=function(){return(_Greater=Module[\"_Greater\"]=Module[\"asm\"][\"ka\"]).apply(null,arguments)};var
_GreaterEqual=Module[\"_GreaterEqual\"]=function(){return(_GreaterEqual=Module[\"_GreaterEqual\"]=Module[\"asm\"][\"la\"]).apply(null,arguments)};var
_LeakyRelu=Module[\"_LeakyRelu\"]=function(){return(_LeakyRelu=Module[\"_LeakyRelu\"]=Module[\"asm\"][\"ma\"]).apply(null,arguments)};var
_Less=Module[\"_Less\"]=function(){return(_Less=Module[\"_Less\"]=Module[\"asm\"][\"na\"]).apply(null,arguments)};var

_LessEqual=Module[\"_LessEqual\"]=function(){return(_LessEqual=Module[\"_LessEqual\"]=Module[\"asm\"][\"oa\"]).apply(null,arguments)};var
_Log=Module[\"_Log\"]=function(){return(_Log=Module[\"_Log\"]=Module[\"asm\"][\"pa\"]).apply(null,arguments)};var
_LogicalAnd=Module[\"_LogicalAnd\"]=function(){return(_LogicalAnd=Module[\"_LogicalAnd\"]=Module[\"asm\"][\"qa\"]).apply(null,arguments)};var
_Max=Module[\"_Max\"]=function(){return(_Max=Module[\"_Max\"]=Module[\"asm\"][\"ra\"]).apply(null,arguments)};var
_MaxPool=Module[\"_MaxPool\"]=function(){return(_MaxPool=Module[\"_MaxPool\"]=Module[\"asm\"][\"sa\"]).apply(null,arguments)};var
_Maximum=Module[\"_Maximum\"]=function(){return(_Maximum=Module[\"_Maximum\"]=Module[\"asm\"][\"ta\"]).apply(null,arguments)};var
_Mean=Module[\"_Mean\"]=function(){return(_Mean=Module[\"_Mean\"]=Module[\"asm\"][\"ua\"]).apply(null,arguments)};var
_Min=Module[\"_Min\"]=function(){return(_Min=Module[\"_Min\"]=Module[\"asm\"][\"va\"]).apply(null,arguments)};var
_Minimum=Module[\"_Minimum\"]=function(){return(_Minimum=Module[\"_Minimum\"]=Module[\"asm\"][\"wa\"]).apply(null,arguments)};var
_MirrorPad=Module[\"_MirrorPad\"]=function(){return(_MirrorPad=Module[\"_MirrorPad\"]=Module[\"asm\"][\"xa\"]).apply(null,arguments)};var
_Multiply=Module[\"_Multiply\"]=function(){return(_Multiply=Module[\"_Multiply\"]=Module[\"asm\"][\"ya\"]).apply(null,arguments)};var
_Neg=Module[\"_Neg\"]=function(){return(_Neg=Module[\"_Neg\"]=Module[\"asm\"][\"za\"]).apply(null,arguments)};var
_NonMaxSuppressionV3=Module[\"_NonMaxSuppressionV3\"]=function(){return(_NonMaxSuppressionV3=Module[\"_NonMaxSuppressionV3\"]=Module[\"asm\"][\"Aa\"]).apply(null,arguments)};var
_NonMaxSuppressionV4=Module[\"_NonMaxSuppressionV4\"]=function(){return(_NonMaxSuppressionV4=Module[\"_NonMaxSuppressionV4\"]=Module[\"asm\"][\"Ba\"]).apply(null,arguments)};var
_NonMaxSuppressionV5=Module[\"_NonMaxSuppressionV5\"]=function(){return(_NonMaxSuppressionV5=Module[\"_NonMaxSuppressionV5\"]=Module[\"asm\"][\"Ca\"]).apply(null,arguments)};var
_NotEqual=Module[\"_NotEqual\"]=function(){return(_NotEqual=Module[\"_NotEqual\"]=Module[\"asm\"][\"Da\"]).apply(null,arguments)};var
_OneHot=Module[\"_OneHot\"]=function(){return(_OneHot=Module[\"_OneHot\"]=Module[\"asm\"][\"Ea\"]).apply(null,arguments)};var
_PadV2=Module[\"_PadV2\"]=function(){return(_PadV2=Module[\"_PadV2\"]=Module[\"asm\"][\"Fa\"]).apply(null,arguments)};var
_Pow=Module[\"_Pow\"]=function(){return(_Pow=Module[\"_Pow\"]=Module[\"asm\"][\"Ga\"]).apply(null,arguments)};var
_Prelu=Module[\"_Prelu\"]=function(){return(_Prelu=Module[\"_Prelu\"]=Module[\"asm\"][\"Ha\"]).apply(null,arguments)};var
_Prod=Module[\"_Prod\"]=function(){return(_Prod=Module[\"_Prod\"]=Module[\"asm\"][\"Ia\"]).apply(null,arguments)};var
_RealDiv=Module[\"_RealDiv\"]=function(){return(_RealDiv=Module[\"_RealDiv\"]=Module[\"asm\"][\"Ja\"]).apply(null,arguments)};var
_Relu=Module[\"_Relu\"]=function(){return(_Relu=Module[\"_Relu\"]=Module[\"asm\"][\"Ka\"]).apply(null,arguments)};var
_Relu6=Module[\"_Relu6\"]=function(){return(_Relu6=Module[\"_Relu6\"]=Module[\"asm\"][\"La\"]).apply(null,arguments)};var

_ResizeBilinear=Module[\"_ResizeBilinear\"]=function(){return(_ResizeBilinear=Module[\"_ResizeBilinear\"]=Module[\"asm\"][\"Ma\"]).apply(null,arguments)};var
_Reverse=Module[\"_Reverse\"]=function(){return(_Reverse=Module[\"_Reverse\"]=Module[\"asm\"][\"Na\"]).apply(null,arguments)};var
_RotateWithOffset=Module[\"_RotateWithOffset\"]=function(){return(_RotateWithOffset=Module[\"_RotateWithOffset\"]=Module[\"asm\"][\"Oa\"]).apply(null,arguments)};var
_Round=Module[\"_Round\"]=function(){return(_Round=Module[\"_Round\"]=Module[\"asm\"][\"Pa\"]).apply(null,arguments)};var
_Rsqrt=Module[\"_Rsqrt\"]=function(){return(_Rsqrt=Module[\"_Rsqrt\"]=Module[\"asm\"][\"Qa\"]).apply(null,arguments)};var
_ScatterNd=Module[\"_ScatterNd\"]=function(){return(_ScatterNd=Module[\"_ScatterNd\"]=Module[\"asm\"][\"Ra\"]).apply(null,arguments)};var
_SelectV2=Module[\"_SelectV2\"]=function(){return(_SelectV2=Module[\"_SelectV2\"]=Module[\"asm\"][\"Sa\"]).apply(null,arguments)};var
_Sigmoid=Module[\"_Sigmoid\"]=function(){return(_Sigmoid=Module[\"_Sigmoid\"]=Module[\"asm\"][\"Ta\"]).apply(null,arguments)};var
_Sin=Module[\"_Sin\"]=function(){return(_Sin=Module[\"_Sin\"]=Module[\"asm\"][\"Ua\"]).apply(null,arguments)};var
_Softmax=Module[\"_Softmax\"]=function(){return(_Softmax=Module[\"_Softmax\"]=Module[\"asm\"][\"Va\"]).apply(null,arguments)};var
_Sqrt=Module[\"_Sqrt\"]=function(){return(_Sqrt=Module[\"_Sqrt\"]=Module[\"asm\"][\"Wa\"]).apply(null,arguments)};var
_Square=Module[\"_Square\"]=function(){return(_Square=Module[\"_Square\"]=Module[\"asm\"][\"Xa\"]).apply(null,arguments)};var
_SquaredDifference=Module[\"_SquaredDifference\"]=function(){return(_SquaredDifference=Module[\"_SquaredDifference\"]=Module[\"asm\"][\"Ya\"]).apply(null,arguments)};var
_Step=Module[\"_Step\"]=function(){return(_Step=Module[\"_Step\"]=Module[\"asm\"][\"Za\"]).apply(null,arguments)};var
_StridedSlice=Module[\"_StridedSlice\"]=function(){return(_StridedSlice=Module[\"_StridedSlice\"]=Module[\"asm\"][\"_a\"]).apply(null,arguments)};var
_Sub=Module[\"_Sub\"]=function(){return(_Sub=Module[\"_Sub\"]=Module[\"asm\"][\"$a\"]).apply(null,arguments)};var
_Sum=Module[\"_Sum\"]=function(){return(_Sum=Module[\"_Sum\"]=Module[\"asm\"][\"ab\"]).apply(null,arguments)};var
_Tan=Module[\"_Tan\"]=function(){return(_Tan=Module[\"_Tan\"]=Module[\"asm\"][\"bb\"]).apply(null,arguments)};var
_Tanh=Module[\"_Tanh\"]=function(){return(_Tanh=Module[\"_Tanh\"]=Module[\"asm\"][\"cb\"]).apply(null,arguments)};var
_Tile=Module[\"_Tile\"]=function(){return(_Tile=Module[\"_Tile\"]=Module[\"asm\"][\"db\"]).apply(null,arguments)};var
_TopK=Module[\"_TopK\"]=function(){return(_TopK=Module[\"_TopK\"]=Module[\"asm\"][\"eb\"]).apply(null,arguments)};var
_Transform=Module[\"_Transform\"]=function(){return(_Transform=Module[\"_Transform\"]=Module[\"asm\"][\"fb\"]).apply(null,arguments)};var
_Transpose=Module[\"_Transpose\"]=function(){return(_Transpose=Module[\"_Transpose\"]=Module[\"asm\"][\"gb\"]).apply(null,arguments)};var
__FusedMatMul=Module[\"__FusedMatMul\"]=function(){return(__FusedMatMul=Module[\"__FusedMatMul\"]=Module[\"asm\"][\"hb\"]).apply(null,arguments)};var

_malloc=Module[\"_malloc\"]=function(){return(_malloc=Module[\"_malloc\"]=Module[\"asm\"][\"ib\"]).apply(null,arguments)};var
_free=Module[\"_free\"]=function(){return(_free=Module[\"_free\"]=Module[\"asm\"][\"jb\"]).apply(null,arguments)};var
___errno_location=Module[\"___errno_location\"]=function(){return(___errno_location=Module[\"___errno_location\"]=Module[\"asm\"][\"kb\"]).apply(null,arguments)};var
_emscripten_get_global_libc=Module[\"_emscripten_get_global_libc\"]=function(){return(_emscripten_get_global_libc=Module[\"_emscripten_get_global_libc\"]=Module[\"asm\"][\"lb\"]).apply(null,arguments)};var
_pthread_self=Module[\"_pthread_self\"]=function(){return(_pthread_self=Module[\"_pthread_self\"]=Module[\"asm\"][\"mb\"]).apply(null,arguments)};var
___pthread_tsd_run_dtors=Module[\"___pthread_tsd_run_dtors\"]=function(){return(___pthread_tsd_run_dtors=Module[\"___pthread_tsd_run_dtors\"]=Module[\"asm\"][\"nb\"]).apply(null,arguments)};var
_emscripten_main_thread_process_queued_calls=Module[\"_emscripten_main_thread_process_queued_calls\"]=function(){return(_emscripten_main_thread_process_queued_calls=Module[\"_emscripten_main_thread_process_queued_calls\"]=Module[\"asm\"][\"ob\"]).apply(null,arguments)};var
_emscripten_current_thread_process_queued_calls=Module[\"_emscripten_current_thread_process_queued_calls\"]=function(){return(_emscripten_current_thread_process_queued_calls=Module[\"_emscripten_current_thread_process_queued_calls\"]=Module[\"asm\"][\"pb\"]).apply(null,arguments)};var
_emscripten_register_main_browser_thread_id=Module[\"_emscripten_register_main_browser_thread_id\"]=function(){return(_emscripten_register_main_browser_thread_id=Module[\"_emscripten_register_main_browser_thread_id\"]=Module[\"asm\"][\"qb\"]).apply(null,arguments)};var
_emscripten_main_browser_thread_id=Module[\"_emscripten_main_browser_thread_id\"]=function(){return(_emscripten_main_browser_thread_id=Module[\"_emscripten_main_browser_thread_id\"]=Module[\"asm\"][\"rb\"]).apply(null,arguments)};var
__emscripten_do_dispatch_to_thread=Module[\"__emscripten_do_dispatch_to_thread\"]=function(){return(__emscripten_do_dispatch_to_thread=Module[\"__emscripten_do_dispatch_to_thread\"]=Module[\"asm\"][\"sb\"]).apply(null,arguments)};var
_emscripten_sync_run_in_main_thread_4=Module[\"_emscripten_sync_run_in_main_thread_4\"]=function(){return(_emscripten_sync_run_in_main_thread_4=Module[\"_emscripten_sync_run_in_main_thread_4\"]=Module[\"asm\"][\"tb\"]).apply(null,arguments)};var
_emscripten_run_in_main_runtime_thread_js=Module[\"_emscripten_run_in_main_runtime_thread_js\"]=function(){return(_emscripten_run_in_main_runtime_thread_js=Module[\"_emscripten_run_in_main_runtime_thread_js\"]=Module[\"asm\"][\"ub\"]).apply(null,arguments)};var
__emscripten_call_on_thread=Module[\"__emscripten_call_on_thread\"]=function(){return(__emscripten_call_on_thread=Module[\"__emscripten_call_on_thread\"]=Module[\"asm\"][\"vb\"]).apply(null,arguments)};var
_emscripten_tls_init=Module[\"_emscripten_tls_init\"]=function(){return(_emscripten_tls_init=Module[\"_emscripten_tls_init\"]=Module[\"asm\"][\"wb\"]).apply(null,arguments)};var
__emscripten_thread_init=Module[\"__emscripten_thread_init\"]=function(){return(__emscripten_thread_init=Module[\"__emscripten_thread_init\"]=Module[\"asm\"][\"xb\"]).apply(null,arguments)};var
stackSave=Module[\"stackSave\"]=function(){return(stackSave=Module[\"stackSave\"]=Module[\"asm\"][\"yb\"]).apply(null,arguments)};var
stackRestore=Module[\"stackRestore\"]=function(){return(stackRestore=Module[\"stackRestore\"]=Module[\"asm\"][\"zb\"]).apply(null,arguments)};var
stackAlloc=Module[\"stackAlloc\"]=function(){return(stackAlloc=Module[\"stackAlloc\"]=Module[\"asm\"][\"Ab\"]).apply(null,arguments)};var
_emscripten_stack_set_limits=Module[\"_emscripten_stack_set_limits\"]=function(){return(_emscripten_stack_set_limits=Module[\"_emscripten_stack_set_limits\"]=Module[\"asm\"][\"Bb\"]).apply(null,arguments)};var
_memalign=Module[\"_memalign\"]=function(){return(_memalign=Module[\"_memalign\"]=Module[\"asm\"][\"Cb

\"]).apply(null,arguments)};var
__emscripten_allow_main_runtime_queued_calls=Module[\"__emscripten_allow_main_runtime_queued_calls\"]=1
0512;var
__emscripten_main_thread_futex=Module[\"__emscripten_main_thread_futex\"]=12148;Module[\"cwrap\"]=cwrap
;Module[\"PThread\"]=PThread;Module[\"PThread\"]=PThread;Module[\"wasmMemory\"]=wasmMemory;Module
[\"ExitStatus\"]=ExitStatus;var
calledRun;function ExitStatus(status){this.name=\"ExitStatus\";this.message=\"Program terminated with
exit(\"+status+\")\";this.status=status}dependenciesFulfilled=function
runCaller(){if(!calledRun)run();if(!calledRun)dependenciesFulfilled=runCaller};function
run(args){args=args||arguments_;if(runDependencies>0){return}if(ENVIRONMENT_IS_PTHREAD){readyPromis
eResolve(Module);initRuntime();postMessage({\"cmd\":\"loaded\"});return}preRun();if(runDependencies>0){retur
n}function
doRun(){if(calledRun)return;calledRun=true;Module[\"calledRun\"]=true;if(ABORT)return;initRuntime();preMain(
);readyPromiseResolve(Module);if(Module[\"onRuntimeInitialized\"])Module[\"onRuntimeInitialized\"]();postRun(
)}if(Module[\"setStatus\"]){Module[\"setStatus\"](\"Running...\");setTimeout(function(){setTimeout(function(){Mo
dule[\"setStatus\"](\"\")},1);doRun()},1)}else{doRun()}}Module[\"run\"]=run;function
exit(status,implicit){if(implicit&&noExitRuntime&&status===0){return}if(!implicit){if(ENVIRONMENT_IS_PT
HREAD){postMessage({\"cmd\":\"exitProcess\",\"returnCode\":status});throw
new
ExitStatus(status)}else{}}if(noExitRuntime){}else{PThread.terminateAllThreads();EXITSTATUS=status;exitRunti
me();if(Module[\"onExit\"])Module[\"onExit\"](status);ABORT=true}quit_(status,new
ExitStatus(status))}if(Module[\"preInit\"]){if(typeof
Module[\"preInit\"]==\"function\")Module[\"preInit\"]=[Module[\"preInit\"]];while(Module[\"preInit\"].length>0){
Module[\"preInit\"].pop()()}}if(ENVIRONMENT_IS_PTHREAD){noExitRuntime=false;PThread.initWorker()}run
();\n\n\n return WasmBackendModuleThreadedSimd.ready\n}\n);\n})();\nif (typeof exports === 'object' && typeof
module === 'object')\n module.exports = WasmBackendModuleThreadedSimd;\nelse if (typeof define ===
'function' && define['amd'])\n define([], function() { return WasmBackendModuleThreadedSimd; });\nelse if
(typeof exports === 'object')\n exports[\"WasmBackendModuleThreadedSimd\"]
= WasmBackendModuleThreadedSimd;\n","\nvar WasmBackendModule = (function() {\n var _scriptDir = typeof
document !== 'undefined' && document.currentScript ? document.currentScript.src : undefined;\n if (typeof
__filename !== 'undefined') _scriptDir = _scriptDir || __filename;\n return (\nfunction(WasmBackendModule) {\n
WasmBackendModule = WasmBackendModule || {};\n\nvar Module=typeof
WasmBackendModule!==\"undefined\"?WasmBackendModule:{};var
readyPromiseResolve,readyPromiseReject;Module[\"ready\"]=new
Promise(function(resolve,reject){readyPromiseResolve=resolve;readyPromiseReject=reject});var
moduleOverrides={};var key;for(key in
Module){if(Module.hasOwnProperty(key)){moduleOverrides[key]=Module[key]}}var arguments_=[];var
thisProgram=\"./this.program\";var quit_=function(status,toThrow){throw toThrow};var
ENVIRONMENT_IS_WEB=false;var ENVIRONMENT_IS_WORKER=false;var
ENVIRONMENT_IS_NODE=false;var ENVIRONMENT_IS_SHELL=false;ENVIRONMENT_IS_WEB=typeof
window===\"object\";ENVIRONMENT_IS_WORKER=typeof
importScripts===\"function\";ENVIRONMENT_IS_NODE=typeof process===\"object\"&&typeof
process.versions===\"object\"&&typeof
process.versions.node===\"string\";ENVIRONMENT_IS_SHELL=!ENVIRONMENT_IS_WEB&&!ENVIRONM
ENT_IS_NODE&&!ENVIRONMENT_IS_WORKER;var scriptDirectory=\"\";function
locateFile(path){if(Module[\"locateFile\"]){return Module[\"locateFile\"](path,scriptDirectory)}return
scriptDirectory+path}var read_,readAsync,readBinary,setWindowTitle;var nodeFS;var
nodePath;if(ENVIRONMENT_IS_NODE){if(ENVIRONMENT_IS_WORKER){scriptDirectory=require(\"path\").

dirname(scriptDirectory)+\"/\"}else{scriptDirectory=__dirname+\"/\"}read_=function shell_read(filename,binary){if(!nodeFS)nodeFS=require(\"fs\");if(!nodePath)nodePath=require(\"path\");filename=nodePath[\"normalize\"](filename);return nodeFS[\"readFileSync\"](filename,binary?null:\"utf8\")};readBinary=function readBinary(filename){var ret=read_(filename,true);if(!ret.buffer){ret=new Uint8Array(ret)}assert(ret.buffer);return ret};if(process[\"argv\"].length>1){thisProgram=process[\"argv\"][1].replace(/\\\\/g,\"/\")}arguments_=process[\"argv\"].slice(2);process[\"on\"](\"uncaughtException\",function(ex){if(!(ex instanceof ExitStatus)){throw ex}});process[\"on\"](\"unhandledRejection\",abort);quit_=function(status){process[\"exit\"](status)};Module[\"inspect\"]=function(){return\"[Emscripten Module object]\"}}else if(ENVIRONMENT_IS_SHELL){if(typeof read!=\"undefined\"){read_=function shell_read(f){return read(f)}}readBinary=function readBinary(f){var data;if(typeof readbuffer===\"function\"){return new Uint8Array(readbuffer(f))}data=read(f,\"binary\");assert(typeof data===\"object\");return data};if(typeof scriptArgs!=\"undefined\"){arguments_=scriptArgs}else if(typeof arguments!=\"undefined\"){arguments_=arguments}if(typeof quit===\"function\"){quit_=function(status){quit(status)}}if(typeof print!==\"undefined\"){if(typeof console===\"undefined\")console={};console.log=print;console.warn=console.error=typeof printErr!==\"undefined\"?printErr:print}}else if(ENVIRONMENT_IS_WEB||ENVIRONMENT_IS_WORKER){if(ENVIRONMENT_IS_WORKER){scriptDirectory=self.location.href}else if(typeof document!==\"undefined\"&&document.currentScript){scriptDirectory=document.currentScript.src}if(_scriptDir){scriptDirectory=_scriptDir}if(scriptDirectory.indexOf(\"blob:\")!==0){scriptDirectory=scriptDirectory.substr(0,scriptDirectory.lastIndexOf(\"/\")+1)}else{scriptDirectory=\"\"}{read_=function(url){var xhr=new XMLHttpRequest;xhr.open(\"GET\",url,false);xhr.send(null);return xhr.responseText};if(ENVIRONMENT_IS_WORKER){readBinary=function(url){var xhr=new XMLHttpRequest;xhr.open(\"GET\",url,false);xhr.responseType=\"arraybuffer\";xhr.send(null);return new Uint8Array(xhr.response)}}readAsync=function(url,onload,onerror){var xhr=new XMLHttpRequest;xhr.open(\"GET\",url,true);xhr.responseType=\"arraybuffer\";xhr.onload=function(){if(xhr.status==200||xhr.status==0&&xhr.response){onload(xhr.response);return}onerror()};xhr.onerror=onerror;xhr.send(null)}}setWindowTitle=function(title){document.title=title}}else{}var out=Module[\"print\"]||console.log.bind(console);var err=Module[\"printErr\"]||console.warn.bind(console);for(key in moduleOverrides){if(moduleOverrides.hasOwnProperty(key)){Module[key]=moduleOverrides[key]}}moduleOverrides=null;if(Module[\"arguments\"])arguments_=Module[\"arguments\"];if(Module[\"thisProgram\"])thisProgram=Module[\"thisProgram\"];if(Module[\"quit\"])quit_=Module[\"quit\"];var wasmBinary;if(Module[\"wasmBinary\"])wasmBinary=Module[\"wasmBinary\"];var noExitRuntime=Module[\"noExitRuntime\"]||true;if(typeof WebAssembly!==\"object\"){abort(\"no native wasm support detected\")}var wasmMemory;var ABORT=false;var EXITSTATUS;function assert(condition,text){if(!condition){abort(\"Assertion failed: \"+text)}}function getCFunc(ident){var func=Module[\"_\"+ident];assert(func,\"Cannot call unknown function \"+ident+\", make sure it is exported\");return func}function ccall(ident,returnType,argTypes,args,opts){var toC={\"string\":function(str){var ret=0;if(str!==null&&str!==undefined&&str!==0){var len=(str.length<<2)+1;ret=stackAlloc(len);stringToUTF8(str,ret,len)}return ret},\"array\":function(arr){var ret=stackAlloc(arr.length);writeArrayToMemory(arr,ret);return ret}};function convertReturnValue(ret){if(returnType===\"string\")return UTF8ToString(ret);if(returnType===\"boolean\")return Boolean(ret);return ret}var func=getCFunc(ident);var cArgs=[];var stack=0;if(args){for(var i=0;i<args.length;i++){var converter=toC[argTypes[i]];if(converter){if(stack===0)stack=stackSave();cArgs[i]=converter(args[i])}else{cArgs[i

]=args[i]}}}var ret=func.apply(null,cArgs);ret=convertReturnValue(ret);if(stack!==0)stackRestore(stack);return ret}function cwrap(ident,returnType,argTypes,opts){argTypes=argTypes||[];var numericArgs=argTypes.every(function(type){return type===\"number\"});var numericRet=returnType!==\"string\";if(numericRet&&numericArgs&&!opts){return getCFunc(ident)}return function(){return ccall(ident,returnType,argTypes,arguments,opts)}}var UTF8Decoder=typeof TextDecoder!==\"undefined\"?new TextDecoder(\"utf8\"):undefined;function UTF8ArrayToString(heap,idx,maxBytesToRead){var endIdx=idx+maxBytesToRead;var endPtr=idx;while(heap[endPtr]&&!(endPtr>=endIdx))++endPtr;if(endPtr-idx>16&&heap.subarray&&UTF8Decoder){return UTF8Decoder.decode(heap.subarray(idx,endPtr))}else{var str=\"\";while(idx<endPtr){var u0=heap[idx++];if(!(u0&128)){str+=String.fromCharCode(u0);continue}var u1=heap[idx++]&63;if((u0&224)==192){str+=String.fromCharCode((u0&31)<<6|u1);continue}var u2=heap[idx++]&63;if((u0&240)==224){u0=(u0&15)<<12|u1<<6|u2}else{u0=(u0&7)<<18|u1<<12|u2<<6|heap[idx++]&63}if(u0<65536){str+=String.fromCharCode(u0)}else{var ch=u0-65536;str+=String.fromCharCode(55296|ch>>10,56320|ch&1023)}}}return str}function UTF8ToString(ptr,maxBytesToRead){return ptr?UTF8ArrayToString(HEAPU8,ptr,maxBytesToRead):\"\"}function stringToUTF8Array(str,heap,outIdx,maxBytesToWrite){if(!(maxBytesToWrite>0))return 0;var startIdx=outIdx;var endIdx=outIdx+maxBytesToWrite-1;for(var i=0;i<str.length;++i){var u=str.charCodeAt(i);if(u>=55296&&u<=57343){var u1=str.charCodeAt(++i);u=65536+((u&1023)<<10)|u1&1023}if(u<=127){if(outIdx>=endIdx)break;heap[outIdx++]=u}else if(u<=2047){if(outIdx+1>=endIdx)break;heap[outIdx++]=192|u>>6;heap[outIdx++]=128|u&63}else if(u<=65535){if(outIdx+2>=endIdx)break;heap[outIdx++]=224|u>>12;heap[outIdx++]=128|u>>6&63;heap[outIdx++]=128|u&63}else{if(outIdx+3>=endIdx)break;heap[outIdx++]=240|u>>18;heap[outIdx++]=128|u>>12&63;heap[outIdx++]=128|u>>6&63;heap[outIdx++]=128|u&63}}heap[outIdx]=0;return outIdx-startIdx}function stringToUTF8(str,outPtr,maxBytesToWrite){return stringToUTF8Array(str,HEAPU8,outPtr,maxBytesToWrite)}function writeArrayToMemory(array,buffer){HEAP8.set(array,buffer)}function alignUp(x,multiple){if(x%multiple>0){x+=multiple-x%multiple}return x}var buffer,HEAP8,HEAPU8,HEAP16,HEAPU16,HEAP32,HEAPU32,HEAPF32,HEAPF64;function updateGlobalBufferAndViews(buf){buffer=buf;Module[\"HEAP8\"]=HEAP8=new Int8Array(buf);Module[\"HEAP16\"]=HEAP16=new Int16Array(buf);Module[\"HEAP32\"]=HEAP32=new Int32Array(buf);Module[\"HEAPU8\"]=HEAPU8=new Uint8Array(buf);Module[\"HEAPU16\"]=HEAPU16=new Uint16Array(buf);Module[\"HEAPU32\"]=HEAPU32=new Uint32Array(buf);Module[\"HEAPF32\"]=HEAPF32=new Float32Array(buf);Module[\"HEAPF64\"]=HEAPF64=new Float64Array(buf)}var INITIAL_MEMORY=Module[\"INITIAL_MEMORY\"]||16777216;var wasmTable;var __ATPRERUN__=[];var __ATINIT__=[];var __ATMAIN__=[];var __ATPOSTRUN__=[];var runtimeInitialized=false;__ATINIT__.push({func:function(){___wasm_call_ctors()}});function preRun(){if(Module[\"preRun\"]){if(typeof Module[\"preRun\"]==\"function\")Module[\"preRun\"]=[Module[\"preRun\"]];while(Module[\"preRun\"].length){addOnPreRun(Module[\"preRun\"].shift())}}callRuntimeCallbacks(__ATPRERUN__)}function initRuntime(){runtimeInitialized=true;callRuntimeCallbacks(__ATINIT__)}function preMain(){callRuntimeCallbacks(__ATMAIN__)}function postRun(){if(Module[\"postRun\"]){if(typeof Module[\"postRun\"]==\"function\")Module[\"postRun\"]=[Module[\"postRun\"]];while(Module[\"postRun\"].length){addOnPostRun(Module[\"postRun\"].shift())}}callRuntimeCallbacks(__ATPOSTRUN__)}function addOnPreRun(cb){__ATPRERUN__.unshift(cb)}function addOnPostRun(cb){__ATPOSTRUN__.unshift(cb)}var runDependencies=0;var runDependencyWatcher=null;var dependenciesFulfilled=null;function

addRunDependency(id){runDependencies++;if(Module[\"monitorRunDependencies\"]){Module[\"monitorRunDependencies\"](runDependencies)}}function removeRunDependency(id){runDependencies--;if(Module[\"monitorRunDependencies\"]){Module[\"monitorRunDependencies\"](runDependencies)}if(runDependencies==0){if(runDependencyWatcher!==null){clearInterval(runDependencyWatcher);runDependencyWatcher=null}if(dependenciesFulfilled){var callback=dependenciesFulfilled;dependenciesFulfilled=null;callback()}}}Module[\"preloadedImages\"]={};Module[\"preloadedAudios\"]={};function abort(what){if(Module[\"onAbort\"]){Module[\"onAbort\"](what)}what+=\"\";err(what);ABORT=true;EXITSTATUS=1;what=\"abort(\"+what+\"). Build with -s ASSERTIONS=1 for more info.\";var e=new WebAssembly.RuntimeError(what);readyPromiseReject(e);throw e}function hasPrefix(str,prefix){return String.prototype.startsWith?str.startsWith(prefix):str.indexOf(prefix)===0}var dataURIPrefix=\"data:application/octet-stream; base64,\";function isDataURI(filename){return hasPrefix(filename,dataURIPrefix)}var fileURIPrefix=\"file://\";function isFileURI(filename){return hasPrefix(filename,fileURIPrefix)}var wasmBinaryFile=\"tfjs-backend-wasm.wasm\";if(!isDataURI(wasmBinaryFile)){wasmBinaryFile=locateFile(wasmBinaryFile)}function getBinary(file){try{if(file==wasmBinaryFile&&wasmBinary){return new Uint8Array(wasmBinary)}if(readBinary){return readBinary(file)}else{throw\"both async and sync fetching of the wasm failed\"}}catch(err){abort(err)}}function getBinaryPromise(){if(!wasmBinary&&(ENVIRONMENT_IS_WEB||ENVIRONMENT_IS_WORKER)){if(typeof fetch===\"function\"&&!isFileURI(wasmBinaryFile)){return fetch(wasmBinaryFile,{credentials:\"same-origin\"}).then(function(response){if(!response[\"ok\"]){throw\"failed to load wasm binary file at '\"+wasmBinaryFile+\"'\"}return response[\"arrayBuffer\"]()}).catch(function(){return getBinary(wasmBinaryFile)})}else{if(readAsync){return new Promise(function(resolve,reject){readAsync(wasmBinaryFile,function(response){resolve(new Uint8Array(response))},reject)})}}}return Promise.resolve().then(function(){return getBinary(wasmBinaryFile)})}function createWasm(){var info={\"a\":asmLibraryArg};function receiveInstance(instance,module){var exports=instance.exports;Module[\"asm\"]=exports;wasmMemory=Module[\"asm\"][\"j\"];updateGlobalBufferAndViews(wasmMemory.buffer);wasmTable=Module[\"asm\"][\"r\"];removeRunDependency(\"wasm-instantiate\")}addRunDependency(\"wasm-instantiate\");function receiveInstantiatedSource(output){receiveInstance(output[\"instance\"])}function instantiateArrayBuffer(receiver){return getBinaryPromise().then(function(binary){return WebAssembly.instantiate(binary,info)}).then(receiver,function(reason){err(\"failed to asynchronously prepare wasm: \"+reason);abort(reason)})}function instantiateAsync(){if(!wasmBinary&&typeof WebAssembly.instantiateStreaming===\"function\"&&!isDataURI(wasmBinaryFile)&&!isFileURI(wasmBinaryFile)&&typeof fetch===\"function\"){return fetch(wasmBinaryFile,{credentials:\"same-origin\"}).then(function(response){var result=WebAssembly.instantiateStreaming(response,info);return result.then(receiveInstantiatedSource,function(reason){err(\"wasm streaming compile failed: \"+reason);err(\"falling back to ArrayBuffer instantiation\");return instantiateArrayBuffer(receiveInstantiatedSource)})})}else{return instantiateArrayBuffer(receiveInstantiatedSource)}}if(Module[\"instantiateWasm\"]){try{var exports=Module[\"instantiateWasm\"](info,receiveInstance);return exports}catch(e){err(\"Module.instantiateWasm callback failed with error: \"+e);return false}}instantiateAsync().catch(readyPromiseReject);return{}}function callRuntimeCallbacks(callbacks){while(callbacks.length>0){var callback=callbacks.shift();if(typeof callback==\"function\"){callback(Module);continue}var func=callback.func;if(typeof func===\"number\"){if(callback.arg===undefined){wasmTable.get(func)()}else{wasmTable.get(func)(callback.arg)}}else{func(callback.arg===undefined?null:callback.arg)}}}function _abort(){abort()}function _emscripten_memcpy_big(dest,src,num){HEAPU8.copyWithin(dest,src,src+num)}function _emscripten_get_heap_size(){return HEAPU8.length}function

emscripten_realloc_buffer(size){try{wasmMemory.grow(size-buffer.byteLength+65535>>>16);updateGlobalBufferAndViews(wasmMemory.buffer);return 1}catch(e){}}function _emscripten_resize_heap(requestedSize){var oldSize=_emscripten_get_heap_size();var maxHeapSize=2147483648;if(requestedSize>maxHeapSize){return false}for(var cutDown=1;cutDown<=4;cutDown*=2){var overGrownHeapSize=oldSize*(1+.2/cutDown);overGrownHeapSize=Math.min(overGrownHeapSize,requestedSize+100663296);var newSize=Math.min(maxHeapSize,alignUp(Math.max(requestedSize,overGrownHeapSize),65536));var replacement=emscripten_realloc_buffer(newSize);if(replacement){return true}}return false}var SYSCALLS={mappings:{},buffers:[null,[],[]],printChar:function(stream,curr){var buffer=SYSCALLS.buffers[stream];if(curr===0||curr===10){(stream===1?out:err)(UTF8ArrayToString(buffer,0));buffer.length=0}else{buffer.push(curr)}},varargs:undefined,get:function(){SYSCALLS.varargs+=4;var ret=HEAP32[SYSCALLS.varargs-4>>2];return ret},getStr:function(ptr){var ret=UTF8ToString(ptr);return ret},get64:function(low,high){return low}};function _fd_close(fd){return 0}function _fd_seek(fd,offset_low,offset_high,whence,newOffset){}function _fd_write(fd,iov,iovcnt,pnum){var num=0;for(var i=0;i<iovcnt;i++){var ptr=HEAP32[iov+i*8>>2];var len=HEAP32[iov+(i*8+4)>>2];for(var j=0;j<len;j++){SYSCALLS.printChar(fd,HEAPU8[ptr+j])}num+=len}HEAP32[pnum>>2]=num;return 0}function _pthread_create(){return 6}function _pthread_join(){return 28}function setErrNo(value){HEAP32[___errno_location()>>2]=value;return value}function _sysconf(name){switch(name){case 30:return 16384;case 85:var maxHeapSize=2147483648;return maxHeapSize/16384;case 132:case 133:case 12:case 137:case 138:case 15:case 235:case 16:case 17:case 18:case 19:case 20:case 149:case 13:case 10:case 236:case 153:case 9:case 21:case 22:case 159:case 154:case 14:case 77:case 78:case 139:case 82:case 68:case 67:case 164:case 11:case 29:case 47:case 48:case 95:case 52:case 51:case 46:return 200809;case 27:case 246:case 127:case 128:case 23:case 24:case 160:case 161:case 181:case 182:case 242:case 183:case 184:case 243:case 244:case 245:case 165:case 178:case 179:case 49:case 50:case 168:case 169:case 175:case 170:case 171:case 172:case 97:case 76:case 32:case 173:case 35:case 80:case 81:case 79:return-1;case 176:case 177:case 7:case 155:case 8:case 157:case 125:case 126:case 92:case 93:case 129:case 130:case 131:case 94:case 91:return 1;case 74:case 60:case 69:case 70:case 4:return 1024;case 31:case 42:case 72:return 32;case 87:case 26:case 33:return 2147483647;case 34:case 1:return 47839;case 38:case 36:return 99;case 43:case 37:return 2048;case 0:return 2097152;case 3:return 65536;case 28:return 32768;case 44:return 32767;case 75:return 16384;case 39:return 1e3;case 89:return 700;case 71:return 256;case 40:return 255;case 2:return 100;case 180:return 64;case 25:return 20;case 5:return 16;case 6:return 6;case 73:return 4;case 84:{if(typeof navigator===\"object\")return navigator[\"hardwareConcurrency\"]||1;return 1}}setErrNo(28);return-1}var asmLibraryArg={\"a\":_abort,\"d\":_emscripten_memcpy_big,\"e\":_emscripten_resize_heap,\"f\":_fd_close,\"c\":_fd_seek,\"b\":_fd_write,\"h\":_pthread_create,\"g\":_pthread_join,\"i\":_sysconf};var asm=createWasm();var ___wasm_call_ctors=Module[\"___wasm_call_ctors\"]=function(){return(___wasm_call_ctors=Module[\"___wasm_call_ctors\"]=Module[\"asm\"][\"k\"]).apply(null,arguments)};var _init=Module[\"_init\"]=function(){return(_init=Module[\"_init\"]=Module[\"asm\"][\"l\"]).apply(null,arguments)};var _init_with_threads_count=Module[\"_init_with_threads_count\"]=function(){return(_init_with_threads_count=Module[\"_init_with_threads_count\"]=Module[\"asm\"][\"m\"]).apply(null,arguments)};var _get_threads_count=Module[\"_get_threads_count\"]=function(){return(_get_threads_count=Module[\"_get_threads_count\"]=Module[\"asm\"][\"n\"]).apply(null,arguments)};var _register_tensor=Module[\"_register_tensor\"]=function(){return(_register_tensor=Module[\"_register_tensor\"]=Module[\"asm\"][\"o\"]).apply(null,arguments)};var _dispose_data=Module[\"_dispose_data\"]=function(){return(_dispose_data=Module[\"_dispose_data\"]=Module[\"asm\"][\"p\"]).apply(null,arguments)};var

_dispose=Module[\"_dispose\"]=function(){return(_dispose=Module[\"_dispose\"]=Module[\"asm\"][\"q\"]).apply(null,arguments)};var
_Abs=Module[\"_Abs\"]=function(){return(_Abs=Module[\"_Abs\"]=Module[\"asm\"][\"s\"]).apply(null,arguments)};var
_Add=Module[\"_Add\"]=function(){return(_Add=Module[\"_Add\"]=Module[\"asm\"][\"t\"]).apply(null,arguments)};var
_AddN=Module[\"_AddN\"]=function(){return(_AddN=Module[\"_AddN\"]=Module[\"asm\"][\"u\"]).apply(null,arguments)};var
_All=Module[\"_All\"]=function(){return(_All=Module[\"_All\"]=Module[\"asm\"][\"v\"]).apply(null,arguments)};var
_Any=Module[\"_Any\"]=function(){return(_Any=Module[\"_Any\"]=Module[\"asm\"][\"w\"]).apply(null,arguments)};var
_ArgMax=Module[\"_ArgMax\"]=function(){return(_ArgMax=Module[\"_ArgMax\"]=Module[\"asm\"][\"x\"]).apply(null,arguments)};var
_AvgPool=Module[\"_AvgPool\"]=function(){return(_AvgPool=Module[\"_AvgPool\"]=Module[\"asm\"][\"y\"]).apply(null,arguments)};var
_BatchMatMul=Module[\"_BatchMatMul\"]=function(){return(_BatchMatMul=Module[\"_BatchMatMul\"]=Module[\"asm\"][\"z\"]).apply(null,arguments)};var
_Ceil=Module[\"_Ceil\"]=function(){return(_Ceil=Module[\"_Ceil\"]=Module[\"asm\"][\"A\"]).apply(null,arguments)};var
_ClipByValue=Module[\"_ClipByValue\"]=function(){return(_ClipByValue=Module[\"_ClipByValue\"]=Module[\"asm\"][\"B\"]).apply(null,arguments)};var
_Conv2D=Module[\"_Conv2D\"]=function(){return(_Conv2D=Module[\"_Conv2D\"]=Module[\"asm\"][\"C\"]).apply(null,arguments)};var
_Conv2DBackpropInput=Module[\"_Conv2DBackpropInput\"]=function(){return(_Conv2DBackpropInput=Module[\"_Conv2DBackpropInput\"]=Module[\"asm\"][\"D\"]).apply(null,arguments)};var
_Cos=Module[\"_Cos\"]=function(){return(_Cos=Module[\"_Cos\"]=Module[\"asm\"][\"E\"]).apply(null,arguments)};var
_Cosh=Module[\"_Cosh\"]=function(){return(_Cosh=Module[\"_Cosh\"]=Module[\"asm\"][\"F\"]).apply(null,arguments)};var
_CropAndResize=Module[\"_CropAndResize\"]=function(){return(_CropAndResize=Module[\"_CropAndResize\"]=Module[\"asm\"][\"G\"]).apply(null,arguments)};var
_Cumsum=Module[\"_Cumsum\"]=function(){return(_Cumsum=Module[\"_Cumsum\"]=Module[\"asm\"][\"H\"]).apply(null,arguments)};var
_DepthToSpace=Module[\"_DepthToSpace\"]=function(){return(_DepthToSpace=Module[\"_DepthToSpace\"]=Module[\"asm\"][\"I\"]).apply(null,arguments)};var
_DepthwiseConv2dNative=Module[\"_DepthwiseConv2dNative\"]=function(){return(_DepthwiseConv2dNative=Module[\"_DepthwiseConv2dNative\"]=Module[\"asm\"][\"J\"]).apply(null,arguments)};var
_Elu=Module[\"_Elu\"]=function(){return(_Elu=Module[\"_Elu\"]=Module[\"asm\"][\"K\"]).apply(null,arguments)};var
_Equal=Module[\"_Equal\"]=function(){return(_Equal=Module[\"_Equal\"]=Module[\"asm\"][\"L\"]).apply(null,arguments)};var
_Exp=Module[\"_Exp\"]=function(){return(_Exp=Module[\"_Exp\"]=Module[\"asm\"][\"M\"]).apply(null,arguments)};var
_FlipLeftRight=Module[\"_FlipLeftRight\"]=function(){return(_FlipLeftRight=Module[\"_FlipLeftRight\"]=Module[\"asm\"][\"N\"]).apply(null,arguments)};var
_Floor=Module[\"_Floor\"]=function(){return(_Floor=Module[\"_Floor\"]=Module[\"asm\"][\"O\"]).apply(null,arguments)};var

_FloorDiv=Module[\"_FloorDiv\"]=function(){return(_FloorDiv=Module[\"_FloorDiv\"]=Module[\"asm\"][\"P\"]).apply(null,arguments)};var
_FusedBatchNorm=Module[\"_FusedBatchNorm\"]=function(){return(_FusedBatchNorm=Module[\"_FusedBatchNorm\"]=Module[\"asm\"][\"Q\"]).apply(null,arguments)};var
_FusedConv2D=Module[\"_FusedConv2D\"]=function(){return(_FusedConv2D=Module[\"_FusedConv2D\"]=Module[\"asm\"][\"R\"]).apply(null,arguments)};var
_FusedDepthwiseConv2D=Module[\"_FusedDepthwiseConv2D\"]=function(){return(_FusedDepthwiseConv2D=Module[\"_FusedDepthwiseConv2D\"]=Module[\"asm\"][\"S\"]).apply(null,arguments)};var
_Gather=Module[\"_Gather\"]=function(){return(_Gather=Module[\"_Gather\"]=Module[\"asm\"][\"T\"]).apply(null,arguments)};var
_GatherNd=Module[\"_GatherNd\"]=function(){return(_GatherNd=Module[\"_GatherNd\"]=Module[\"asm\"][\"U\"]).apply(null,arguments)};var
_Greater=Module[\"_Greater\"]=function(){return(_Greater=Module[\"_Greater\"]=Module[\"asm\"][\"V\"]).apply(null,arguments)};var
_GreaterEqual=Module[\"_GreaterEqual\"]=function(){return(_GreaterEqual=Module[\"_GreaterEqual\"]=Module[\"asm\"][\"W\"]).apply(null,arguments)};var
_LeakyRelu=Module[\"_LeakyRelu\"]=function(){return(_LeakyRelu=Module[\"_LeakyRelu\"]=Module[\"asm\"][\"X\"]).apply(null,arguments)};var
_Less=Module[\"_Less\"]=function(){return(_Less=Module[\"_Less\"]=Module[\"asm\"][\"Y\"]).apply(null,arguments)};var
_LessEqual=Module[\"_LessEqual\"]=function(){return(_LessEqual=Module[\"_LessEqual\"]=Module[\"asm\"][\"Z\"]).apply(null,arguments)};var
_Log=Module[\"_Log\"]=function(){return(_Log=Module[\"_Log\"]=Module[\"asm\"][\"_\"]).apply(null,arguments)};var
_LogicalAnd=Module[\"_LogicalAnd\"]=function(){return(_LogicalAnd=Module[\"_LogicalAnd\"]=Module[\"asm\"][\"$\"]).apply(null,arguments)};var
_Max=Module[\"_Max\"]=function(){return(_Max=Module[\"_Max\"]=Module[\"asm\"][\"aa\"]).apply(null,arguments)};var
_MaxPool=Module[\"_MaxPool\"]=function(){return(_MaxPool=Module[\"_MaxPool\"]=Module[\"asm\"][\"ba\"]).apply(null,arguments)};var
_Maximum=Module[\"_Maximum\"]=function(){return(_Maximum=Module[\"_Maximum\"]=Module[\"asm\"][\"ca\"]).apply(null,arguments)};var
_Mean=Module[\"_Mean\"]=function(){return(_Mean=Module[\"_Mean\"]=Module[\"asm\"][\"da\"]).apply(null,arguments)};var
_Min=Module[\"_Min\"]=function(){return(_Min=Module[\"_Min\"]=Module[\"asm\"][\"ea\"]).apply(null,arguments)};var
_Minimum=Module[\"_Minimum\"]=function(){return(_Minimum=Module[\"_Minimum\"]=Module[\"asm\"][\"fa\"]).apply(null,arguments)};var
_MirrorPad=Module[\"_MirrorPad\"]=function(){return(_MirrorPad=Module[\"_MirrorPad\"]=Module[\"asm\"][\"ga\"]).apply(null,arguments)};var
_Multiply=Module[\"_Multiply\"]=function(){return(_Multiply=Module[\"_Multiply\"]=Module[\"asm\"][\"ha\"]).apply(null,arguments)};var
_Neg=Module[\"_Neg\"]=function(){return(_Neg=Module[\"_Neg\"]=Module[\"asm\"][\"ia\"]).apply(null,arguments)};var
_NonMaxSuppressionV3=Module[\"_NonMaxSuppressionV3\"]=function(){return(_NonMaxSuppressionV3=Module[\"_NonMaxSuppressionV3\"]=Module[\"asm\"][\"ja\"]).apply(null,arguments)};var
_NonMaxSuppressionV4=Module[\"_NonMaxSuppressionV4\"]=function(){return(_NonMaxSuppressionV4=Module[\"_NonMaxSuppressionV4\"]=Module[\"asm\"][\"ka\"]).apply(null,arguments)};var

_NonMaxSuppressionV5=Module[\"_NonMaxSuppressionV5\"]=function(){return(_NonMaxSuppressionV5=Module[\"_NonMaxSuppressionV5\"]=Module[\"asm\"][\"la\"]).apply(null,arguments)};var
_NotEqual=Module[\"_NotEqual\"]=function(){return(_NotEqual=Module[\"_NotEqual\"]=Module[\"asm\"][\"ma\"]).apply(null,arguments)};var
_OneHot=Module[\"_OneHot\"]=function(){return(_OneHot=Module[\"_OneHot\"]=Module[\"asm\"][\"na\"]).apply(null,arguments)};var
_PadV2=Module[\"_PadV2\"]=function(){return(_PadV2=Module[\"_PadV2\"]=Module[\"asm\"][\"oa\"]).apply(null,arguments)};var
_Pow=Module[\"_Pow\"]=function(){return(_Pow=Module[\"_Pow\"]=Module[\"asm\"][\"pa\"]).apply(null,arguments)};var
_Prelu=Module[\"_Prelu\"]=function(){return(_Prelu=Module[\"_Prelu\"]=Module[\"asm\"][\"qa\"]).apply(null,arguments)};var
_Prod=Module[\"_Prod\"]=function(){return(_Prod=Module[\"_Prod\"]=Module[\"asm\"][\"ra\"]).apply(null,arguments)};var
_RealDiv=Module[\"_RealDiv\"]=function(){return(_RealDiv=Module[\"_RealDiv\"]=Module[\"asm\"][\"sa\"]).apply(null,arguments)};var
_Relu=Module[\"_Relu\"]=function(){return(_Relu=Module[\"_Relu\"]=Module[\"asm\"][\"ta\"]).apply(null,arguments)};var
_Relu6=Module[\"_Relu6\"]=function(){return(_Relu6=Module[\"_Relu6\"]=Module[\"asm\"][\"ua\"]).apply(null,arguments)};var
_ResizeBilinear=Module[\"_ResizeBilinear\"]=function(){return(_ResizeBilinear=Module[\"_ResizeBilinear\"]=Module[\"asm\"][\"va\"]).apply(null,arguments)};var
_Reverse=Module[\"_Reverse\"]=function(){return(_Reverse=Module[\"_Reverse\"]=Module[\"asm\"][\"wa\"]).apply(null,arguments)};var
_RotateWithOffset=Module[\"_RotateWithOffset\"]=function(){return(_RotateWithOffset=Module[\"_RotateWithOffset\"]=Module[\"asm\"][\"xa\"]).apply(null,arguments)};var
_Round=Module[\"_Round\"]=function(){return(_Round=Module[\"_Round\"]=Module[\"asm\"][\"ya\"]).apply(null,arguments)};var
_Rsqrt=Module[\"_Rsqrt\"]=function(){return(_Rsqrt=Module[\"_Rsqrt\"]=Module[\"asm\"][\"za\"]).apply(null,arguments)};var
_ScatterNd=Module[\"_ScatterNd\"]=function(){return(_ScatterNd=Module[\"_ScatterNd\"]=Module[\"asm\"][\"Aa\"]).apply(null,arguments)};var
_SelectV2=Module[\"_SelectV2\"]=function(){return(_SelectV2=Module[\"_SelectV2\"]=Module[\"asm\"][\"Ba\"]).apply(null,arguments)};var
_Sigmoid=Module[\"_Sigmoid\"]=function(){return(_Sigmoid=Module[\"_Sigmoid\"]=Module[\"asm\"][\"Ca\"]).apply(null,arguments)};var
_Sin=Module[\"_Sin\"]=function(){return(_Sin=Module[\"_Sin\"]=Module[\"asm\"][\"Da\"]).apply(null,arguments)};var
_Softmax=Module[\"_Softmax\"]=function(){return(_Softmax=Module[\"_Softmax\"]=Module[\"asm\"][\"Ea\"]).apply(null,arguments)};var
_Sqrt=Module[\"_Sqrt\"]=function(){return(_Sqrt=Module[\"_Sqrt\"]=Module[\"asm\"][\"Fa\"]).apply(null,arguments)};var
_Square=Module[\"_Square\"]=function(){return(_Square=Module[\"_Square\"]=Module[\"asm\"][\"Ga\"]).apply(null,arguments)};var
_SquaredDifference=Module[\"_SquaredDifference\"]=function(){return(_SquaredDifference=Module[\"_SquaredDifference\"]=Module[\"asm\"][\"Ha\"]).apply(null,arguments)};var
_Step=Module[\"_Step\"]=function(){return(_Step=Module[\"_Step\"]=Module[\"asm\"][\"Ia\"]).apply(null,arguments)};var

_StridedSlice=Module[\"_StridedSlice\"]=function(){return(_StridedSlice=Module[\"_StridedSlice\"]=Module[\"asm\"][\"Ja\"]).apply(null,arguments)};var
_Sub=Module[\"_Sub\"]=function(){return(_Sub=Module[\"_Sub\"]=Module[\"asm\"][\"Ka\"]).apply(null,arguments)};var
_Sum=Module[\"_Sum\"]=function(){return(_Sum=Module[\"_Sum\"]=Module[\"asm\"][\"La\"]).apply(null,arguments)};var
_Tan=Module[\"_Tan\"]=function(){return(_Tan=Module[\"_Tan\"]=Module[\"asm\"][\"Ma\"]).apply(null,arguments)};var
_Tanh=Module[\"_Tanh\"]=function(){return(_Tanh=Module[\"_Tanh\"]=Module[\"asm\"][\"Na\"]).apply(null,arguments)};var
_Tile=Module[\"_Tile\"]=function(){return(_Tile=Module[\"_Tile\"]=Module[\"asm\"][\"Oa\"]).apply(null,arguments)};var
_TopK=Module[\"_TopK\"]=function(){return(_TopK=Module[\"_TopK\"]=Module[\"asm\"][\"Pa\"]).apply(null,arguments)};var
_Transform=Module[\"_Transform\"]=function(){return(_Transform=Module[\"_Transform\"]=Module[\"asm\"][\"Qa\"]).apply(null,arguments)};var
_Transpose=Module[\"_Transpose\"]=function(){return(_Transpose=Module[\"_Transpose\"]=Module[\"asm\"][\"Ra\"]).apply(null,arguments)};var
__FusedMatMul=Module[\"__FusedMatMul\"]=function(){return(__FusedMatMul=Module[\"__FusedMatMul\"]=Module[\"asm\"][\"Sa\"]).apply(null,arguments)};var
_malloc=Module[\"_malloc\"]=function(){return(_malloc=Module[\"_malloc\"]=Module[\"asm\"][\"Ta\"]).apply(null,arguments)};var
_free=Module[\"_free\"]=function(){return(_free=Module[\"_free\"]=Module[\"asm\"][\"Ua\"]).apply(null,arguments)};var
___errno_location=Module[\"___errno_location\"]=function(){return(___errno_location=Module[\"___errno_location\"]=Module[\"asm\"][\"Va\"]).apply(null,arguments)};var
stackSave=Module[\"stackSave\"]=function(){return(stackSave=Module[\"stackSave\"]=Module[\"asm\"][\"Wa\"]).apply(null,arguments)};var
stackRestore=Module[\"stackRestore\"]=function(){return(stackRestore=Module[\"stackRestore\"]=Module[\"asm\"][\"Xa\"]).apply(null,arguments)};var
stackAlloc=Module[\"stackAlloc\"]=function(){return(stackAlloc=Module[\"stackAlloc\"]=Module[\"asm\"][\"Ya\"]).apply(null,arguments)};Module[\"cwrap\"]=cwrap;var calledRun;function
ExitStatus(status){this.name=\"ExitStatus\";this.message=\"Program terminated with
exit(\"+status+\")\";this.status=status}dependenciesFulfilled=function
runCaller(){if(!calledRun)run();if(!calledRun)dependenciesFulfilled=runCaller};function
run(args){args=args||arguments_;if(runDependencies>0){return}preRun();if(runDependencies>0){return}function
doRun(){if(calledRun)return;calledRun=true;Module[\"calledRun\"]=true;if(ABORT)return;initRuntime();preMain();readyPromiseResolve(Module);if(Module[\"onRuntimeInitialized\"])Module[\"onRuntimeInitialized\"]();postRun()}if(Module[\"setStatus\"]){Module[\"setStatus\"](\"Running...\");setTimeout(function(){setTimeout(function(){Module[\"setStatus\"](\"\")},1);doRun()},1)}else{doRun()}}Module[\"run\"]=run;if(Module[\"preInit\"]){if(typeof
Module[\"preInit\"]==\"function\")Module[\"preInit\"]=[Module[\"preInit\"]];while(Module[\"preInit\"].length>0){
Module[\"preInit\"].pop()()}run();\n\n\n return WasmBackendModule.ready\n}\n);\n})();\nif (typeof exports ===
'object' && typeof module === 'object')\n module.exports = WasmBackendModule;\nelse if (typeof define ===
'function' && define['amd'])\n define([], function() { return WasmBackendModule; });\nelse if (typeof exports ===
'object')\n exports[\"WasmBackendModule\"] = WasmBackendModule;\n","/**\n * @license\n * Copyright 2019
Google LLC. All Rights Reserved.\n * Licensed under
 the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the
License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n *

Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\nimport './flags_wasm';\n\nimport {backend_util, BackendTimingInfo, DataStorage, DataType, deprecationWarn, engine, env, KernelBackend, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasmModule, WasmFactoryConfig} from '../wasm-out/tfjs-backend-wasm';\nimport {BackendWasmThreadedSimdModule} from '../wasm-out/tfjs-backend-wasm-threaded-simd';\nimport wasmFactoryThreadedSimd from '../wasm-out/tfjs-backend-wasm-threaded-simd.js';\n// @ts-ignore\nimport {wasmWorkerContents} from '../wasm-out/tfjs-backend-wasm-threaded-simd.worker.js';\nimport wasmFactory from '../wasm-out/tfjs-backend-wasm.js';\n\ninterface TensorData {\n id: number;\n memoryOffset: number;\n shape: number[];\n dtype: DataType;\n refCount: number;\n /** Only used for string tensors, storing encoded bytes. */\n stringBytes?: Uint8Array[];\n}\n\nexport type DataId = object; // object instead of {} to force non-primitive.\n\nexport class BackendWasm extends KernelBackend {\n // 0 is reserved for null data ids.\n private dataIdNextNumber = 1;\n dataIdMap: DataStorage<TensorData>;\n\n constructor(public wasm: BackendWasmModule|BackendWasmThreadedSimdModule) {\n super();\n this.wasm.tfjs.initWithThreadsCount(threadsCount);\n actualThreadsCount = this.wasm.tfjs.getThreadsCount();\n this.dataIdMap = new DataStorage(this, engine());\n }\n\n write(values: backend_util.BackendValues, shape: number[], dtype: DataType):\n DataId {\n const dataId = {id: this.dataIdNextNumber++};\n this.move(dataId, values, shape, dtype, 1);\n return dataId;\n }\n\n numDataIds(): number {\n return this.dataIdMap.numDataIds();\n }\n\n async time(f: () => void): Promise<BackendTimingInfo> {\n const start = util.now();\n f();\n const kernelMs = util.now() - start;\n return {kernelMs};\n }\n\n move(\n dataId: DataId, values: backend_util.BackendValues, shape: number[],\n dtype: DataType, refCount: number): void {\n const id = this.dataIdNextNumber++;\n if (dtype === 'string') {\n const stringBytes = values as Uint8Array[];\n this.dataIdMap.set(\n dataId,\n {id, stringBytes, shape, dtype, memoryOffset: null, refCount});\n return;\n }\n\n const size = util.sizeFromShape(shape);\n const numBytes = size * util.bytesPerElement(dtype);\n const memoryOffset = this.wasm._malloc(numBytes);\n\n this.dataIdMap.set(dataId, {id, memoryOffset, shape, dtype, refCount});\n\n this.wasm.tfjs.registerTensor(id, size, memoryOffset);\n\n if (values != null) {\n this.wasm.HEAPU8.set(\n new Uint8Array(\n (values as backend_util.TypedArray).buffer,\n (values as backend_util.TypedArray).byteOffset, numBytes),\n memoryOffset);\n }\n }\n\n async read(dataId: DataId): Promise<backend_util.BackendValues> {\n return this.readSync(dataId);\n }\n\n readSync(dataId: DataId): backend_util.BackendValues {\n const {memoryOffset, dtype, shape, stringBytes} =\n this.dataIdMap.get(dataId);\n if (dtype === 'string') {\n return stringBytes;\n }\n const bytes = this.wasm.HEAPU8.slice(\n memoryOffset,\n memoryOffset + util.sizeFromShape(shape) * util.bytesPerElement(dtype));\n return typedArrayFromBuffer(bytes.buffer, dtype);\n }\n\n /**\n * Dispose the memory if the dataId has 0 refCount. Return true if the memory\n * is released, false otherwise.\n * @param dataId\n * @oaram force Optional, remove the data regardless of refCount\n */\n disposeData(dataId: DataId, force = false): boolean {\n if (this.dataIdMap.has(dataId)) {\n const data = this.dataIdMap.get(dataId);\n data.refCount--;\n if (!force && data.refCount > 0) {\n return false;\n }\n\n this.wasm._free(data.memoryOffset);\n this.wasm.tfjs.disposeData(data.id);\n this.dataIdMap.delete(dataId);\n }\n return true;\n }\n\n /** Return refCount of a `TensorData`. */\n refCount(dataId: DataId): number {\n if (this.dataIdMap.has(dataId)) {\n const tensorData = this.dataIdMap.get(dataId);\n return tensorData.refCount;\n }\n return 0;\n }\n\n incRef(dataId: DataId) {\n const data = this.dataIdMap.get(dataId);\n if (data != null) {\n data.refCount++;\n }\n }\n\n floatPrecision(): 32 {\n return 32;\n

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  }\n\n  // Returns the memory offset of a tensor. Useful for debugging and unit\n  // testing.\n
getMemoryOffset(dataId: DataId): number {\n    return this.dataIdMap.get(dataId).memoryOffset;\n  }\n\n
dispose() {\n    this.wasm.tfjs.dispose();\n    if ('PThread' in this.wasm) {\n
this.wasm.PThread.terminateAllThreads();\n    }\n    this.wasm = null;\n  }\n\n  memory() {\n    return {unreliable:
false};\n  }\n\n  /**\n   * Make a tensor info for the output of an op. If `memoryOffset` is not\n   * present, this
method allocates memory on the WASM heap. If `memoryOffset`\n   * is present, the memory was allocated
elsewhere (in c++) and we just record\n   * the pointer where that memory lives.\n   */\n  makeOutput(shape:
number[], dtype: DataType, memoryOffset?: number):\n      TensorInfo {\n    let dataId: {};\n    if (memoryOffset
== null) {\n      dataId = this.write(null /* values */, shape, dtype);\n    } else {\n      const id =
this.dataIdNextNumber++;\n      dataId = {id};\n
      this.dataIdMap.set(dataId, {id, memoryOffset, shape, dtype, refCount: 1});\n      const size =
util.sizeFromShape(shape);\n      this.wasm.tfjs.registerTensor(id, size, memoryOffset);\n    }\n    return {dataId,
shape, dtype};\n  }\n\n  typedArrayFromHeap({shape, dtype, dataId}: TensorInfo):\n      backend_util.TypedArray
{\n    const buffer = this.wasm.HEAPU8.buffer;\n    const {memoryOffset} = this.dataIdMap.get(dataId);\n    const
size = util.sizeFromShape(shape);\n    switch (dtype) {\n      case 'float32':\n        return new Float32Array(buffer,
memoryOffset, size);\n      case 'int32':\n        return new Int32Array(buffer, memoryOffset, size);\n      case 'bool':\n
    return new Uint8Array(buffer, memoryOffset, size);\n      default:\n        throw new Error(`Unknown dtype
${dtype}`);\n    }\n  }\n}\n\nfunction createInstantiateWasmFunc(path: string) {\n  // this will be replace by rollup
plugin patchWechatWebAssembly in\n  // minprogram's output.\n  // tslint:disable-next-line:no-any\n
  return (imports: any, callback: any) => {\n    util.fetch(path, {credentials: 'same-origin'}).then((response) => {\n
if (!response['ok']) {\n        imports.env.a(`failed to load wasm binary file at '${path}'`);\n      }\n
response.arrayBuffer().then(binary => {\n        WebAssembly.instantiate(binary, imports).then(output => {\n
callback(output.instance, output.module);\n        });\n      });\n    });\n    return {};\n  };\n}\n\n/**\n * Returns the
path of the WASM binary.\n * @param simdSupported whether SIMD is supported\n * @param threadsSupported
whether multithreading is supported\n * @param wasmModuleFolder the directory containing the WASM
binaries.\n */\nfunction getPathToWasmBinary(\n    simdSupported: boolean, threadsSupported: boolean,\n
wasmModuleFolder: string) {\n  if (wasmPath != null) {\n    // If wasmPath is defined, the user has supplied a full
path to\n    // the vanilla .wasm binary.\n    return wasmPath;\n  }\n\n  let path:
 WasmBinaryName = 'tfjs-backend-wasm.wasm';\n  if (simdSupported && threadsSupported) {\n    path = 'tfjs-
backend-wasm-threaded-simd.wasm';\n  } else if (simdSupported) {\n    path = 'tfjs-backend-wasm-simd.wasm';\n
}\n\n  if (wasmFileMap != null) {\n    if (wasmFileMap[path] != null) {\n      return wasmFileMap[path];\n    }\n
}\n\n  return wasmModuleFolder + path;\n}\n\n/**\n * Initializes the wasm module and creates the js <--> wasm
bridge.\n *\n * NOTE: We wrap the wasm module in a object with property 'wasm' instead of\n * returning
Promise<BackendWasmModule> to avoid freezing Chrome (last tested\n * in Chrome 76).\n */\nexport async
function init(): Promise<{wasm: BackendWasmModule}> {\n  const [simdSupported, threadsSupported] = await
Promise.all([\n    env().getAsync('WASM_HAS_SIMD_SUPPORT'),\n
env().getAsync('WASM_HAS_MULTITHREAD_SUPPORT')\n  ]);\n\n  return new Promise((resolve, reject) =>
{\n    const factoryConfig: WasmFactoryConfig = {};\n\n    /**\n     * This function
 overrides the Emscripten module locateFile utility.\n     * @param path The relative path to the file that needs to be
loaded.\n     * @param prefix The path to the main JavaScript file's directory.\n     */\n    factoryConfig.locateFile =
(path, prefix) => {\n      if (path.endsWith('.worker.js')) {\n        const response = wasmWorkerContents;\n        const
blob = new Blob([response], {type: 'application/javascript'});\n        return URL.createObjectURL(blob);\n      }\n\n
  if (path.endsWith('.wasm')) {\n        return getPathToWasmBinary(\n            simdSupported as boolean,
threadsSupported as boolean,\n            wasmPathPrefix != null ? wasmPathPrefix : prefix);\n      }\n      return prefix
+ path;\n    };\n\n    // Use the instantiateWasm override when system fetch is not available.\n    // Reference:\n    //
https://github.com/emscripten-
core/emscripten/blob/2bca083cbbd5a4133db61fbd74d04f7feecfa907/tests/manual_wasm_instantiate.html#L170\n
if (customFetch) {\n
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factoryConfig.instantiateWasm =\n createInstantiateWasmFunc(getPathToWasmBinary(\n simdSupported as boolean, threadsSupported as boolean,\n wasmPathPrefix != null ? wasmPathPrefix :\n ''));\n }\n\n let initialized = false;\n factoryConfig.onAbort = () => {\n if (initialized) {\n // Emscripten already called console.warn so no need to double log.\n return;\n }\n if (initAborted) {\n // Emscripten calls `onAbort` twice, resulting in double error\n // messages.\n return;\n }\n initAborted = true;\n const rejectMsg =\n 'Make sure the server can serve the `.wasm` file relative to the ' +\n 'bundled js file. For more details see https://github.com/tensorflow/tfjs/blob/master/tfjs-backend-wasm/README.md#using-bundlers';\n reject({message: rejectMsg});\n };\n\n let wasm: Promise<BackendWasmModule>;\n // If `wasmPath` has been defined we must initialize the vanilla module.\n if (threadsSupported && simdSupported && wasmPath == null) {\n factoryConfig.mainScriptUrlOrBlob = new Blob(\n [`var WasmBackendModuleThreadedSimd = ` +\n wasmFactoryThreadedSimd.toString()],\n {type: 'text/javascript'});\n wasm = wasmFactoryThreadedSimd(factoryConfig);\n } else {\n // The wasmFactory works for both vanilla and SIMD binaries.\n wasm = wasmFactory(factoryConfig);\n }\n\n // The WASM module has been successfully created by the factory.\n // Any error will be caught by the onAbort callback defined above.\n wasm.then((module) => {\n initialized = true;\n initAborted = false;\n\n const voidReturnType: string = null;\n // Using the tfjs namespace to avoid conflict with emscripten's API.\n module.tfjs = {\n init: module.cwrap('init', null, []),\n initWithThreadsCount:\n module.cwrap('init_with_threads_count', null, ['number']),\n getThreadsCount: module.cwrap('get_threads_count', 'number', []),\n registerTensor: module.cwrap(\n 'register_tensor', null,\n [\n 'number', // id\n 'number', // size\n 'number', // memoryOffset\n ]),\n disposeData: module.cwrap('dispose_data', voidReturnType, ['number']),\n dispose: module.cwrap('dispose', voidReturnType, []),\n };\n\n resolve({wasm: module});\n });\n});\n}\n\nfunction typedArrayFromBuffer(\n buffer: ArrayBuffer, dtype: DataType): backend_util.TypedArray {\n switch (dtype) {\n case 'float32':\n return new Float32Array(buffer);\n case 'int32':\n return new Int32Array(buffer);\n case 'bool':\n return new Uint8Array(buffer);\n default:\n throw new Error(`Unknown dtype ${dtype}`);\n }\n}\n\nconst wasmBinaryNames = [\n 'tfjs-backend-wasm.wasm', 'tfjs-backend-wasm-simd.wasm',\n 'tfjs-backend-wasm-threaded-simd.wasm'\n] as const\n;\ntype WasmBinaryName = typeof wasmBinaryNames[number];\n\nlet wasmPath: string = null;\nlet wasmPathPrefix: string = null;\nlet wasmFileMap: {[key in WasmBinaryName]?: string} = {};\nlet initAborted = false;\nlet customFetch = false;\n\n/**\n * @deprecated Use `setWasmPaths` instead.\n * Sets the path to the `.wasm` file which will be fetched when the wasm\n * backend is initialized. See\n * https://github.com/tensorflow/tfjs/blob/master/tfjs-backend-wasm/README.md#using-bundlers\n * for more details.\n * @param path wasm file path or url\n * @param usePlatformFetch optional boolean to use platform fetch to download\n * the wasm file, default to false.\n *\n * @doc {heading: 'Environment', namespace: 'wasm'}\n */\nexport function setWasmPath(path: string, usePlatformFetch = false): void {\n deprecationWarn(\n 'setWasmPath has been deprecated in favor of setWasmPaths and' +\n ' will be removed in a future release.');\n if (initAborted) {\n throw new Error(\n 'The WASM backend was already initialized. Make sure you call ' +\n '`setWasmPath()` before you call `tf.setBackend()` or `tf.ready()`');\n }\n wasmPath = path;\n customFetch = usePlatformFetch;\n}\n\n/**\n * Configures the locations of the WASM binaries.\n *\n * ```js\n * setWasmPaths({\n * 'tfjs-backend-wasm.wasm': 'renamed.wasm',\n * 'tfjs-backend-wasm-simd.wasm': 'renamed-simd.wasm',\n * 'tfjs-backend-wasm-threaded-simd.wasm': 'renamed-threaded-simd.wasm'\n * });\n * tf.setBackend('wasm');\n * ```\n *\n * @param prefixOrFileMap This can be either a string or object:\n * - (string) The path to the directory where the WASM binaries are located.\n * Note that this prefix will be used to load each binary (vanilla,\n * SIMD-enabled, threading-enabled, etc.).\n * - (object) Mapping from names of WASM binaries to custom\n * full paths specifying the locations of those binaries. This is useful if\n * your WASM binaries are not all located in the same directory,
```

or if your\n * WASM binaries have been renamed.\n * @param usePlatformFetch optional boolean to use platform fetch to download\n * the wasm file, default to false.\n *\n * @doc {heading: 'Environment', namespace: 'wasm'}\n */\nexport function setWasmPaths(\n prefixOrFileMap: string|{[key in WasmBinaryName]?: string},\n usePlatformFetch = false): void {\n if (initAborted) {\n throw new Error(\n 'The WASM backend was already initialized. Make sure you call ' +\n '`setWasmPaths()` before you call `tf.setBackend()` or ' +\n '`tf.ready()`');\n }\n\n if (typeof prefixOrFileMap === 'string') {\n wasmPathPrefix = prefixOrFileMap;\n } else {\n wasmFileMap = prefixOrFileMap;\n const missingPaths =\n wasmBinaryNames.filter(name => wasmFileMap[name] == null);\n if (missingPaths.length > 0) {\n throw new Error(\n `There were no entries found for the following binaries: ` +\n `${missingPaths.join(',')}. Please either call setWasmPaths with a ` +\n `map providing a path for each binary, or with a string indicating ` +\n `the directory where all the binaries can be found.`);\n }\n }\n\n customFetch = usePlatformFetch;\n}\n\n/** Used in unit tests. */\nexport function resetWasmPath(): void {\n wasmPath = null;\n wasmPathPrefix = null;\n wasmFileMap = {};\n customFetch = false;\n initAborted = false;\n}\n\nlet threadsCount = -1;\nlet actualThreadsCount = -1;\n\n/**\n * Sets the number of threads that will be used by XNNPACK to create\n * threadpool (default to the number of logical CPU cores).\n *\n * This must be called before calling `tf.setBackend('wasm')`.\n */\nexport function setThreadsCount(numThreads: number) {\n threadsCount = numThreads;\n}\n\n/**\n * Gets the actual threads count that is used by XNNPACK.\n *\n * It is set after the backend is intialized.\n */\nexport function getThreadsCount(): number {\n if (actualThreadsCount === -1) {\n throw new Error(`WASM backend not initialized.`);\n }\n return actualThreadsCount;\n}\n","export const wasmWorkerContents = 'var Module={};function threadPrintErr(){var text=Array.prototype.slice.call(arguments).join(\" \");console.error(text)}function threadAlert(){var text=Array.prototype.slice.call(arguments).join(\" \");postMessage({cmd:\"alert\",text:text,threadId:Module[\"_pthread_self\"]()})}var err=threadPrintErr;this.alert=threadAlert;Module[\"instantiateWasm\"]=function(info,receiveInstance){var instance=new WebAssembly.Instance(Module[\"wasmModule\"],info);Module[\"wasmModule\"]=null;receiveInstance(instance);return instance.exports};function moduleLoaded(){}this.onmessage=function(e){try{if(e.data.cmd===\"load\"){Module[\"wasmModule\"]=e.data.wasmModule;Module[\"wasmMemory\"]=e.data.wasmMemory;Module[\"buffer\"]=Module[\"wasmMemory\"].buffer;Module[\"ENVIRONMENT_IS_PTHREAD\"]=true;if(typeof e.data.urlOrBlob===\"string\"){importScripts(e.data.urlOrBlob)}else{var objectUrl=URL.createObjectURL(e.data.urlOrBlob);importScripts(objectUrl);URL.revokeObjectURL(objectUrl)}WasmBackendModuleThreadedSimd(Module).then(function(instance){Module=instance;moduleLoaded()})}else if(e.data.cmd===\"objectTransfer\"){Module[\"PThread\"].receiveObjectTransfer(e.data)}else if(e.data.cmd===\"run\"){Module[\"__performance_now_clock_drift\"]=performance.now()-e.data.time;Module[\"__emscripten_thread_init\"](e.data.threadInfoStruct,0,0);var max=e.data.stackBase;var top=e.data.stackBase+e.data.stackSize;Module[\"establishStackSpace\"](top,max);Module[\"_emscripten_tls_init\"]();Module[\"PThread\"].receiveObjectTransfer(e.data);Module[\"PThread\"].setThreadStatus(Module[\"_pthread_self\"](),1);try{var result=Module[\"invokeEntryPoint\"](e.data.start_routine,e.data.arg);if(!Module[\"getNoExitRuntime\"]())Module[\"PThread\"].threadExit(result)}catch(ex){if(ex===\"Canceled!\"){Module[\"PThread\"].threadCancel()}else if(ex!=\"unwind\"){if(ex instanceof Module[\"ExitStatus\"]){if(Module[\"getNoExitRuntime\"]()){}else{Module[\"PThread\"].threadExit(ex.status)}}else{Module[\"PThread\"].threadExit(-2);throw ex}}}}else if(e.data.cmd===\"cancel\"){if(Module[\"_pthread_self\"]()){Module[\"PThread\"].threadCancel()}}else if(e.data.target===\"setimmediate\"){}else if(e.data.cmd===\"processThreadQueue\"){if(Module[\"_pthread_self\"]()){Module[\"_emscripten_current_thread_

process_queued_calls\"]()}}else{err(\"worker.js received unknown command \"+e.data.cmd);err(e.data)}}catch(ex){err(\"worker.js onmessage() captured an uncaught exception: \"+ex);if(ex&&ex.stack)err(ex.stack);throw ex}};if(typeof process===\"object\"&&typeof process.versions===\"object\"&&typeof process.versions.node===\"string\"){self={location:{href:__filename}};var onmessage=this.onmessage;var nodeWorkerThreads=require(\"worker_threads\");global.Worker=nodeWorkerThreads.Worker;var parentPort=nodeWorkerThreads.parentPort;parentPort.on(\"message\",function(data){onmessage({data:data})});var nodeFS=require(\"fs\");var nodeRead=function(filename){return nodeFS.readFileSync(filename,\"utf8\")};function globalEval(x){global.require=require;global.Module=Module;eval.call(null,x)}importScripts=function(f){globalEval(nodeRead(f))};postMessage=function(msg){parentPort.postMessage(msg)};if(typeof performance===\"undefined\"){performance={now:function(){return Date.now()}}}';","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==*/\n\nimport './flags_wasm';\n\nimport {registerBackend} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm, init} from './backend_wasm';\n\nexport {BackendWasm, getThreadsCount, setThreadsCount, setWasmPath, setWasmPaths} from './backend_wasm';\nexport {version as version_wasm} from './version';\n\nconst WASM_PRIORITY = 2;\nregisterBackend('wasm', async () => {\n const {wasm} = await init();\n return new BackendWasm(wasm);\n}, WASM_PRIORITY);\n","/** @license See the LICENSE file. */\n\n// This code is auto-generated, do not modify this file!\nconst version = '3.11.0';\nexport {version};\n"],"names":["CppDType","FusableActivation","wasmFusedMatMul","fusedMatMulConfig","kernelName","_FusedMatMul","backendName","setupFunc","backend","wasm","cwrap","kernelFunc","args","inputs","attrs","a","b","bias","preluActivationWeights","dtype","Error","transposeA","transposeB","activation","leakyreluAlpha","aId","dataIdMap","get","dataId","id","bId","biasId","biasData","shape","length","preluActivationWeightsId","fusedActivation","leftDim","rightDim","batchDim","out","makeOutput","outId","aShapeBytes","Uint8Array","Int32Array","buffer","bShapeBytes","createUnaryKernelConfig","outType","wasmFunc","x","xId","util","sizeFromShape","absConfig","Abs","createBinaryKernelConfig","supportsFullBroadcast","outputType","newShape","backend_util","assertAndGetBroadcastShape","aBroadcastDims","getBroadcastDims","bBroadcastDims","loopsOverAllOfA","every","v","i","loopsOverAllOfB","addConfig","Add","addNConfig","AddN","inputIds","map","inputIdsBytes","identity","inVals","typedArrayFromHeap","set","identityConfig","Identity","wasmTranspose","transpose","reducedShape","perm","newPerm","push","minValIdx","j","removeOneSizeDims","permIsNoOp","outShape","inShape","Array","computeOutShape","cloned","permBytes","xShapeBytes","transposeConfig","Transpose","permuteAxesAndTranspose","axis","xShape","xRank","originalAxes","parseAxisParam","axes","permutedAxes","getAxesPermutation","xTransposed","inputWasTransposed","getInnerMostAxes","transposed","wasmAll","allConfig","All","keepDims","inputId","input","inputRank","assertAxesAreInnerMostDims","reduceShape","computeOutAndReduceShapes","reduceSize","disposeData","expandShapeToKeepDim","wasmAny","anyConfig","Any","argMaxConfig","ArgMax","transposedId","slice","outerSize","innerSize","wasmAvgPool","avgPoolConfig","AvgPool","filterSize","strides","pad","dimRoundingMode","convInfo","computePool2DInfo","filterHeight","filterWidth","padTop","padInfo","top","padRight","right","padBottom","bottom","padLeft","left","strideHeight","strideWidth","channels","inChannels","dataFormat","dilationWidth","dilationHeight","reshape","xSize","$shape","inferFromImplicitShape","assert","incRef","reshapeConfig","Reshape","wasmBatchMatMul","batchMatMulConfig","BatchMatMul","aRank","bRank","innerShapeA","innerShapeB","outerShapeA","outerShapeB","outerDimsA","outerDimsB","batchDimA","batchDimB","batchDimsCompatible","concat","b3dShape","a3d","b3d","a3dId","b3dId","Math","max","sliceImpl","vals","begin","siz

e","isContinous","slice_util","isSliceContinous","xStrides","computeStrides","flatOffset","computeFlatOffset","subarray","decodedData","fromUint8ToStringArray","inBuf","outBuf","outLoc","indexToLoc","inLoc","idx","fromStringArrayToUint8","values","begin_","size_","parseSliceParams","xVals","readSync","outData","stringBytes","res","sliceImplCPU","outVals","rank","xStride","outOffset","beginI","beginJ","endI","xOffset","slice2d","xStride1","xStride2","beginK","endJ","slice3d","xStride3","endK","beginL","k","slice4d","sliceConfig","Slice","batchToSpaceNDConfig","BatchToSpaceND","blockShape","crops","prod","reduce","reshaped","getReshaped","permuted","getPermuted","reshapedPermuted","getReshapedPermuted","sliceBeginCoords","getSliceBeginCoords","sliceSize","getSliceSize","xReshaped","result","cast","castConfig","Cast","ceilConfig","Ceil","wasmClip","clipByValueConfig","ClipByValue","clipValueMin","clipValueMax","t","$inputs","filter","shapes","assertParamsConsistent","inputs2D","inputsValShapes","simplyConcat","getArrayFromDType","offset","forEach","colOffset","tIdx","row","resIdx","col","concatImplCPU","finalOutShape","sumInnerDims","innerDims","innerDim","inOffset","concatConfig","Concat","wasmConv2d","conv2DConfig","Conv2D","filterId","dilations","$dataFormat","convertConv2DDataFormat","computeConv2DInfo","inputChannels","outputChannels","outChannels","isSamePad","type","wasmConv2DBackpropInput","conv2DBackpropInputConfig","Conv2DBackpropInput","dy","inputShape","batchSize","inHeight","inWidth","outHeight","outWidth","topPad","leftPad","isChannelsLast","dxStrides","dyStrides","fltS0","fltS1","fltS2","xBatchStride","xRowStride","xColStride","xChannelStride","yBatchStride","yRowStride","yColStride","yChannelStride","dyId","cosConfig","Cos","coshConfig","Cosh","InterpolationMethod","wasmCropAndResize","cropAndResizeConfig","CropAndResize","method","extrapolationValue","cropSize","image","boxes","boxInd","numBoxes","cropHeight","cropWidth","castedData","imagesData","imagesId","boxesId","boxIndId","imagesShapeBytes","wasmCumsum","cumsumConfig","Cumsum","exclusive","reverse","permutation","permutedX","permutedAxis","permutedOut","finalDim","permutedXId","permutedOutId","getUndoAxesPermutation","wasmDepthToSpace","depthToSpaceConfig","DepthToSpace","blockSize","outputHeight","outputWidth","outputDepth","outputShape","xStridesBytes","outputShapeBytes","outStridesBytes","wasmDepthwiseConv2d","depthwiseConv2dNativeConfig","DepthwiseConv2dNative","$dilations","eluConfig","Elu","equalConfig","Equal","expConfig","Exp","expandDims","dim","$dim","splice","expandDimsConfig","ExpandDims","fill","value","fillConfig","Fill","wasmFlipLeftRight","flipLeftRightConfig","FlipLeftRight","imageId","batch","imageHeight","imageWidth","numChannels","floorConfig","Floor","floorDivConfig","FloorDiv","wasmBatchNorm","fusedBatchNormConfig","FusedBatchNorm","varianceEpsilon","mean","variance","scale","meanId","varianceId","offsetId","scaleId","wasmFusedConv2d","fusedConv2DConfig","FusedConv2D","wasmFusedDepthwiseConv2d","fusedDepthwiseConv2DConfig","FusedDepthwiseConv2D","wasmGatherNd","gatherNdConfig","GatherNd","params","indices","resultShape","numSlices","gather_util","prepareAndValidate","indicesShape","sliceRank","indicesId","stridesBytes","wasmGather","gatherV2Config","GatherV2","batchDims","parsedAxis","indicesVals","axisDim","index","shapeInfo","segment_util","collectGatherOpShapeInfo","flattenX","dimSize","indicesSize","flattenIndex","flattenOutputShape","stridesSize","greaterConfig","Greater","greaterEqualConfig","GreaterEqual","leakyReluConfig","LeakyRelu","alpha","lessConfig","Less","lessEqualConfig","LessEqual","logConfig","Log","logicalAndConfig","LogicalAnd","wasmMax","maxConfig","Max","reductionIndices","maximumConfig","Maximum","wasmMaxPool","maxPoolConfig","MaxPool","wasmMean","meanConfig","Mean","reductionAxes","castedInput","wasmMin","minConfig","Min","minimumConfig","Minimum","MirrorPaddingMode","wasmMirrorPad","mirrorPadConfig","MirrorPad","paddings","mode","p","prePaddingsFlat","padTuple","postPaddingsFlat","prePaddingsBytes","postPaddingsBytes","multiplyConfig","Multiply","negConfig","Neg","parseResultStruct","resOffset","HEAPU8","pSelectedIndices","selectedSize","pSelectedScores","pValidOutputs","_free","nonMaxSuppressionV3Config","NonMaxSuppressionV3","iouThreshold","maxOutputSize","scoreThreshold","scores","scoresId","nonMaxSuppressionV4Config","NonMaxSuppressionV4","padToMaxOutputSize","nonMaxSuppressionV5Config","NonMaxSuppressionV5","softNmsSigma","notEqualConfig","NotEqual","wasmOneHot","oneHotConfig","OneHot","depth","onValue","offValue","onesLikeConfig","OnesLike","packConfig","Pack","assertShapesMatch","intermediateTensorInfos","expandedT","wasmPadV2","padV2Config","PadV2","constantValue","powConfig","Pow","wasmPrelu","preluConfig","Prelu","weightsId","wasmProd","prodConfig","Prod","rangeConfig","Range","start","stop","step","makeZerosTypedArray","numElements","abs","ceil","rangeImplCPU","realDivConfig","Rea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FILE","EMFILE","ENOTTY","ETXT

BSY","EFBIG","ENOSPC","ESPIPE","EROFS","EMLINK","EPIPE","EDOM","ERANGE","ENOMSG","EIDRM","ECHRNG","EL2NSYNC","EL3HLT","EL3RST","ELNRNG","EUNATCH","ENOCSI","EL2HLT","EDEADLK","ENOLCK","EBADE","EBADR","EXFULL","ENOANO","EBADRQC","EBADSLT","EDEADLOCK","EBFONT","ENOSTR","ENODATA","ETIME","ENOSR","ENONET","ENOPKG","EREMOTE","ENOLINK","EADV","ESRMNT","ECOMM","EPROTO","EMULTIHOP","EDOTDOT","EBADMSG","ENOTUNIQ","EBADFD","EREMCHG","ELIBACC","ELIBBAD","ELIBSCN","ELIBMAX","ELIBEXEC","ENOSYS","ENOTEMPTY","ENAMETOOLONG","ELOOP","EOPNOTSUPP","EPFNOSUPPORT","ECONNRESET","ENOBUFS","EAFNOSUPPORT","EPROTOTYPE","ENOTSOCK","ENOPROTOOPT","ESHUTDOWN","ECONNREFUSED","EADDRINUSE","ECONNABORTED","ENETUNREACH","ENETDOWN","ETIMEDOUT","EHOSTDOWN","EHOSTUNREACH","EINPROGRESS","EALREADY","EDESTADDRREQ","EMSGSIZE","EPROTONOSUPPORT","ESOCKTNOSUPPORT","EADDRNOTAVAIL","ENETRESET","EISCONN","ENOTCONN","ETOOMANYREFS","EUSERS","EDQUOT","ESTALE","ENOTSUP","ENOMEDIUM","EILSEQ","EOVERFLOW","ECANCELED","ENOTRECOVERABLE","EOWNERDEAD","ESTRPIPE","_emscripten_futex_wake","addr","count","Infinity","mainThreadWaitAddress","Atomics","load","__emscripten_main_thread_futex","mainThreadWoken","compareExchange","notify","killThread","pthread_ptr","pthread","pthreads","worker","terminate","freeThreadData","runningWorkers","cancelThread","cmd","cleanupThread","returnWorkerToPool","_emscripten_get_now","initMainThreadBlock","allocateUnusedWorker","tb","_malloc","headPtr","tlsMemory","store","__emscripten_thread_init","_emscripten_register_main_browser_thread_id","initWorker","threadExitHandlers","setThreadStatus","runExitHandlers","pop","_pthread_self","___pthread_tsd_run_dtors","runExitHandlersAndDeinitThread","exitCode","threadExit","threadCancel","terminateAllThreads","threadInfoStruct","allocatedOwnStack","stackBase","runWithoutMainThreadQueuedCalls","__emscripten_allow_main_runtime_queued_calls","receiveObjectTransfer","onFinishedLoading","onmessage","d","currentProxiedOperationCallerThread","thread","targetThread","_emscripten_main_thread_process_queued_calls","spawnThread","loaded","runPthread","alert","exit","target","lineno","message","on","urlOrBlob","pthreadMainJs","getNewWorker","busySpinWait","msecs","now","establishStackSpace","stackTop","stackMax","_emscripten_stack_set_limits","getNoExitRuntime","invokeEntryPoint","___assert_fail","line","___call_main","argc","argv","_main","setErrNo","___errno_location","_atexit","_emscripten_proxy_to_main_thread_js","__emscripten_notify_thread_queue","targetThreadId","mainThreadId","_abort","_emscripten_asm_const_int","code","sigPtr","argbuf","readAsmConstArgs","_emscripten_conditional_set_current_thread_status","expectedStatus","newStatus","_emscripten_futex_wait","val","timeout","tNow","tEnd","exchange","wait","_emscripten_memcpy_big","dest","num","copyWithin","_emscripten_num_logical_cores","require$$4","cpus","navigator","sync","numCallArgs","serializedNumCallArgs","_emscripten_run_in_main_runtime_thread_js","dateNow","_emscripten_receive_on_main_thread_js_callArgs","readAsmConstArgsArray","double","_emscripten_receive_on_main_thread_js","proxiedFunctionTable","_emscripten_get_heap_size","emscripten_realloc_buffer","grow","_emscripten_resize_heap","requestedSize","oldSize","maxHeapSize","cutDown","overGrownHeapSize","min","JSEvents","inEventHandler","removeAllEventListeners","eventHandlers","_removeHandler","deferredCalls","registerRemoveEventListeners","removeEventListenersRegistered","deferCall","targetFunction","precedence","argsList","arraysHaveEqualContent","arrA","arrB","call","sort","y","removeDeferredCalls","canPerformEventHandlerRequests","currentEventHandler","allowsDeferredCalls","runDeferredCalls","removeAllHandlersOnTarget","eventTypeString","h","removeEventListener","eventListenerFunc","useCapture","registerOrRemoveHandler","eventHandler","jsEventHandler","event","handlerFunc","callbackfunc","addEventListener","queueEventHandlerOnThread_iiii","eventHandlerFunc","eventTypeId","eventData","userData","varargs","__emscripten_call_on_thread","getTargetThreadForEventCallback","getNodeNameForTarget","screen","nodeName","fullscreenEnabled","webkitFullscreenEnabled","stringToNewUTF8","jsString","cString","_emscripten_set_offscreencanvas_size_on_target_thread_js","targetCanvas","width","height","targetCanvasPtr","_emscripten_set_offscreencanvas_size_on_target_thread","maybeCStringToJsString","specialHTMLTargets","findEventTarget","querySelector","findCanvasEventTarget","_emscripten_set_canvas_element_size_calling_thread","canvas","canvasSharedPtr","offscreenCanvas","controlTransferredOffscreen","autoResizeViewport","GLctxObject","GLctx","prevViewport","getParameter","viewport","_emscripten_set_canvas_element_size_main_thread","_emscripten_set_canvas_element_size","_emscripten_set_current_thread_status","_emscripten_set_thread_name","threadId","name","__

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C,MAAM,CAAC;IAC1C,MAAM,OAAO,GAAG,QAAQ,CAAC,OAAO,CAAC,IAAI,CAAC;IACtC,MAAM,YAAAY,GAAG,QAAQ,CAAC,YAAY,CAAC;IAC3C,MAAM,WAAW,GAAG,QAAQ,CAAC,WAAW,CAAC;IACzC,MAAM,QAAQ,GAAG,QAAQ,CAAC,UAAU,CAAC;IAErC,IAAI,QAAQ,CAAC,UAAU,KAAK,cAAAc,EAAE;QAC1C,MAAM,IAAI,KAAK,CAAC,4CAA4C;YAC5C,GAAG,QAAQ,CAAC,UAAU,+BAA+B,CAAC,CAAC;KAC5D;IAED,IAAI,QAAQ,CAAC,aAAa,KAAK,CAAC,IAAI,QAAQ,CAAC,cAAc,KAAK,CAAC,EAAE;QACjE,MAAM,IAAI,KAAK,CAAC,oEAAoE;YACpE,QAAQ,QAAQ,CAAC,cAAc,KAAK,QAAQ,CAAC,aAAa,IAAI,CAAC,CAAC;KACrE;IAED,MAAM,GAAG,GAAG,QAAQ,CAAC,UAAU,CAAC,QAAQ,CAAC,QAAQ,EAAE,EAAE,SAAS,CAAC,CAAC;IAEpE,MAAM,KAAK,GAAG,QAAQ,CAAC,UAAU,CAAC,QAAQ,CAAC,SAAS,EAAE,EAAE,SAAS,CAAC,CAAC;IAEn

Found in path(s):
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernels/AvgPool.js.map
No license file was found, but licenses were detected in source scan.

{"version":3,"file":"RotateWithOffset.js","sourceRoot":"","sources":["../../src/kernels/RotateWithOffset.ts"],"names":[],"mappings":"AAAA;;;;;;;;;;;;;;;GAeG;AAEH,OAAO,EAA2B,gBAAgB,EAA4D,MAAM,uBAAuB,CAAC;AAC5I,OAAO,EAAC,YAAY,EAAC,MAAM,uBAAuB,CAAC;AAInD,IAAI,UAAiE,CAAC;AAEtE,SAAS,KAAK,CAAC,OAAoB;IACjC,UAAU,GAAG,OAAO,CAAC,IAAI,CAAC,gBAAgB,EAAE,IAAI,EAAE;QAChD,OAAO,CAAC,CAAC,CAAC

imageWidth, numChannels] = image.shape;\n\n const [centerX, centerY] =\n backend_util.getImageCenter(center, imageHeight, imageWidth);\n\n const fillIsBlack = fillValue === 0;\n const fullOpacityValue = 255;\n\n const fillValues = typeof fillValue === 'number' ?\n   [fillValue, fillValue, fillValue, fillIsBlack ? 0 : fullOpacityValue] :\n   [...fillValue, fullOpacityValue];\n const fillBytes = new Uint8Array(new Int32Array(fillValues).buffer);\n\n wasmRotate(\n   imageId, batch, imageHeight, imageWidth, numChannels, radians, centerX,\n   centerY, fillBytes, fillValues.length, outId);\n return out;\n}\n\nexport const rotateWithOffsetConfig: KernelConfig = {\n kernelName: RotateWithOffset,\n backendName: 'wasm',\n kernelFunc: rotateWithOffset as {} as KernelFunc,\n setupFunc: setup\n};\n"]}

Found in path(s):
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernels/RotateWithOffset.js.map
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```
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* =============================================================================
*/
/**
* @deprecated Use `setWasmPaths` instead.
* Sets the path to the `.wasm` file which will be fetched when the wasm
 * backend is initialized. See
* https://github.com/tensorflow/tfjs/blob/master/tfjs-backend-wasm/README.md#using-bundlers
* for more details.
* @param path wasm file path or url
* @param usePlatformFetch optional boolean to use platform fetch to download
*     the wasm file, default to false.
*
* @doc {heading: 'Environment', namespace: 'wasm'}
*/
```

Found in path(s):

* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/tf-backend-wasm.fesm.js

No license file was found, but licenses were detected in source scan.

{"version":3,"file":"tf-backend-wasm.fesm.js","sources":["../src/kernels/types.ts","../src/kernels/_FusedMatMul.ts","../src/kernels/unary_kernel.ts","../src/kernels/Abs.ts","../src/kernels/binary_kernel.ts","../src/kernels/Add.ts","../src/kernels/AddN.ts","../src/kernels/Identity.ts","../src/kernels/Transpose.ts","../src/kernels/kernel_utils.ts","../src/kernels/All.ts","../src/kernels/Any.ts","../src/kernels/ArgMax.ts","../src/kernels/AvgPool.ts","../src/kernels/Reshape.ts","../src/kernels/BatchMatMul.ts","../node_modules/@tensorflow/tfjs-backend-cpu/dist/kernels/Concat_impl.js","../node_modules/@tensorflow/tfjs-backend-cpu/dist/kernels/Range_impl.js","../node_modules/@tensorflow/tfjs-backend-cpu/dist/kernels/Slice.js","../src/kernels/Slice.ts","../src/kernels/BatchToSpaceND.ts","../src/kernels/Cast.ts","../src/kernels/Ceil.ts","../src/kernels/ClipByValue.ts","../src/kernels/Concat.ts","../src/kernels/Conv2D.ts","../src/kernels/Conv2DBackpropInput.ts","../src/kernels/Cos.ts","../src/kernels/Cosh.ts","../src/kernels/CropAndResize.ts","../src/kernels/Cumsum.ts","../src/kernels/DepthToSpace.ts","../src/kernels/DepthwiseConv2dNative.ts","../src/kernels/Elu.ts","../src/kernels/Equal.ts","../src/kernels/Exp.ts","../src/kernels/ExpandDims.ts","../src/kernels/Fill.ts","../src/kernels/FlipLeftRight.ts","../src/kernels/Floor.ts","../src/kernels/FloorDiv.ts","../src/kernels/FusedBatchNorm.ts","../src/kernels/FusedConv2D.ts","../src/kernels/FusedDepthwiseConv2D.ts","../src/kernels/GatherNd.ts","../src/kernels/GatherV2.ts","../src/kernels/Greater.ts","../src/kernels/GreaterEqual.ts","../src/kernels/LeakyRelu.ts","../src/kernels/Less.ts","../src/kernels/LessEqual.ts","../src/kernels/Log.ts","../src/kernels/LogicalAnd.ts","../src/kernels/Max.ts","../src/kernels/Maximum.ts","../src/kernels/MaxPool.ts","../src/kernels/Mean.ts","../src/kernels/Min.ts","../src/kernels/Minimum.ts","../src/kernels/MirrorPad.ts","../src/kernels/Multiply.ts","../src/kernels/Neg.ts","../src/kernels/NonMaxSuppression_util.ts","../src/kernels/NonMaxSuppressionV3.ts","../src/kernels/NonMaxSuppressionV4.ts","../src/kernels/NonMaxSuppressionV5.ts","../src/kernels/NotEqual.ts","../src/kernels/OneHot.ts","../src/kernels/OnesLike.ts","../src/kernels/Pack.ts","../src/kernels/PadV2.ts","../src/kernels/Pow.ts","../src/kernels/Prelu.ts","../src/kernels/Prod.ts","../src/kernels/Range.ts","../src/kernels/RealDiv.ts","../src/kernels/Relu.ts","../src/kernels/Relu6.ts","../src/kernels/ResizeBilinear.ts","../src/kernels/Reverse.ts","../src/kernels/RotateWithOffset.ts","../src/kernels/Round.ts","../src/kernels/Rsqrt.ts","../src/kernels/ScatterNd.ts","../src/kernels/Select.ts","../src/kernels/Sigmoid.ts","../src/kernels/Sin.ts","../src/kernels/Softmax.ts","../src/kernels/SpaceToBatchND.ts","../src/kernels/SplitV.ts","../src/kernels/Sqrt.ts","../src/kernels/Square.ts","../src/kernels/SquaredDifference.ts","../src/kernels/Step.ts","../src/kernels/StridedSlice.ts","../src/kernels/Sub.ts","../src/kernels/Sum.ts","../src/kernels/Tan.ts","../src/kernels/Tanh.ts","../src/kernels/Tile.ts","../src/kernels/TopK.ts","../src/kernels/Transform.ts","../src/kernels/Unpack.ts","../src/kernels/ZerosLike.ts","../src/register_all_kernels.ts","../src/flags_wasm.ts","../wasm-out/tfjs-backend-wasm-threaded-simd.js","../wasm-out/tfjs-backend-wasm-threaded-simd.worker.js","../wasm-out/tfjs-backend-wasm.js","../src/backend_wasm.ts","../src/version.ts","../src/base.ts"],"sourcesContent":["/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT
 WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==*\n\n// This enum must align with the enum defined in cc/backend.h.\nexport enum CppDType {\n float32 = 0,\n int32 = 1,\n bool = 2,\n string = 3,\n complex64 = 4\n}\n\n// Must match enum in cc/fusable_activations.h.\nexport enum FusableActivation {\n linear = 0,\n relu = 1,\n relu6 = 2,\n prelu = 3,\n leakyrelu = 4,\n sigmoid = 5,\n elu = 6\n}\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing

permissions and\n * limitations under the License.\n *
==========\n
*/\n\nimport {_FusedMatMul, _FusedMatMulAttrs, _FusedMatMulInputs, KernelConfig, KernelFunc} from
'@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {FusableActivation} from
'./types';\n\nlet wasmFusedMatMul:\n (aId: number, aShape: Uint8Array, aShapeSize: number, bId: number,\n
bShape: Uint8Array, bShapeSize: number, transposeA: boolean,\n transposeB: boolean, activation: number,
biasId: number,\n preluActivationWeightsId: number, leakyreluAlpha: number, outId: number) =>\n
void;\n\nfunction setup(backend: BackendWasm) {\n wasmFusedMatMul = backend.wasm.cwrap(_FusedMatMul,
null /* void */, [\n 'number',
// a_id\n 'array', // a_shape\n 'number', // a_shape.length\n 'number', // b_id\n 'array', // b_shape\n
'number', // b_shape.length\n 'number', // transpose_a\n 'number', // transpose_b\n 'number', // activation\n
'number', // biasId\n 'number', // preluActivationWeightsId\n 'number', // leakyreluAlpha\n 'number' //
out_id\n]);\n}\n\nfunction fusedBatchMatMul(args: {\n inputs: _FusedMatMulInputs,\n backend:
BackendWasm,\n attrs: _FusedMatMulAttrs\n}) {\n const {inputs, backend, attrs} = args;\n const {a, b, bias,
preluActivationWeights} = inputs;\n\n if (a.dtype !== 'float32' || b.dtype !== 'float32') {\n throw new Error(\n
`_FusedMatMul for non non-float32 tensors not yet supported.`);\n }\n\n const {transposeA, transposeB,
activation, leakyreluAlpha} = attrs;\n const aId = backend.dataIdMap.get(a.dataId).id;\n const bId =
backend.dataIdMap.get(b.dataId).id;\n\n let biasId = 0;\n if (bias != null) {\n
const biasData = backend.dataIdMap.get(bias.dataId);\n if (biasData.shape.length !== 1) {\n throw new
Error(\n `_FusedMatMul only supports rank-1 bias but got ` +\n `rank ${biasData.shape.length}.`);\n
}\n biasId = biasData.id;\n }\n const preluActivationWeightsId = preluActivationWeights == null ?\n 0 :\n
backend.dataIdMap.get(preluActivationWeights.dataId).id;\n const fusedActivation =\n
FusableActivation[activation as {} as keyof typeof FusableActivation];\n if (fusedActivation == null) {\n throw
new Error(\n `${activation} activation not yet supported for FusedConv2D ` +\n `in the wasm backend.`);\n
}\n\n const leftDim = transposeA ? a.shape[2] : a.shape[1];\n const rightDim = transposeB ? b.shape[1] :
b.shape[2];\n const batchDim = a.shape[0];\n\n const out = backend.makeOutput([batchDim, leftDim, rightDim],
a.dtype);\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n const aShapeBytes = new Uint8Array(new
Int32Array(a.shape).buffer);\n const bShapeBytes = new Uint8Array(new Int32Array(b.shape).buffer);\n\n
wasmFusedMatMul(\n aId, aShapeBytes, a.shape.length, bId, bShapeBytes, b.shape.length,\n transposeA,
transposeB, fusedActivation, biasId, preluActivationWeightsId,\n leakyreluAlpha || 0, outId);\n\n return
out;\n}\n\nexport const fusedMatMulConfig: KernelConfig = {\n kernelName: _FusedMatMul,\n backendName:
'wasm',\n setupFunc: setup,\n kernelFunc: fusedBatchMatMul as {} as KernelFunc\n};\n","/**\n * @license\n *
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==========\n
*/\n\nimport {DataType, KernelConfig, TensorInfo, UnaryInputs, util} from '@tensorflow/tfjs-core';\n\nimport
{BackendWasm} from '../backend_wasm';\n\nimport {CppDType} from './types';\n\nexport function
createUnaryKernelConfig(\n kernelName: string, outType?: DataType): KernelConfig {\n let wasmFunc: (xId:
number, dtype: number, outId: number) => void;\n\n function setupFunc(backend: BackendWasm): void {\n
wasmFunc = backend.wasm.cwrap(kernelName, null /* void */, [\n 'number', // x_id\n 'number', // dtype\n
'number', // out_id\n]);\n }\n\n function kernelFunc(args: {backend: BackendWasm, inputs: UnaryInputs}):\n
TensorInfo {\n const {backend, inputs: {x}} = args;\n const xId = backend.dataIdMap.get(x.dataId).id;\n

const out = backend.makeOutput(x.shape, outType || x.dtype);\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n // Short-circuit zero-sized tensors.\n if (util.sizeFromShape(out.shape) === 0) {\n return out;\n }\n\n wasmFunc(xId, CppDType[x.dtype], outId);\n return out;\n }\n\n return {kernelName, backendName: 'wasm', setupFunc, kernelFunc};\n}\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\nimport {Abs, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\n\nexport const absConfig: KernelConfig = createUnaryKernelConfig(Abs);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {backend_util, BinaryInputs, DataType, KernelConfig, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {CppDType} from './types';\n\nexport function createBinaryKernelConfig(\n kernelName: string, supportsFullBroadcast: boolean,\n dtype?: DataType): KernelConfig {\n let wasmFunc:\n (aId: number, aShape: Uint8Array, aShapeLen: number, bId: number,\n bShape: Uint8Array, bShapeLen: number, dtype: number, outId: number) =>\n void;\n\n function setupFunc(backend: BackendWasm): void {\n wasmFunc = backend.wasm.cwrap(kernelName, null /* void */, [\n 'number', // a_id,\n 'array', // a_shape\n 'number', // a_shape.length\n 'number', // b_id\n 'array', // b_shape\n 'number', // b_shape.length\n 'number', // dtype\n 'number' // out_id\n]);\n }\n\n function kernelFunc(args: {backend: BackendWasm, inputs: BinaryInputs}):\n TensorInfo {\n const {backend, inputs} = args;\n const {a, b} = inputs;\n const aId = backend.dataIdMap.get(a.dataId).id;\n const bId = backend.dataIdMap.get(b.dataId).id;\n\n const outputType = dtype != null ? dtype : a.dtype;\n const newShape = backend_util.assertAndGetBroadcastShape(a.shape, b.shape);\n const out = backend.makeOutput(newShape, outputType);\n\n // Short-circuit zero-sized tensors.\n if (util.sizeFromShape(newShape) === 0) {\n return out;\n }\n\n const aShapeBytes = new Uint8Array(new Int32Array(a.shape).buffer);\n const bShapeBytes = new Uint8Array(new Int32Array(b.shape).buffer);\n const outId = backend.dataIdMap.get(out.dataId).id;\n const kernelFunc = () => wasmFunc(\n aId, aShapeBytes, a.shape.length, bId, bShapeBytes, b.shape.length,\n CppDType[a.dtype], outId);\n\n // Currently only some float operations support full broadcast.\n if (supportsFullBroadcast && a.dtype === 'float32') {\n kernelFunc();\n return out;\n }\n\n const aBroadcastDims = backend_util.getBroadcastDims(a.shape, newShape);\n const bBroadcastDims = backend_util.getBroadcastDims(b.shape, newShape);\n const loopsOverAllOfA = aBroadcastDims.every((v, i) => v === i);\n const loopsOverAllOfB = bBroadcastDims.every((v, i) => v === i);\n if (loopsOverAllOfA && loopsOverAllOfB) {\n kernelFunc();\n return out;\n } else {\n throw new Error(\n `Broadcasting along outer dims is not yet ` +\n `supported for ${a.dtype} ${kernelName}.`);\n }\n }\n\n return {kernelName, backendName: 'wasm', setupFunc, kernelFunc};\n}\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n *

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==========\n
*/\n\nimport {Add, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from
'./binary_kernel';\n\nconst supportsFullBroadcast = true;\n\nexport const addConfig: KernelConfig =\n
createBinaryKernelConfig(Add, supportsFullBroadcast);\n","/**\n * @license\n * Copyright 2019 Google LLC. All
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the specific language governing permissions and\n * limitations under the License.\n *
==========\n
*/\n\nimport {AddN, KernelConfig, KernelFunc, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport
{BackendWasm} from '../backend_wasm';\n\nimport {CppDType} from './types';\n\nlet wasmFunc:\n (inputIds:
Uint8Array, inputIdsLen: number, dtype: number, outId: number) =>\n void;\n\nfunction setupFunc(backend:
BackendWasm): void {\n wasmFunc = backend.wasm.cwrap(AddN, null /* void */, [\n 'array', // input_ids\n
'number', // input_ids.length\n 'number', // dtype\n 'number', // out_id\n]);\n}\n\nfunction addn(args: {inputs:
TensorInfo[], backend: BackendWasm}) {\n const {inputs,
backend} = args;\n const out = backend.makeOutput(inputs[0].shape, inputs[0].dtype);\n\n // Short-circuit zero-
sized tensors.\n if (util.sizeFromShape(out.shape) === 0) {\n return out;\n }\n\n const inputIds = inputs.map(x
=> backend.dataIdMap.get(x.dataId).id);\n const inputIdsBytes = new Uint8Array(new
Int32Array(inputIds).buffer);\n const outId = backend.dataIdMap.get(out.dataId).id;\n wasmFunc(inputIdsBytes,
inputIds.length, CppDType[out.dtype], outId);\n\n return out;\n}\n\nexport const addNConfig: KernelConfig = {\n
kernelName: AddN,\n backendName: 'wasm',\n setupFunc,\n kernelFunc: addn as {} as KernelFunc,\n};\n","/**\n
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WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific
language governing permissions and\n * limitations under the License.\n *
==========\n
*/\n\nimport {Identity, IdentityInputs, KernelConfig, KernelFunc} from '@tensorflow/tfjs-core';\nimport
{TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nexport function
identity(args: {inputs: IdentityInputs, backend: BackendWasm}):\n TensorInfo {\n const {inputs: {x}, backend} =
args;\n const out = backend.makeOutput(x.shape, x.dtype);\n const inVals = backend.typedArrayFromHeap(x);\n
const outVals = backend.typedArrayFromHeap(out);\n outVals.set(inVals);\n return out;\n}\n\nexport const
identityConfig: KernelConfig = {\n kernelName: Identity,\n backendName: 'wasm',\n
kernelFunc: identity as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights
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==========================================================================\n
*/\n\nimport {KernelConfig, KernelFunc, TensorInfo, Transpose, TransposeAttrs, TransposeInputs} from
'@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {identity} from
'./Identity';\nimport {CppDType}
 from './types';\n\nlet wasmTranspose: (\n    xId: number, xShape: Uint8Array, xShapeLength: number, dtype:
CppDType,\n    outId: number, perm: Uint8Array, permLength: number) => void;\n\nfunction setup(backend:
BackendWasm) {\n  wasmTranspose = backend.wasm.cwrap(Transpose, null /* void */, [\n    'number',  // xId\n
'array',   // x.shape\n    'number',  // x.shape.length\n    'number',  // dtype\n    'number',  // outId\n    'array',   // perm\n
 'number',  // perm.length\n  ]);\n}\n\nexport function transpose(\n    args:\n        {inputs: TransposeInputs, backend:
BackendWasm, attrs: TransposeAttrs}):\n    TensorInfo {\n  const {inputs, backend, attrs} = args;\n  // Reduce any
dimensions with size one. Lower-rank transpose kernel performs\n  // better due to simpler memory access pattern.\n
const [reducedShape, perm] = removeOneSizeDims(inputs.x.shape, attrs.perm);\n\n  let permIsNoOp = true;\n  for
(let i = 0; i < perm.length; i++) {\n    if (perm[i] !== i) {\n      permIsNoOp
 = false;\n    }\n  }\n  const outShape = computeOutShape(inputs.x.shape, attrs.perm);\n  const x = {\n    dataId:
inputs.x.dataId,\n    shape: reducedShape,\n    dtype: inputs.x.dtype\n  };\n\n  if (permIsNoOp) {\n    const cloned =
identity({inputs, backend});\n    cloned.shape = outShape;\n    return cloned;\n  }\n\n  const out =
backend.makeOutput(outShape, x.dtype);\n  const xId = backend.dataIdMap.get(x.dataId).id;\n  const outId =
backend.dataIdMap.get(out.dataId).id;\n  const permBytes = new Uint8Array(new Int32Array(perm).buffer);\n
const xShapeBytes = new Uint8Array(new Int32Array(x.shape).buffer);\n\n  wasmTranspose(\n      xId,
xShapeBytes, x.shape.length, CppDType[x.dtype], outId, permBytes,\n      perm.length);\n  return
out;\n}\n\nfunction computeOutShape(inShape: number[], perm: number[]): number[] {\n  const outShape = new
Array(inShape.length);\n  for (let i = 0; i < outShape.length; i++) {\n    outShape[i] = inShape[perm[i]];\n  }\n
return outShape;\n}\n\nfunction
 removeOneSizeDims(\n    shape: number[], perm: number[]): [number[], number[]] {\n  const newShape: number[]
= [];\n  const newPerm: number[] = [];\n  for (let i = 0; i < shape.length; ++i) {\n    if (shape[i] !== 1) {\n
newShape.push(shape[i]);\n    }\n    if (shape[perm[i]] !== 1) {\n      newPerm.push(perm[i]);\n    }\n  }\n  for (let i =
0; i < newPerm.length; ++i) {\n    let minValIdx = -1;\n    for (let j = 0; j < newPerm.length; ++j) {\n      if
(newPerm[j] >= i &&\n          (minValIdx === -1 || newPerm[minValIdx] > newPerm[j])) {\n        minValIdx = j;\n
  }\n    }\n    newPerm[minValIdx] = i;\n  }\n  return [newShape, newPerm];\n}\n\nexport const transposeConfig:
KernelConfig = {\n  kernelName: Transpose,\n  backendName: 'wasm',\n  kernelFunc: transpose as {} as
KernelFunc,\n  setupFunc: setup,\n};\n","/**\n * @license\n * Copyright 2020 Google Inc. All Rights Reserved.\n *
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OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language
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==========================================================================\n
*/\n\nimport {backend_util, TensorInfo, util} from '@tensorflow/tfjs-core';\nimport {BackendWasm} from
'../backend_wasm';\nimport {transpose} from './Transpose';\n\n/**\n * Compute permutation axes and do a transpose
if necessary.\n *\n * Used by reduction ops.\n * @param x input TensorInfo\n * @param axis reduction axes\n *
@param backend wasm backend instance\n */\nexport function permuteAxesAndTranspose(\n    x: TensorInfo,
axis: number|number[],
 backend: BackendWasm): {\n  transposed: TensorInfo|null,\n  axes: number[],\n  originalAxes: number[],\n
inputWasTransposed: boolean\n} {\n  const xShape = x.shape;\n  const xRank = x.shape.length;\n\n  const
originalAxes = util.parseAxisParam(axis, xShape);\n  let axes = originalAxes;\n  const permutedAxes =
backend_util.getAxesPermutation(axes, xRank);\n  let xTransposed = null;\n  let inputWasTransposed = false;\n  if
(permutedAxes != null) {\n    const newShape: number[] = new Array(xRank);\n    for (let i = 0; i <
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newShape.length; i++) {\n newShape[i] = xShape[permutedAxes[i]];\n }\n\n axes = backend_util.getInnerMostAxes(axes.length, xRank);\n xTransposed =\n transpose({inputs: {x}, attrs: {perm: permutedAxes}, backend});\n\n const xId = backend.dataIdMap.get(x.dataId).id;\n const transposedId = backend.dataIdMap.get(xTransposed.dataId).id;\n if (transposedId !== xId) {\n inputWasTransposed = true;\n }\n }\n\n return {transposed:
xTransposed, originalAxes, axes, inputWasTransposed};\n}\n","/**\n * @license\n * Copyright 2021 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
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*/\n\nimport {All, AllAttrs, AllInputs, backend_util, KernelConfig, KernelFunc, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {permuteAxesAndTranspose} from './kernel_utils';\n\nlet
wasmAll: (xId: number, reduceSize: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n wasmAll = backend.wasm.cwrap(All, null /*void*/, ['number, number, number']);\n}\n\nfunction all(args: {backend: BackendWasm, inputs: AllInputs, attrs: AllAttrs}):\n TensorInfo {\n const {backend, inputs, attrs} = args;\n const {axis, keepDims} = attrs;\n const {x} = inputs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n let inputId = xId;\n let input = x;\n\n const {transposed, axes, originalAxes, inputWasTransposed} =\n permuteAxesAndTranspose(x, axis, backend);\n\n if (inputWasTransposed) {\n const transposedId = backend.dataIdMap.get(transposed.dataId).id;\n input = transposed;\n inputId = transposedId;\n }\n\n const inputRank = input.shape.length;\n backend_util.assertAxesAreInnerMostDims('all', axes, inputRank);\n const [outShape, reduceShape] =\n backend_util.computeOutAndReduceShapes(input.shape, axes);\n
const reduceSize = util.sizeFromShape(reduceShape);\n\n const out = backend.makeOutput(outShape, x.dtype);\n if (util.sizeFromShape(input.shape) !== 0) {\n const outId = backend.dataIdMap.get(out.dataId).id;\n wasmAll(inputId, reduceSize, outId);\n }\n\n if (inputWasTransposed) {\n // dispose of the transposed tensor.\n backend.disposeData(transposed.dataId);\n }\n\n if (keepDims) {\n // reshape\n const newShape = backend_util.expandShapeToKeepDim(out.shape, originalAxes);\n out.shape = newShape;\n }\n\n return out;\n}\n\nexport const allConfig: KernelConfig = {\n kernelName: All,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: all as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2021 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n
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*/\n\nimport {Any, AnyAttrs, AnyInputs, backend_util, KernelConfig, KernelFunc, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {permuteAxesAndTranspose} from './kernel_utils';\n\nlet wasmAny: (xId: number, reduceSize: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n wasmAny = backend.wasm.cwrap(Any, null /*void*/, ['number, number, number']);\n}\n\nfunction any(args: {backend: BackendWasm, inputs: AnyInputs, attrs: AnyAttrs}):\n TensorInfo {\n const {backend, inputs,
attrs} = args;\n const {axis, keepDims} = attrs;\n const {x} = inputs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n let inputId = xId;\n let input = x;\n\n const {transposed, axes, originalAxes,

inputWasTransposed} =\n permuteAxesAndTranspose(x, axis, backend);\n\n if (inputWasTransposed) {\n const transposedId = backend.dataIdMap.get(transposed.dataId).id;\n input = transposed;\n inputId = transposedId;\n }\n\n const inputRank = input.shape.length;\n backend_util.assertAxesAreInnerMostDims('any', axes, inputRank);\n const [outShape, reduceShape] =\n backend_util.computeOutAndReduceShapes(input.shape, axes);\n const reduceSize = util.sizeFromShape(reduceShape);\n\n const out = backend.makeOutput(outShape, x.dtype);\n if (util.sizeFromShape(input.shape) !== 0) {\n const outId = backend.dataIdMap.get(out.dataId).id;\n wasmAny(inputId, reduceSize, outId);\n }\n\n if (inputWasTransposed) {\n // dispose of the transposed tensor.\n backend.disposeData(transposed.dataId);\n }\n\n if (keepDims) {\n // reshape\n const newShape = backend_util.expandShapeToKeepDim(out.shape, originalAxes);\n out.shape = newShape;\n }\n\n return out;\n}\n\nexport const anyConfig: KernelConfig = {\n kernelName: Any,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: any as {} as KernelFunc\n};\n\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {ArgMax, ArgMaxAttrs, ArgMaxInputs, KernelConfig, KernelFunc, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {permuteAxesAndTranspose} from './kernel_utils';\nimport {CppDType} from './types';\n\nlet wasmFunc: (\n xId: number, dtype: number, outerSize: number, innerSize: number,\n outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmFunc = backend.wasm.cwrap(ArgMax, null /* void */, [\n 'number', // x_id\n 'number', // dtype\n 'number', // outer_size\n 'number', // inner_size\n 'number' // out_id\n]);\n}\n\nfunction argmax(\n args: {inputs: ArgMaxInputs, backend: BackendWasm, attrs: ArgMaxAttrs}) {\n const {backend, inputs, attrs} = args;\n const {axis} = attrs as {} as ArgMaxAttrs;\n const {x} = inputs as {} as ArgMaxInputs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n let inputId\n = xId;\n let input = x;\n\n const {transposed, axes, inputWasTransposed} =\n permuteAxesAndTranspose(x, axis, backend);\n\n if (inputWasTransposed) {\n const transposedId = backend.dataIdMap.get(transposed.dataId).id;\n if (transposedId !== xId) {\n // transpose was not a no-op. We will need to dispose of this\n // once we are done.\n input = transposed;\n inputId = transposedId;\n }\n }\n\n const outShape = input.shape.slice(0, -1);\n const out = backend.makeOutput(outShape, 'int32');\n const outId = backend.dataIdMap.get(out.dataId).id;\n const outerSize = util.sizeFromShape(out.shape);\n const innerSize = input.shape[axes[0]];\n wasmFunc(inputId, CppDType[input.dtype], outerSize, innerSize, outId);\n\n if (inputWasTransposed) {\n // dispose of the transposed tensor.\n backend.disposeData(transposed.dataId);\n }\n\n return out;\n}\n\nexport const argMaxConfig: KernelConfig = {\n kernelName: ArgMax,\n backendName: 'wasm',\n kernelFunc: argmax as {} as KernelFunc,\n setupFunc: setup\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n * ==========\n */\n\nimport {AvgPool, AvgPoolAttrs, AvgPoolInputs, backend_util, KernelConfig, KernelFunc, Tensor4D} from

'@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmAvgPool: (\n xId: number, batchSize: number, inputHeight: number, inputWidth: number,\n filterHeight: number, filterWidth: number, padTop: number, padRight: number,\n padBottom: number, padLeft: number, strideHeight: number,\n strideWidth: number, channels: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmAvgPool = backend.wasm.cwrap(AvgPool, null /* void */, [\n 'number', // xId\n 'number', // batchSize\n 'number', // inputHeight\n 'number', // inputWidth\n 'number', // filterHeight\n 'number', // filterWidth\n 'number', // padTop\n 'number', // padRight\n 'number', // padBottom\n 'number', // padLeft\n 'number', // strideHeight\n 'number', // strideWidth\n 'number', // channels\n 'number', // outId\n]);\n}\n\nfunction avgPool(\n args: {inputs: AvgPoolInputs, backend: BackendWasm, attrs: AvgPoolAttrs}) {\n const {inputs, attrs, backend} = args;\n\n const x = inputs.x as Tensor4D;\n const xId = backend.dataIdMap.get(x.dataId).id;\n\n const {filterSize, strides, pad, dimRoundingMode} = attrs;\n const convInfo = backend_util.computePool2DInfo(\n x.shape, filterSize, strides, 1 /* dilations */, pad, dimRoundingMode);\n\n const filterHeight = convInfo.filterHeight;\n const filterWidth = convInfo.filterWidth;\n const padTop = convInfo.padInfo.top;\n const padRight = convInfo.padInfo.right;\n const padBottom = convInfo.padInfo.bottom;\n const padLeft = convInfo.padInfo.left;\n const strideHeight = convInfo.strideHeight;\n const strideWidth = convInfo.strideWidth;\n const channels = convInfo.inChannels;\n\n if (convInfo.dataFormat !== 'channelsLast') {\n throw new Error(\n `wasm backend does not support dataFormat:` +\n `${convInfo.dataFormat}'. Please use 'channelsLast'.`);\n }\n\n if (convInfo.dilationWidth !== 1 || convInfo.dilationHeight !== 1) {\n throw new Error(\n `was backend only supports average pooling with dilation = [1, 1], ` +\n `got [${convInfo.dilationHeight}, ${convInfo.dilationWidth}].`);\n }\n\n const out = backend.makeOutput(convInfo.outShape, 'float32');\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n wasmAvgPool(\n xId, x.shape[0], x.shape[1], x.shape[2], filterHeight, filterWidth,\n padTop, padRight, padBottom, padLeft, strideHeight, strideWidth, channels,\n outId);\n return out;\n}\n\nexport const avgPoolConfig: KernelConfig = {\n kernelName: AvgPool,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: avgPool as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==*/\n\nimport {KernelConfig, KernelFunc, Reshape, ReshapeAttrs, ReshapeInputs, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nexport function reshape(\n args: {inputs: ReshapeInputs, attrs: ReshapeAttrs, backend: BackendWasm}) {\n const {inputs, attrs} = args;\n const {x} = inputs;\n const {shape} = attrs;\n\n const xSize = util.sizeFromShape(x.shape);\n const $shape = util.inferFromImplicitShape(shape, xSize);\n\n util.assert(\n xSize === util.sizeFromShape($shape),\n () => `new shape: ${$shape}, old shape: ${x.shape}. New shape and old ` +\n `shape must have the same number of elements.`);\n\n // Backend needs to track refCount for the dataId for reshape op\n args.backend.incRef(x.dataId);\n return {dataId: x.dataId, shape: $shape, dtype: x.dtype};\n}\n\nexport const reshapeConfig: KernelConfig = {\n kernelName: Reshape,\n backendName: 'wasm',\n kernelFunc: reshape as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language

governing permissions and\n * limitations under the License.\n *
==========\n
*/\n\nimport
{BatchMatMul, BatchMatMulAttrs, BatchMatMulInputs, KernelConfig, KernelFunc, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {reshape} from './Reshape';\n\nlet wasmBatchMatMul: (\n aId: number, aShape: Uint8Array, aShapeSize: number, bId: number,\n bShape: Uint8Array, bShapeSize: number, transposeA: boolean,\n transposeB: boolean, outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmBatchMatMul = backend.wasm.cwrap(BatchMatMul, null /* void */, [\n 'number', // a_id\n 'array', // a_shape\n 'number', // a_shape.length\n 'number', // b_id\n 'array', // b_shape\n 'number', // b_shape.length\n 'number', // transpose_a\n 'number', // transpose_b\n 'number' // out_id\n]);\n}\n\nfunction batchMatMul(args: {\n inputs: BatchMatMulInputs,\n backend: BackendWasm,\n attrs: BatchMatMulAttrs\n}) {\n const {inputs, backend, attrs} = args;\n const {a, b} = inputs;\n const
{transposeA, transposeB} = attrs;\n\n if (a.dtype !== 'float32' || b.dtype !== 'float32') {\n throw new Error(\n `BatchMatMul for non non-float32 tensors not yet supported.`);\n }\n\n const aRank = a.shape.length;\n const bRank = b.shape.length;\n\n const innerShapeA = transposeA ? a.shape[aRank - 2] : a.shape[aRank - 1];\n const innerShapeB = transposeB ? b.shape[bRank - 1] : b.shape[bRank - 2];\n\n const outerShapeA = transposeA ? a.shape[aRank - 1] : a.shape[aRank - 2];\n const outerShapeB = transposeB ? b.shape[bRank - 2] : b.shape[bRank - 1];\n\n const outerDimsA = a.shape.slice(0, -2);\n const outerDimsB = b.shape.slice(0, -2);\n\n const batchDimA = util.sizeFromShape(outerDimsA);\n const batchDimB = util.sizeFromShape(outerDimsB);\n\n const batchDimsCompatible =\n batchDimA === batchDimB || batchDimA === 1 || batchDimB === 1;\n\n util.assert(\n aRank >= 2 && bRank >= 2 && batchDimsCompatible,\n () => `Error in matMul: the input batch dimensions
must either be the ` +\n `same or at least one input batch dimension must be 1. Got input ` +\n `batch dimensions of (${outerDimsA}) and (${outerDimsB}).`);\n\n const outShapeOuterDims =\n batchDimA > batchDimB ? a.shape.slice(0, -2) : b.shape.slice(0, -2);\n const outShape = outShapeOuterDims.concat([outerShapeA, outerShapeB]);\n\n util.assert(\n innerShapeA === innerShapeB,\n () => `Error in matMul: inner shapes (${innerShapeA}) and (` +\n `${innerShapeB}) of Tensors with shapes ${a.shape} and ` +\n `${b.shape} and transposeA=${transposeA}` +\n ` and transposeB=${transposeB} must match.`);\n\n const a3dShape = transposeA ? [batchDimA, innerShapeA, outerShapeA] :\n [batchDimA, outerShapeA, innerShapeA];\n const b3dShape = transposeB ? [batchDimB, outerShapeB, innerShapeB] :\n [batchDimB, innerShapeB, outerShapeB];\n\n // The rest of the implementation is
designed to operate on rank-3 tensors\n const a3d = reshape({inputs: {x: a}, backend, attrs: {shape: a3dShape}});\n const b3d = reshape({inputs: {x: b}, backend, attrs: {shape: b3dShape}});\n\n const a3dId = backend.dataIdMap.get(a3d.dataId).id;\n const b3dId = backend.dataIdMap.get(b3d.dataId).id;\n\n const leftDim = transposeA ? a3d.shape[2] : a3d.shape[1];\n const rightDim = transposeB ? b3d.shape[1] : b3d.shape[2];\n const batchDim = Math.max(batchDimA, batchDimB);\n\n const out = backend.makeOutput([batchDim, leftDim, rightDim], a3d.dtype);\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n const aShapeBytes = new Uint8Array(new Int32Array(a3d.shape).buffer);\n const bShapeBytes = new Uint8Array(new Int32Array(b3d.shape).buffer);\n\n wasmBatchMatMul(\n a3dId, aShapeBytes, a3d.shape.length, b3dId, bShapeBytes,\n b3d.shape.length, transposeA, transposeB, outId);\n\n backend.disposeData(a3d.dataId);\n backend.disposeData(b3d.dataId);\n\n out.shape =
outShape;\n return out;\n}\n\nexport const batchMatMulConfig: KernelConfig = {\n kernelName: BatchMatMul,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: batchMatMul as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n *

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==========\n */\nimport { backend_util, util } from '@tensorflow/tfjs-core';\nexport function concatImpl(inputs, outShape, dtype, simplyConcat) {\n const outVals = util.getArrayFromDType(dtype, util.sizeFromShape(outShape));\n if (simplyConcat && dtype !== 'string') {\n // Use built-in TypedArray.set() method for speed.\n let offset = 0;\n inputs.forEach(input => {\n const size = util.sizeFromShape(input.shape);\n outVals.set(input.vals, offset);\n offset += size;\n });\n }\n else {\n let colOffset = 0;\n inputs.forEach(input => {\n const decodedData = dtype === 'string' ?\n backend_util.fromUint8ToStringArray(input.vals) :\n input.vals;\n let tIdx = 0;\n for (let row = 0; row < input.shape[0]; ++row) {\n const resIdx = row * outShape[1] + colOffset;\n for (let col = 0; col < input.shape[1]; ++col) {\n outVals[resIdx + col] = decodedData[tIdx++];\n }\n }\n colOffset += input.shape[1];\n });\n }\n return outVals;\n}\n//# sourceMappingURL=data:application/json; base64,eyJ2ZXJzaW9uIjozLCJmaWxlIjoiQ29uY2F0X2ltcGwuanMiLCJzb3VyY2VSb290IjoiIiwic291cmNlcyI6WyIuLi8uLi8uLi8uLi8uLi8uLi90ZmpzLWJhY2tlbmQtY3B1L3NyYy9rZXJuZWxzL0NvbmNhdF9pbXBsLnRzIl0sIm5hbWVzIjpbXSwibWFwcGluZ3MiOiJBQUFBOzs7Ozs7Ozs7Ozs7R0FlRztBQUVILE9BQU8sRUFBRSxZQUFZLEVBQUUsSUFBSSxFQUFFLE1BQU0sdUJBQXVCLENBQUM7QUFFM0QsTUFBTSxVQUFVLFVBQVUsQ0FBQyxNQUFNLEVBQUUsUUFBUSxFQUFFLEtBQUssRUFBRSxZQUFZO0lBQzVELE1BQU0sT0FBTyxHQUFHLElBQUksQ0FBQyxlQUFlLENBQUMsS0FBSyxFQUFFLElBQUksQ0FBQyxlQUFlLENBQUMsUUFBUSxDQUFDLENBQUMsQ0FBQztJQUMzRSxJQUFJLFlBQVksSUFBSSxLQUFLLEtBQUssUUFBUSxFQUFFO1FBQ3RDLDBDQUEwQztRQUMxQyxvQ0FBb0M7UUFDcEMsSUFBSSxNQUFNLEdBQUcsQ0FBQyxDQUFDO1FBQ2YsTUFBTSxDQUFDLE9BQU8sQ0FBQyxLQUFLLENBQUMsRUFBRTtZQUNyQixNQUFNLElBQUksR0FBRyxJQUFJLENBQUMsZUFBZSxDQUFDLEtBQUssQ0FBQyxLQUFLLENBQUMsQ0FBQztZQUMvQyxPQUFPLENBQUMsSUFBSSxDQUFDLEtBQUssQ0FBQyxJQUFJLEVBQUUsTUFBTSxDQUFDLENBQUM7WUFDakMsTUFBTSxJQUFJLElBQUksQ0FBQztRQUNqQixDQUFDLENBQUMsQ0FBQztLQUNKO1NBQU07UUFDTCxJQUFJLFNBQVMsR0FBRyxDQUFDLENBQUM7UUFDbEIsTUFBTSxDQUFDLE9BQU8sQ0FBQyxLQUFLLENBQUMsRUFBRTtZQUNyQixNQUFNLFdBQVcsR0FBRyxLQUFLLEtBQUssUUFBUSxDQUFDLENBQUM7Z0JBQ3RDLFlBQVksQ0FBQyx1QkFBdUIsQ0FBQyxLQUFLLENBQUMsSUFBSSxDQUFDLENBQUMsQ0FBQztnQkFDbEQsS0FBSyxDQUFDLElBQUksQ0FBQztZQUNiLElBQUksSUFBSSxHQUFHLENBQUMsQ0FBQztZQUNiLEtBQUssSUFBSSxHQUFHLEdBQUcsQ0FBQyxFQUFFLEdBQUcsR0FBRyxLQUFLLENBQUMsS0FBSyxDQUFDLENBQUMsQ0FBQyxFQUFFLEVBQUUsR0FBRyxFQUFFO2dCQUNqRCxNQUFNLE1BQU0sR0FBRyxHQUFHLEdBQUcsUUFBUSxDQUFDLENBQUMsQ0FBQyxHQUFHLFNBQVMsQ0FBQztnQkFDN0MsS0FBSyxJQUFJLEdBQUcsR0FBRyxDQUFDLEVBQUUsR0FBRyxHQUFHLEtBQUssQ0FBQyxLQUFLLENBQUMsQ0FBQyxDQUFDLEVBQUUsRUFBRSxHQUFHLEVBQUU7b0JBQ2pELE9BQU8sQ0FBQyxNQUFNLEdBQUcsR0FBRyxDQUFDLEdBQUcsV0FBVyxDQUFDLElBQUksRUFBRSxDQUFDLENBQUM7aUJBQzdDO2FBQ0Y7WUFDRCxTQUFTLElBQUksS0FBSyxDQUFDLEtBQUssQ0FBQyxDQUFDLENBQUMsQ0FBQztRQUM5QixDQUFDLENBQUMsQ0FBQztLQUNKO0lBQ0QsT0FBTyxPQUFPLENBQUM7QUFDakIsQ0FBQyIsInNvdXJjZXNDb250ZW50IjpbIi8qKlxuICogQGxpY2Vuc2VcbiAqIENvcHlyaWdodCAyMDIwIEdvb2dsZSBMTEMuIEFsbCBSaWdodHMgUmVzZXJ2ZWQuXG4gKlxuICogTGljZW5zZWQgdW5kZXIgdGhlIEFwYWNoZSBMaWNlbnNlLCBWZXJzaW9uIDIuMCAodGhlIFwiTGljZW5zZVwiKTtcbiAqIHlvdSBtYXkgbm90IHVzZSB0aGlzIGZpbGUgZXhjZXB0IGluIGNvbXBsaWFuY2Ugd2l0aCB0aGUgTGljZW5zZS5cbiAqIFlvdSBtYXkgb2J0YWluIGEgY29weSBvZiB0aGUgTGljZW5zZSBhdFxuICpcbiAqIGh0dHA6Ly93d3cuYXBhY2hlLm9yZy9saWNlbnNlcy9MSUNFTlNFLTIuMFxuICpcbiAqIFVubGVzcyByZXF1aXJlZCBieSBhcHBsaWNhYmxlIGxhdyBvciBhZ3JlZWQgdG8gaW4gd3JpdGluZywgc29mdHdhcmVcbiAqIGRpc3RyaWJ1dGVkIHVuZGVyIHRoZSBMaWNlbnNlIGlzIGRpc3RyaWJ1dGVkIG9uIGFuIFwiQVMgSVNcIiBCQVNJUyxcbiAqIFdJVEhPVVQgV0FSUkFOVElFUyBPUiBDT05ESVRJT05TIE9GIEFOWSBLSU5ELCBlaXRoZXIgZXhwcmVzcyBvciBpbXBsaWVkLlxuICogU2VlIHRoZSBMaWNlbnNlIGZvciB0aGUgc3BlY2lmaWMgbGFuZ3VhZ2UgZ292ZXJuaW5nIHBlcm1pc3Npb25zIGFuZFxuICogbGltaXRhdGlvbnMgdW5kZXIgdGhlIExpY2Vuc2UuXG4gKiA9PT09PT09PT09PT09PT09PT09PT09PT09PT09PT09PT09PT09PT09PT09PT09PT09PT09PT09PT09PT09PT09PT09PVxuICovXG5pbXBvcnQgeyBiYWNrZW5kX3V0aWwsIHV0aWwgfSBmcm9tICdAdGVuc29yZmxvdy90ZmpzLWNvcmUnO1xuZXhwb3J0IGZ1bmN0aW9uIGNvbmNhdEltcGwoaW5wdXRzLCBvdXRTaGFwZSwgZHR5cGUsIHNpbXBseUNvbmNhdCkge1xuICAgIGNvbnN0IG91dFZhbHMgPSB1dGlsLmdldEFycmF5RnJvbURUeXBlKGR0eXBlLCB1dGlsLnNpemVGcm9tU2hhcGUob3V0U2hhcGUpKTtcbiAgICBpZiAoc2ltcGx5Q29uY2F0ICYmIGR0eXBlICE9PSAnc3RyaW5nJykge1xuICAgICAgICAvLyBVc2UgYnVpbHQtaW4gVHlwZWRBcnJheS5zZXQoKSBtZXRob2QgZm9yIHNwZWVkLlxuICAgICAgICBsZXQgb2Zmc2V0ID0gMDtcbiAgICAgICAgaW5wdXRzLmZvckVhY2goaW5wdXQgPT4gezFcbiAgICAgICAgICAgIGNvbnN0IHNpemUgPSB1dGlsLnNpemVGcm9tU2hhcGUoaW5wdXQuc2hhcGUpO1xuICAgICAgICAgICAgb3V0VmFscy5zZXQoaW5wdXQudmFscywgb2Zmc2V0KTtcbiAgICAgICAgICAgIG9mZnNldCArPSBzaXplO1xuICAgICAgICB9KTtcbiAgICB9XG4gICAgZWxzZSB7XG4gICAgICAgIGxldCBjb2xPZmZzZXQgPSAwO1xuICAgICAgICBpbnB1dHMuZm9yRWFjaChpbnB1dCA9PiB7XG4gICAgICAgICAgICBjb25zdCBkZWNvZGVkRGF0YSA9IGR0eXBlID09PSAnc3RyaW5nJyA/XG4gICAgICAgICAgICAgICAgYmFja2VuZF91dGlsLmZyb21VaW50OFRvU3RyaW5nQXJyYXkoaW5wdXQudmFscykgOlxuICAgICAgICAgICAgICAgIGlucHV0LnZhbHM7XG4gICAgICAgICAgICBsZXQgdElkeCA9IDA7XG4gICAgICAgICAgICBmb3IgKGxldCByb3cgPSAwOyByb3cgPCBpbnB1dC5zaGFwZVswXTsgKytyb3cpIHtcbiAgICAgICAgICAgICAgICBjb25zdCByZXNJZHggPSByb3cgKiBvdXRTaGFwZVsxXSArIGNvbE9mZnNldDtcbiAgICAgICAgICAgICAgICBmb3IgKGxldCBjb2wgPSAwOyBjb2wgPCBpbnB1dC5zaGFwZVsxXTsgKytjb2wpIHtcbiAgICAgICAgICAgICAgICAgICAgb3V0VmFsc1tyZXNJZHggKyBjb2xdID0gZGVjb2RlZERhdGFbdElkeCsrXTtcbiAgICAgICAgICAgICAgICB9XG4gICAgICAgICAgICB9XG4gICAgICAgICAgICBjb2xPZmZzZXQgKz0gaW5wdXQuc2hhcGVbMV07XG4gICAgICAgIH0pO1xuICAgIH1cbiAgICByZXR1cm4gb3V0VmFscztcbn1cbi8vIyBzb3VyY2VNYXBwaW5nVVJMPWRhdGE6YXBwbGljYXRpb24vanNvbjtiYXNlNjQsZXlKMlpYSnphVzl1SWpvekxDSm1hV3hsSWpvaVEyOXVZMkYwWDJ4MFkzQjNkV0poYm1NaUxDSnpiM1Z5WTJWU2IyOTBJam9pSWl3aWMyOTFjbVpsY3lJNld5SXVMaTR1TDRqTGk0dUxpNHVMaTR1TGk0dUxpNHVMaTR1TGk5MFkzcHpMV0poWTJ0bGJtUXRZM0IxTDNOeVl5OXlaVzVrWlhNdlEyOXVibUZvZEY5d2FXNWtaWGd1ZEhNaVhTd2libUZ0WlhNaU9sdGRMQ0p0WlhSeWFXTWlPaUpCUVVGQlFUczdPenM3T3pzN096czdPenM3UjBGbFJ6dEJRVVZMTzBGQlEwc3NSVUZCUXl4UlFVRkVMRWxCUVVNc1NVRkJReXhOUVVOTExFbEJRVVVzVFVGQlRTeEZRVUZGTEVsQlFVTXNTVUZCU1N4RlFVRkZMRWxCUVVNc1NVRkJTU3hGUVVGRkxFVk

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PT09PT09PT09PT09XG4gKi9cblxuaW1wb3J0IHtiYWNrZW5kX3V0aWwsIEJhY2tlbmRWYWx1ZXMsIERhdG
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izZSh2YWx1ZXMpO

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==========\n */\nimport { util } from '@tensorflow/tfjs-core';\nexport function rangeImpl(start, stop, step, dtype) {\n   const sameStartStop = start === stop;\n   const increasingRangeNegativeStep = start < stop && step < 0;\n   const decreasingRangePositiveStep = stop < start && step > 1;\n   if (sameStartStop || increasingRangeNegativeStep ||\n   decreasingRangePositiveStep) {\n   return util.makeZerosTypedArray(0, dtype);\n   }\n   const numElements = Math.abs(Math.ceil((stop - start) / step));\n   const values = util.makeZerosTypedArray(numElements, dtype);\n   if (stop < start && step === 1) {\n   // Auto adjust

the step's sign if it hasn't been set\n   // (or was set to 1)\n   step = -1;\n   }\n   values[0] = start;\n   for (let i = 1; i < values.length; i++) {\n   values[i] = values[i - 1] + step;\n   }\n   return values;\n}\n//# sourceMappingURL=data:application/json; base64,eyJ2ZXJzaW9uIjozLCJmaWxlIjoiUmFuZ2VfaW1wbC5qcyIsInNvdXJjZVJvb3QiOiIiLCJzb3VyY2VzIjpbIi4uLy4uLy4uLy4uLy4uLy4uL3RmanMtYmFja2VuZC1jcHUvc3JjL3tlcm5lbHMvUmFuZ2VfaW1wbC50cyJdLCJuYW1lcyI6W10sImhcHBpbmdzIjoiQUFBQTs7Ozs7Ozs7Ozs7O0dBZUc7QUFFSCxPQUFPLEVBQUMsSUFBSSxFQUFDLE1BQU0sdUJBQXVCLENBQUM7QUFFM0MsTUFBTSxVQUFVLFNCCxPQUFPLEVBQUUsSUFBSSxFQUFFLElBQUksRUFBRSxLQUFLO0lBQ3hELE1BQU0sYUFBYSxHQUFHLEtBQUssS0FBSyxJQUFJLENBQUM7SUFDckMsTUFBTSwyQkFBMkIsR0FBRyxLQUFLLEdBQUcsSUFBSSxJQUFJLElBQUksR0FBRyxDQUFDLENBQUM7SUFDN0QsTUFBTSwyQkFBMkIsR0FBRyxJQUFJLEdBQUcsS0FBSyxJQUFJLElBQUksR0FBRyxDQUFDLENBQUM7SUFDN0QsSUFBSSxhQUFhLElBQUksMkJBQTJCLElBQUk7UUFDaEQsMkJBQTJCLEVBQUU7UUFDN0IsT0FBTyxJQUFJLENBQUMsb0JBQW9CLENBQUMsQ0FBQyxFQUFFLEtBQUssQ0FBQyxDQUFDO0tBQzVDO0lBQ0QsTUFBTSxXQUFXLEdBQUcsSUFBSSxDQUFDLEdBQUcsQ0FBQyxJQUFJLENBQUMsSUFBSSxDQUFDLENBQUMsSUFBSSxHQUFHLEtBQUssQ0FBQyxHQUFHLElBQUksQ0FBQyxDQUFDLENBQUM7SUFDOUQsTUFBTSxNQUFNLEdBQUcsSUFBSSxDQUFDLG9CQUFvQixDQUFDLFdBQVcsRUFBRSxLQUFLLENBQUMsQ0FBQztJQUM3RCxJQUFJLElBQUksR0FBRyxLQUFLLElBQUksSUFBSSxLQUFLLENBQUMsRUFBRTtRQUM5QixnQkFBZ0I7UUFDaEIsMkNBQTJDO1FBQzNDLElBQUksR0FBRyxDQUFDLENBQUMsQ0FBQztLQUNYO0lBQ0QsTUFBTSxDQUFDLENBQUMsQ0FBQyxHQUFHLEtBQUssQ0FBQztJQUNsQixLQUFLLElBQUksQ0FBQyxHQUFHLENBQUMsRUFBRSxDQUFDLEdBQUcsTUFBTSxDQUFDLE1BQU0sRUFBRSxDQUFDLEVBQUUsRUFBRTtRQUN0QyxNQUFNLENBQUMsQ0FBQyxDQUFDLEdBQUcsTUFBTSxDQUFDLENBQUMsR0FBRyxDQUFDLENBQUMsR0FBRyxJQUFJLENBQUM7S0FDbEM7SUFDRCxPQUFPLE1BQU0sQ0FBQztBQUNoQixDQUFDIiwibmFtZXMiOltdLCJzb3VyY2VzIjpbIi4uLy4uLy4uLy4uLy4uLy4uL3RmanMtYmFja2VuZC1jcHUvc3JjL2tlcm5lbHMvUmFuZ2VfaW1wbC50cyJdLCJzb3VyY2VzQ29udGVudC

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*/\nimport { backend_util, buffer, Slice, slice_util, util } from '@tensorflow/tfjs-core';\nimport { assertNotComplex } from '../cpu_util';\nexport function sliceImpl(vals, begin, size, shape, dtype) {\n   const isContinous = slice_util.isSliceContinous(shape, begin, size);\n   const length = util.sizeFromShape(size);\n   const xStrides = util.computeStrides(shape);\n   if (isContinous) {\n   const flatOffset = slice_util.computeFlatOffset(begin, xStrides);\n   if (dtype === 'string') {\n   return vals.slice(flatOffset, flatOffset + length);\n   }\n   return vals.subarray(flatOffset, flatOffset + length);\n   }\n   const decodedData = dtype === 'string' ?\n   backend_util.fromUint8ToStringArray(vals) :\n   vals;\n   const inBuf = buffer(shape, dtype, decodedData);\n   const outBuf = buffer(size, dtype);\n   for (let i = 0; i < outBuf.size; ++i) {\n   const outLoc = outBuf.indexToLoc(i);\n   const inLoc = outLoc.map((idx, j) => idx + begin[j]);\n   outBuf.set(inBuf.get(...inLoc), ...outLoc);\n   }\n   if (dtype === 'string') {\n   return backend_util.fromStringArrayToUint8(outBuf.values);\n   }\n   return outBuf.values;\n}\nexport function slice(args) {\n   const { inputs, backend, attrs } = args;\n   const { x } = inputs;\n   const { begin, size } = attrs;\n   assertNotComplex(x, 'slice');\n   const [$begin, $size] = slice_util.parseSliceParams(x, begin, size);\n   slice_util.assertParamsValid(x, $begin, $size);\n   const vals = backend.data.get(x.dataId).values;\n   const outVals = sliceImpl(vals, $begin, $size, x.shape, x.dtype);\n   return backend.makeTensorInfo($size, x.dtype, outVals);\n}\nexport const sliceConfig = {\n   kernelName: Slice,\n   backendName: 'cpu',\n   kernelFunc: slice\n};\n//# sourceMappingURL=data:application/json; base64,eyJ2ZXJzaW9uIjozLCJmaWxlIjoiU2xpY2UuanMiLCJzb3VyY2VSb290IjoiIiwic291cmNlcyI6WyIuLi8uLi8uLi8uLi8uLi8uLi90ZmpzLWJhY2tlbmQtY3B1L3NyYy9rZXJuZWxzL1NsaWNlLnRzIl0sIm5hbWVzIjpbXSwibWFwcGluZ3MiOiJBQUFBOzs7OztBQUVILE9BQU8sRUFBRSxZQUFZLEVBQUUsTUFBTSxFQUFFLEtBQUssRUFBRSxVQUFVLEVBQUUsSUFBSSxFQUFFLE1BQU0sdUJBQXVCLENBQUM7QUFDeEYsT0FBTyxFQUFFLGdCQUFnQixFQUFFLE1BQU0sZUFBZSxDQUFDO0FBQ2pELE1BQU0sVUFBVSxTQUFTLENBQUMsSUFBSSxFQUFFLE1BQU0sRUFBRSxJQUFJLEVBQUUsS0FBSyxFQUFFLEtBQUs7SUFDdEQsTUFBTSxXQUFXLEdBQUcsVUFBVSxDQUFDLGlCQUFpQixDQUFDLEtBQUssRUFBRSxLQUFLLEVBQUUsSUFBSSxDQUFDLENBQUM7SUFDckUsTUFBTSxNQUFNLEdBQUcsSUFBSSxDQUFDLGNBQWMsQ0FBQyxJQUFJLENBQUMsQ0FBQztJQUN6QyxNQUFNLFFBQVEsR0FBRyxJQUFJLENBQUMsZUFBZSxDQUFDLEtBQUssQ0FBQyxDQUFDO0lBQzdDLElBQUksV0FBVyxFQUFFO1FBQ2IsTUFBTSxVQUFVLEdBQUcsVUFBVSxDQUFDLGlCQUFpQixDQUFDLEtBQUssRUFBRSxRQUFRLENBQUMsQ0FBQztRQUNqRSxJQUFJLEtBQUssS0FBSyxRQUFRLEVBQUU7WUFDcEIsT0FBTyxJQUFJLENBQUMsS0FBSyxDQUFDLFVBQVUsRUFBRSxVQUFVLEdBQUcsTUFBTSxDQUFDLENBQUM7U0FDdEQ7UUFDRCxPQUFPLElBQUksQ0FBQyxRQUFRLENBQUMsVUFBVSxFQUFFLFVBQVUsR0FBRyxNQUFNLENBQUMsQ0FBQztLQUN6RDtJQUNELE1BQU0sV0FBVyxHQUFHLEtBQUssS0FBSyxRQUFRLENBQUMsQ0FBQztRQUNwQyxVQUFVLENBQUMsc0JBQXNCLENBQUMsSUFBSSxDQUFDLENBQUMsQ0FBQztRQUN6QyxJQUFJLENBQUM7SUFDVCxNQUFNLEtBQUssR0FBRyxNQUFNLENBQUMsS0FBSyxFQUFFLEtBQUssRUFBRSxXQUFXLENBQUMsQ0FBQztJQUNoRCxNQUFNLE1BQU0sR0FBRyxNQUFNLENBQUMsSUFBSSxFQUFFLEtBQUssQ0FBQyxDQUFDO0lBQ25DLEtBQUssSUFBSSxDQUFDLEdBQUcsQ0FBQyxFQUFFLENBQUMsR0FBRyxNQUFNLENBQUMsSUFBSSxFQUFFLEVBQUUsQ0FBQyxFQUFFO1FBQ2xDLE1BQU0sTUFBTSxHQUFHLE1BQU0sQ0FBQyxZQUFZLENBQUMsQ0FBQyxDQUFDLENBQUM7UUFDdEMsTUFBTSxLQUFLLEdBQUcsTUFBTSxDQUFDLEdBQUcsQ0FBQyxDQUFDLEdBQUcsRUFBRSxDQUFDLEVBQUUsRUFBRSxDQUFDLEdBQUcsR0FBRyxLQUFLLENBQUMsQ0FBQyxDQUFDLENBQUMsQ0FBQztRQUNuRCxNQUFNLENBQUMsR0FBRyxDQUFDLEtBQUssQ0FBQyxHQUFHLENBQUMsR0FBRyxLQUFLLENBQUMsRUFBRSxHQUFHLE1BQU0sQ0FBQyxDQUFDO0tBQzlDO0lBQ0QsSUFBSSxLQUFLLEtBQUssUUFBUSxFQUFFO1FBQ3BCLE9BQU8sVUFBVSxDQUFDLHNCQUFzQixDQUFDLE1BQU0sQ0FBQyxNQUFNLENBQUMsQ0FBQztLQUMzRDtJQUNELE9BQU8sTUFBTSxDQUFDLE1BQU0sQ0FBQztBQUN6QixDQUFDO0FBQ0QsTUFBTSxVQUFVLEtBQUssQ0FBQyxJQUFJO0lBQ3RCLE1BQU0sRUFBRSxNQUFNLEVBQUUsT0FBTyxFQUFFLEtBQUssRUFBRSxHQUFHLElBQUksQ0FBQztJQUN4QyxNQUFNLEVBQUUsQ0FBQyxFQUFFLEdBQUcsTUFBTSxDQUFDO0lBQ3JCLE1BQU0sRUFBRSxLQUFLLEVBQUUsSUFBSSxFQUFFLEdBQUcsS0FBSyxDQUFDO0lBQzlCLGdCQUFnQixDQUFDLENBQUMsRUFBRSxPQUFPLENBQUMsQ0FBQztJQUM3QixNQUFNLENBQUMsTUFBTSxFQUFFLEtBQUssQ0FBQyxHQUFHLFVBQVUsQ0FBQyxnQkFBZ0IsQ0FBQyxDQUFDLEVBQUUsS0FBSyxFQUFFLElBQUksQ0FBQyxDQUFDO0lBQ3BFLFVBQVUsQ0FBQyxrQkFBa0IsQ0FBQyxDQUFDLEVBQUUsTUFBTSxFQUFFLEtBQUssRUFBRSxDQUFDLENBQUMsS0FBSyxFQUFFLENBQUMsQ0FBQyxLQUFLLENBQUMsQ0FBQztJQUN6RSxNQUFNLElBQUksR0FBRyxPQUFPLENBQUMsSUFBSSxDQUFDLEdBQUcsQ0FBQyxDQUFDLENBQUMsTUFBTSxDQUFDLENBQUMsTUFBTSxDQUFDO0lBQzlDLE1BQU0sT0FBTyxHQUFHLFNBQVMsQ0FBQyxJQUFJLEVBQUUsTTFBTSxFQUFFLEtBQUssRUFBRSxDQUFDLENBQUMsS0FBSyxFQUFFLENBQUMsQ0FBQyxLQUFLLENBQUMsQ0FBQztJQUNoRSxPQUFPLE9BQU8sQ0FBQyxjQUFjLENBQUMsS0FBSyxFQUFFLENBQUMsQ0FBQyxLQUFLLEVBQUUsT0FBTyxDQUFDLENBQUM7QUFDM0QsQ0FBQztBQUNELE1BQU0sQ0FBQyxNQUFNLFdBQVcsR0FBRztJQUN2QixVQUFVLEVBQUUsS0FBSztJQUNqQixXQUFXLEVBQUUsS0FBSztJQUNsQixVQUFVLEVBQUUsS0FBSztDQUNwQixDQUFDIn0=

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2xpY2VfdXRpbC5jb21wdXRlRmxhdE9mZnNldChiZWdpbiwgeFN0cmlkZXMpO1xuICAgIGNvbnN0IHN
hdE9mZnNldCwgZmxhdE9mZnNldCArIGxlbmd0aCk7

wgYXR0cnN9ID0gYXJncztcbiAgY29uc3Qge3h9ID0gaW5wdXRzO1xuICBjb25zdCB7YmVnaW4sIHNpemV9ID0gYXR0cnM7XG5cbiAgYXNzZXJ0Tm90Q29tcGxleCh4LCAnc2xpY2UnKTtcblxuICBjb25zdCBbJGJlZ2luLCAkc2l6ZV0gPSBzbGljZV91dGlsLnBhcnNlU2xpY2VQYXJhbXMoeCwgYmVnaW4sIHNpemUpO1xuXG4gIGNvbnN0IGlzQ29udGlub3VzID0gc2xpY2VfdXRpbC5pc1NsaWNlQ29udGlub3VzKHguc2hhcGUsICRiZWdpbiwgJHNpemUpO1xuICBjb25zdCB4VmFscyA9IGJhY2tlbmQucmVhZFN5bmMoeC5kYXRhSWQpO1xuICBjb25zdCBvdXQgPSBiYWNrZW5kLm1ha2VPdXRwdXQoJHNpemUsIHguZHR5cGUpO1xuICBjb25zdCB4U3RyaWRlcyA9IHV0aWwuY29tcHV0ZVN0cmlkZXMoeC5zaGFwZSk7XG4gIGNvbnN0IG91dERhdGEgPSBiYWNrZW5kLmRhdGFJZE1hcC5nZXQob3V0LmRhdGFJZCk7XG5cbiAgaWYgKGlzQ29udGlub3VzKSB7XG4gICAgY29uc3QgZmxhdE9mZnNldCA9IHNsaWNlX3V0aWwuY29tcHV0ZUZsYXRPZmZzZXQoJGJlZ2luLCB4U3RyaWRlcyk7XG5cbiAgICBpZiAoeC5kdHlwZSA9PT0gJ3N0cmluZycpIHtcbiAgICAgIG91dERhdGEuc3RyaW5nQnl0ZXMgPVxuICAgICAgICAgICh4VmFscyBhcyBVaW50OEFycmF5W10pXG4gICAgICAgICAgICAgIC5zbGljZShmbGF0T2Zmc2V0LCBmbGF0T2Zmc2V0ICtcbiAgICAgICAgICAgICAgICAgIHV0aWwuc2l6ZUZyb21TaGFwZSgkc2l6ZV8pKTtcbiAgICB9IGVsc2Uge1xuICAgICAgY29uc3Qgb3V0VmFscyA9IGJhY2tlbmQudHlwZWRBcnJheUZyb21IZWFwKG91dCk7XG4gICAgICBvdXRWYWxzLnNldChcbiAgICAgICAgICAoeFZhbHMgYXMgVHlwZWRBcnJheSlcbiAgICAgICAgICAgICAgLnN1YmFycmF5KGZsYXRPZmZzZXQsIGZsYXRPZmZzZXQgK1xuICAgICAgICAgICAgICAgICAgdXRpbC5zaXplRnJvbVNoYXBlKCRzaXplXykpKTtcbiAgICB9XG5cbiAgICByZXR1cm4gb3V0O1xuICB9XG5cbiAgaWYgKHguZHR5cGUgPT09ICdzdHJpbmcnKSB7XG4gICAgY29uc3QgcmVzID1cbiAgICAgICAgc2xpY2VJbXBsQ1BVKHhWYWxzLCAkYmVnaW4sICRzaXplLCB4LnNoYXBlLCB4LmR0eXBlKTtcbiAgICBvdXREYXRhLnN0cmluZ0J5dGVzID0gcmVzIGFzIFVpbnQ4QXJyYXlbXTtcbiAgICByZXR1cm4gb3V0O1xuICB9XG5cbiAgY29uc3Qgb3V0VmFscyA9IGJhY2tlbmQudHlwZWRBcnJheUZyb21IZWFwKG91dCk7XG4gIGNvbnN0IHJhbmsgPSB4LnNoYXBlLmxlbmd0aDtcbiAgaWYgKHJhbmsgPT09IDIpIHtcbiAgICBzbGljZTJkKFxuICAgICAgICB4VmFscyBhcyBUeXBlZEFycmF5LCB4U3RyaWRlc1swXSwgb3V0VmFscywgJGJlZ2luIGFzIFtudW1iZXIsIG51bWJlcl0sXG4gICAgICAgICRzaXplIGFzIFtudW1iZXIsIG51bWJlcl0pO1xuICB9IGVsc2UgaWYgKHJhbmsgPT09IDMpIHtcbiAgICBzbGljZTNkKFxuICAgICAgICB4VmFsc1xuICAgICAgICAgICAgYXMgVHlwZWRBcnJheSwgeFN0cmlkZXNbMF0sIHhTdHJpZGVzWzFdLCBvdXRWYWxzLFxuICAgICAgICAkYmVnaW4gYXMgW251bWJlciwgbnVtYmVyLCBudW1iZXJdLCAkc2l6ZSBhcyBbbnVtYmVyLFxuICAgICAgICBudW1iZXIsIG51bWJlcl0pO1xuICB9IGVsc2UgaWYgKHJhbmsgPT09IDQpIHtcbiAgICBzbGljZTRkKFxuICAgICAgICB4VmFscyBhcyBUeXBlZEFycmF5LCB4U3RyaWRlc1swXSwgeFN0cmlkZXNbMV0sXG4gICAgICAgIHhTdHJpZGVzWzJdLCBvdXRWYWxzLFxuICAgICAgICAkYmVnaW4gYXMgW251bWJlciwgbnVtYmVyLCBudW1iZXIsIG51bWJlcl0sXG4gICAgICAgICRzaXplIGFzIFtudW1iZXIsIG51bWJlciwgbnVtYmVyLFxuICAgICAgICBudW1iZXJdKTtcbiAgfSBlbHNlIHtcbiAgICBjb25zdCByZXMgPVxuICAgICAgICBzbGljZUltcGxDUFUoeFZhbHMsICRiZWdpbiwgJHNpemUsIHguc2hhcGUsIHguZHR5cGUpIGFzIFR5cGVkQXJyYXk7XG4gICAgb3V0VmFscy5zZXQocmVzKTtcbiAgfVxuXG4gIHJldHVybiBvdXQ7XG59XG5cbmZ1bmN0aW9uIHNsaWNlMmQoXG4gICAgeFZhbHM6IGJhY2tlbmRfdXRpbC5UeXBlZEFycmF5LCB4U3RyaWRlOiBudW1iZXIsXG4gICAgb3V0VmFsczogYmFja2VuZF91dGlsLlR5cGVkQXJyYXksIGJlZ2luOiBbbnVtYmVyLCBudW1iZXJdLFxuICAgIHNpemU6IFtudW1iZXIsIG51bWJlcl0pOiB2b2lkIHtcbiAgbGV0IG91dE9mZnNldCA9IDA7XG4gIGNvbnN0IGJlZ2luSSA9IGJlZ2luWzBdO1xuICBjb25zdCBiZWdpbkogPSBiZWdpblsxXTtcbiAgY29uc3QgZW5kSSA9IGJlZ2luSSArIHNpemVbMF07XG4gIGZvciAobGV0IGkgPVxuICAgICAgIGJlZ2luSTsgaSA8IGVuZEk7IGkrKykge1xuICAgIGNvbnN0IHhPZmZzZXQgPSBpICogeFN0cmlkZSArIGJlZ2luSjtcbiAgICBvdXRWYWxzLnNldCh4VmFscy5zdWJhcnJheSh4T2Zmc2V0LCB4T2Zmc2V0ICtcbiAgICAgICAgc2l6ZVsxXSksIG91dE9mZnNldCk7XG4gICAgb3V0T2Zmc2V0ICs9IHNpemVbMV07XG4gIH1cbn1cblxuZnVuY3Rpb25cbiBzbGljZTNkKFxuICAgIHhWYWxzOiBiYWNrZW5kX3V0aWwuVHlwZWRBcnJheSwgeFN0cmlkZTE6IG51bWJlciwgeFN0cmlkZTI6IG51bWJlcixcbiAgICBvdXRWYWxzOlxuICAgICAgICBiYWNrZW5kX3V0aWwuVHlwZWRBcnJheSwgYmVnaW46IFtudW1iZXIsIG51bWJlciwgbnVtYmVyXSxcbiAgICBzaXplOiBbbnVtYmVyLCBudW1iZXIsIG51bWJlcl0pOiB2b2lkIHtcbiAgbGV0XG4gICAgICAgIG91dE9mZnNldCA9IDA7XG4gIGNvbnN0IGJlZ2luSSA9IGJlZ2luWzBdO1xuICBjb25zdCBiZWdpbkogPSBiZWdpblsxXTtcbiAgY29uc3QgYmVnaW5LID0gYmVnaW5bMl07XG4gIGNvbnN0IGVuZEkgPVxuICAgICAgICBiZWdpbkkgKyBzaXplWzBdO1xuICBjb25zdCBlbmRKID0gYmVnaW5KICsgc2l6ZVsxXTtcbiAgZm9yIChsZXQgaSA9IGJlZ2luSTsgaSA8XG4gICAgICAgIGVuZEk7IGkrKykge1xuICAgIGZvciAobGV0IGogPSBiZWdpbko7IGogPFxuICAgICAgICBlbmRKOyBqKyspIHtcbiAgICAgIGNvbnN0IHhPZmZzZXQgPSBpICogeFN0cmlkZTEgKyBqICogeFN0cmlkZTIgKyBiZWdpbks7XG4gICAgICBvdXRWYWxzLnNldCh4VmFscy5zdWJhcnJheSh4T2Zmc2V0LFxuICAgICAgICAgIHhPZmZzZXQgKyBzaXplWzJdKSwgb3V0T2Zmc2V0KTtcbiAgICAgIG91dE9mZnNldCArPSBzaXplWzJdO1xuICAgIH1cbiAgfVxufVxuXG5mdW5jdGlvbiBzbGljZTRkKFxuICAgIHhWYWxzOlxuICAgICAgICBiYWNrZW5kX3V0aWwuVHlwZWRBcnJheSwgeFN0cmlkZTE6IG51bWJlciwgeFN0cmlkZTI6IG51bWJlcixcbiAgICB4U3RyaWRlMzogbnVtYmVyLCBvdXRWYWxzOg==

backend_util.TypedArray,\n begin: [number, number, number, number],\n size: [number, number, number, number]): void {\n let outOffset = 0;\n const beginI = begin[0];\n const beginJ = begin[1];\n const beginK = begin[2];\n
  const endI = beginI + size[0];\n const endJ = beginJ + size[1];\n const endK = beginK + size[2];\n const beginL = begin[3];\n\n for (let i = beginI; i < endI; i++) {\n   for (let j = beginJ; j < endJ; j++) {\n   for (let k = beginK; k < endK; k++) {\n   const xOffset = i * xStride1 + j * xStride2 + k * xStride3 + beginL;\n outVals.set(xVals.subarray(xOffset, xOffset + size[3]), outOffset);\n   outOffset += size[3];\n   }\n   }\n }\n}\n\nexport const sliceConfig: KernelConfig = {\n kernelName: Slice,\n backendName: 'wasm',\n kernelFunc: slice as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2021 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed
 under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n */\n\nimport {backend_util, BatchToSpaceND, BatchToSpaceNDAttrs, BatchToSpaceNDInputs, KernelConfig, KernelFunc} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {reshape} from './Reshape';\nimport {slice} from './Slice';\nimport {transpose} from './Transpose';\n\nfunction batchToSpaceND(args: {\n inputs: BatchToSpaceNDInputs,\n backend: BackendWasm,\n attrs: BatchToSpaceNDAttrs\n}) {\n const {inputs, backend, attrs} = args;\n const {x} = inputs;\n const {blockShape, crops} = attrs;\n\n const prod = blockShape.reduce((a, b) => a * b);\n\n const reshaped = backend_util.getReshaped(x.shape, blockShape, prod);\n const
 permuted = backend_util.getPermuted(reshaped.length, blockShape.length);\n const reshapedPermuted =\n backend_util.getReshapedPermuted(x.shape, blockShape, prod);\n const sliceBeginCoords =\n backend_util.getSliceBeginCoords(crops, blockShape.length);\n const sliceSize =\n backend_util.getSliceSize(reshapedPermuted, crops, blockShape.length);\n\n const xReshaped = reshape({inputs: {x}, backend, attrs: {shape: reshaped}});\n const xTransposed =\n   transpose({inputs: {x: xReshaped}, backend, attrs: {perm: permuted}});\n const xTransposedReshaped = reshape(\n   {inputs: {x: xTransposed}, backend, attrs: {shape: reshapedPermuted}});\n const result = slice({\n   inputs: {x: xTransposedReshaped},\n   backend,\n   attrs: {begin: sliceBeginCoords, size: sliceSize}\n });\n\n backend.disposeData(xReshaped.dataId);\n backend.disposeData(xTransposed.dataId);\n backend.disposeData(xReshaped.dataId);\n\n return result;\n}\n\nexport const batchToSpaceNDConfig: KernelConfig
 = {\n kernelName: BatchToSpaceND,\n backendName: 'wasm',\n kernelFunc: batchToSpaceND as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n */\n\nimport {Cast, CastAttrs, CastInputs, KernelConfig, KernelFunc} from '@tensorflow/tfjs-core';\nimport {TensorInfo} from '@tensorflow/tfjs-core';\n\nimport
 {BackendWasm} from '../backend_wasm';\n\nexport function cast(\n args: {inputs: CastInputs, attrs: CastAttrs, backend: BackendWasm}):\n TensorInfo {\n const {inputs: {x}, attrs: {dtype}, backend} = args;\n const out = backend.makeOutput(x.shape, dtype);\n const inVals = backend.typedArrayFromHeap(x);\n const outVals =

backend.typedArrayFromHeap(out);\n outVals.set(inVals);\n return out;\n}\n\nexport const castConfig: KernelConfig = {\n kernelName: Cast,\n backendName: 'wasm',\n kernelFunc: cast as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2021 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n
 * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n
*/\nimport {KernelConfig, Ceil} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\n\nexport const ceilConfig: KernelConfig = createUnaryKernelConfig(Ceil);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n
 * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n
/\n\nimport {ClipByValue, ClipByValueAttrs, ClipByValueInputs, KernelConfig, KernelFunc} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmClip: (xId: number, min: number, max: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmClip = backend.wasm.cwrap(ClipByValue, null / void */, [\n   'number', // x_id\n   'number', // min\n   'number', // max\n   'number'   // out_id\n]);\n}\n\nfunction clip(args: {\n inputs: ClipByValueInputs,\n backend: BackendWasm,\n attrs: ClipByValueAttrs\n}) {\n const {inputs, backend, attrs} = args;\n const {x} = inputs;\n const {clipValueMin, clipValueMax} = attrs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n const out = backend.makeOutput(x.shape, x.dtype);\n const outId = backend.dataIdMap.get(out.dataId).id;\n
  wasmClip(xId, clipValueMin, clipValueMax, outId);\n return out;\n}\n\nexport const clipByValueConfig: KernelConfig = {\n kernelName: ClipByValue,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: clip as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n
*/\n\nimport
 {backend_util, Concat, ConcatAttrs, ConcatInputs, KernelConfig, KernelFunc, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\nimport {concatImplCPU} from '../kernel_utils/shared';\nimport {identity} from './Identity';\nimport {reshape} from './Reshape';\n\nexport function concat(\n   args: {inputs: ConcatInputs, backend: BackendWasm, attrs: ConcatAttrs}) {\n const {inputs, backend} = args;\n\n const axis = util.parseAxisParam(args.attrs.axis, inputs[0].shape)[0];\n\n let outShape = backend_util.computeOutShape(inputs.map(t => t.shape), axis);\n\n // Keep only non-empty tensors (ignore tensors with 0 in their shape).\n const $inputs = inputs.filter(t => util.sizeFromShape(t.shape) > 0);\n if ($inputs.length === 1) {\n   return identity({inputs: {x: $inputs[0]}, backend});\n }\n\n const out = backend.makeOutput(outShape, inputs[0].dtype);\n\n if (util.sizeFromShape(outShape) === 0) {\n   return out;\n }\n\n const shapes = $inputs.map(t

=> t.shape);\n backend_util.assertParamsConsistent(shapes, axis);\n\n if ($inputs[0].dtype === 'string') {\n   // Any concat of n-dimensional tensors across any axis can be reduced to\n   // a concatenation of two-dimensional tensors across the axis 1 by first\n   // partitioning the axes of the original tensors into those less than the\n   // axis to be concatenated and the rest. Then reshape the tensors\n   // into a two-dimensional tensor by collapsing these two sets of axes and\n   // concatenate the resulting matrices across the axis 1, finally reshaping\n   // the result to have the proper shape.\n   const inputs2D = $inputs.map(t => {\n   const innerSize = util.sizeFromShape(t.shape.slice(axis));\n   const shape = [-1, innerSize];\n   return reshape({inputs: {x: t}, backend, attrs: {shape}});\n   });\n\n   const inputsValShapes = inputs2D.map(t => {\n   return {vals: backend.readSync(t.dataId), shape: t.shape};\n   });\n\n   // Concats 2d tensors along axis=1.\n   outShape =\n   backend_util.computeOutShape(inputs2D.map(t => t.shape), 1 /* axis */);\n   const simplyConcat = inputs2D[0].shape[0] === 1;\n   const outVals = concatImplCPU(\n   inputsValShapes, outShape, inputs[0].dtype,\n   simplyConcat) as string[];\n\n   const finalOutShape =\n   backend_util.computeOutShape($inputs.map(t => t.shape), axis);\n\n   out.shape = finalOutShape;\n   const outData = backend.dataIdMap.get(out.dataId);\n   outData.stringBytes = backend_util.fromStringArrayToUint8(outVals);\n\n   inputs2D.forEach(t => backend.disposeData(t.dataId));\n\n   return out;\n }\n\n const batchDim = util.sizeFromShape($inputs[0].shape.slice(0, axis));\n let sumInnerDims = 0;\n const innerDims = $inputs.map(input => {\n   const innerDim = util.sizeFromShape(input.shape.slice(axis));\n   sumInnerDims += innerDim;\n   return innerDim;\n });\n const inVals = $inputs.map(input => backend.typedArrayFromHeap(input));\n const outVals = backend.typedArrayFromHeap(out);\n for (let b = 0; b < batchDim; b++) {\n   let outOffset = b * sumInnerDims;\n   for (let i = 0; i < inVals.length; i++) {\n   const innerDim = innerDims[i];\n   const inOffset = b * innerDim;\n   const vals = inVals[i].subarray(inOffset, inOffset + innerDim);\n   outVals.set(vals, outOffset);\n   outOffset += innerDim;\n   }\n }\n return out;\n}\n\nexport const concatConfig: KernelConfig = {\n kernelName: Concat,\n backendName: 'wasm',\n kernelFunc: concat as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ===\n */\n\nimport {backend_util, Conv2D, Conv2DAttrs, Conv2DInputs, KernelConfig, KernelFunc, Tensor4D} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmConv2d: (\n   xId: number, batchSize: number, inputHeight: number, inputWidth: number,\n   filterId: number, filterHeight: number, filterWidth: number, padTop: number,\n   padRight: number, padBottom: number, padLeft: number, isSamePad: number,\n   dilationHeight: number, dilationWidth: number, strideHeight: number,\n   strideWidth: number, inputChannels: number, outputChannels: number,\n   outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmConv2d = backend.wasm.cwrap(Conv2D, null /* void */, [\n   'number', // xId\n   'number', // batchSize\n   'number', // inputHeight\n   'number', // inputWidth\n   'number', // filterId\n   'number', // filterHeight\n   'number', // filterWidth\n   'number', // padTop\n   'number', // padRight\n   'number', // padBottom\n   'number', // padLeft\n   'number', // isSamePad\n   'number', // dilationHeight\n   'number', // dilationWidth\n   'number', // strideHeight\n   'number', // strideWidth\n   'number', // inputChannels\n   'number', // outputChannels\n   'number', // outId\n]);\n}\n\nfunction conv2d(\n   args: {inputs: Conv2DInputs, backend: BackendWasm, attrs: Conv2DAttrs}) {\n const {inputs, attrs, backend} = args;\n\n const {x, filter} = inputs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n const filterId = backend.dataIdMap.get(filter.dataId).id;\n\n const {strides, dilations, pad, dimRoundingMode, dataFormat} = attrs;\n const $dataFormat =

backend_util.convertConv2DDataFormat(dataFormat);\n
const convInfo = backend_util.computeConv2DInfo(\n (x as Tensor4D).shape, (filter as Tensor4D).shape, strides, dilations,\n pad, dimRoundingMode, false, $dataFormat);\n\n const filterHeight = convInfo.filterHeight;\n const filterWidth = convInfo.filterWidth;\n const padTop = convInfo.padInfo.top;\n const padRight = convInfo.padInfo.right;\n const padBottom = convInfo.padInfo.bottom;\n const padLeft = convInfo.padInfo.left;\n const dilationHeight = convInfo.dilationHeight;\n const dilationWidth = convInfo.dilationWidth;\n const strideHeight = convInfo.strideHeight;\n const strideWidth = convInfo.strideWidth;\n const inputChannels = convInfo.inChannels;\n const outputChannels = convInfo.outChannels;\n const isSamePad = convInfo.padInfo.type === 'SAME' ? 1 : 0;\n\n if (convInfo.dataFormat !== 'channelsLast') {\n throw new Error(\n `wasm backend Conv2D does not support dataFormat:'` +\n `${convInfo.dataFormat}'. Please use 'channelsLast'.`);\n }\n\n const out = backend.makeOutput(convInfo.outShape, 'float32');\n const outId = backend.dataIdMap.get(out.dataId).id;\n wasmConv2d(\n xId, x.shape[0], x.shape[1], x.shape[2], filterId, filterHeight,\n filterWidth, padTop, padRight, padBottom, padLeft, isSamePad,\n dilationHeight, dilationWidth, strideHeight, strideWidth, inputChannels,\n outputChannels, outId);\n return out;\n}\n\nexport const conv2DConfig: KernelConfig = {\n kernelName: Conv2D,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: conv2d as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==*/\n\nimport {backend_util, Conv2DBackpropInput, Conv2DBackpropInputAttrs, Conv2DBackpropInputInputs, KernelConfig, KernelFunc, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmConv2DBackpropInput: (\n dyId: number, filterId: number, batchSize: number, filterHeight: number,\n filterWidth: number, inHeight: number, inWidth: number, inChannels: number,\n outHeight: number, outWidth: number, outChannels: number,\n strideHeight: number, strideWidth: number, topPad: number, leftPad: number,\n fltS0: number, fltS1: number, fltS2: number, xBatchStride: number,\n xRowStride: number, xColStride: number, xChannelStride: number,\n yBatchStride: number, yRowStride: number, yColStride: number,\n yChannelStride: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n wasmConv2DBackpropInput = backend.wasm.cwrap(Conv2DBackpropInput, null, [\n 'number', // dyId\n 'number', // filterId\n 'number', // batchSize\n 'number', // filterHeight\n 'number', // filterWidth\n 'number', // inHeight\n 'number', // inWidth\n 'number', // inChannels\n 'number', // outHeight\n 'number', // outWidth\n 'number', // outChannels\n 'number', // strideHeight\n 'number', // strideWidth\n 'number', // topPad\n 'number', // leftPad\n 'number', // fltS0\n 'number', // fltS1\n 'number', // fltS2\n 'number', // xBatchStride\n 'number', // xRowStride\n 'number', // xColStride\n 'number', // xChannelStride\n 'number', // yBatchStride\n 'number', // yRowStride\n 'number', // yColStride\n 'number', // yChannelStride\n 'number', // outId\n]);\n}\n\nfunction conv2DBackpropInput(args: {\n backend: BackendWasm,\n inputs: Conv2DBackpropInputInputs,\n attrs: Conv2DBackpropInputAttrs\n}): TensorInfo {\n const {backend, inputs, attrs} = args;\n const {dy, filter} = inputs;\n const {strides, pad, dataFormat, dimRoundingMode, inputShape} = attrs;\n\n const dilations = 1;\n\n const $dataFormat = backend_util.convertConv2DDataFormat(dataFormat);\n const convInfo = backend_util.computeConv2DInfo(\n inputShape, filter.shape as [number, number, number, number], strides,\n dilations, pad, dimRoundingMode, false /* depthwise */, $dataFormat);\n const {\n batchSize,\n filterHeight,\n filterWidth,\n inChannels,\n

inHeight,\n inWidth,\n outChannels,\n outHeight,\n outWidth,\n strideHeight,\n strideWidth\n } = convInfo;\n\n const topPad = filterHeight - 1 - convInfo.padInfo.top;\n const leftPad = filterWidth - 1 - convInfo.padInfo.left;\n\n
const isChannelsLast = convInfo.dataFormat === 'channelsLast';\n const dxStrides = util.computeStrides(convInfo.inShape);\n const dyStrides = util.computeStrides(dy.shape);\n const [fltS0, fltS1, fltS2] = util.computeStrides(filter.shape);\n const xBatchStride = dxStrides[0];\n const xRowStride = isChannelsLast ? dxStrides[1] : dxStrides[2];\n const xColStride = isChannelsLast ? dxStrides[2] : 1;\n const xChannelStride = isChannelsLast ? 1 : dxStrides[1];\n const yBatchStride = dyStrides[0];\n const yRowStride = isChannelsLast ? dyStrides[1] : dyStrides[2];\n const yColStride = isChannelsLast ? dyStrides[2] : 1;\n const yChannelStride = isChannelsLast ? 1 : dyStrides[1];\n\n const out = backend.makeOutput(convInfo.inShape, 'float32');\n const outId = backend.dataIdMap.get(out.dataId).id;\n const dyId = backend.dataIdMap.get(dy.dataId).id;\n const filterId = backend.dataIdMap.get(filter.dataId).id;\n\n wasmConv2DBackpropInput(\n dyId, filterId, batchSize,
filterHeight, filterWidth, inHeight, inWidth,\n inChannels, outHeight, outWidth, outChannels, strideHeight, strideWidth,\n topPad, leftPad, fltS0, fltS1, fltS2, xBatchStride, xRowStride,\n xColStride, xChannelStride, yBatchStride, yRowStride, yColStride,\n yChannelStride, outId);\n return out;\n}\n\nexport const conv2DBackpropInputConfig: KernelConfig = {\n kernelName: Conv2DBackpropInput,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: conv2DBackpropInput as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES
OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n */\n\nimport {Cos, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\n\nexport const cosConfig: KernelConfig = createUnaryKernelConfig(Cos);\n","/**\n * @license\n * Copyright 2021 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the
specific language governing permissions and\n * limitations under the License.\n *
==\n */\nimport {Cosh, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\n\nexport const coshConfig: KernelConfig = createUnaryKernelConfig(Cosh);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n */\n\nimport {CropAndResize, CropAndResizeAttrs, CropAndResizeInputs, KernelConfig, KernelFunc, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {cast} from './Cast';\n\n// Must match enum in CropAndResize.cc\nenum InterpolationMethod {\n bilinear = 0,\n nearest

= 1\n}\n\nlet wasmCropAndResize: (\n imagesId: number, boxesId: number, boxIndId: number, numBoxes: number,\n imagesShape: Uint8Array, cropHeight: number, cropWidth: number,\n method: number, extrapolationValue: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n wasmCropAndResize = backend.wasm.cwrap(CropAndResize, null /*void*/, [\n 'number', // imagesId\n 'number', // boxesId\n 'number', // boxIndId\n 'number', // numBoxes\n 'array', // images shape\n 'number', // cropHeight\n 'number', // cropWidth\n 'number', // method\n
'number', // extrapolation value\n 'number' // out id\n]);\n}\n\nfunction cropAndResize(args: {\n backend: BackendWasm,\n inputs: CropAndResizeInputs,\n attrs: CropAndResizeAttrs\n}): TensorInfo {\n const {backend, inputs, attrs} = args;\n const {method, extrapolationValue, cropSize} = attrs;\n const {image, boxes, boxInd} = inputs;\n\n const numBoxes = boxes.shape[0];\n\n const [cropHeight, cropWidth] = cropSize as [number, number];\n const outShape = [numBoxes, cropHeight, cropWidth, image.shape[3]];\n\n let imagesData = backend.dataIdMap.get(image.dataId);\n let castedData;\n if (image.dtype !== 'float32') {\n castedData = cast({backend, inputs: {x: image}, attrs: {dtype: 'float32'}});\n imagesData = backend.dataIdMap.get(castedData.dataId);\n }\n\n const imagesId = imagesData.id;\n const boxesId = backend.dataIdMap.get(boxes.dataId).id;\n const boxIndId = backend.dataIdMap.get(boxInd.dataId).id;\n\n const out = backend.makeOutput(outShape, 'float32');\n
const outId = backend.dataIdMap.get(out.dataId).id;\n\n const imagesShapeBytes = new Uint8Array(new Int32Array(image.shape).buffer);\n\n wasmCropAndResize(\n imagesId, boxesId, boxIndId, numBoxes, imagesShapeBytes, cropHeight,\n cropWidth,\n InterpolationMethod[method as {} as keyof typeof InterpolationMethod],\n extrapolationValue, outId);\n\n if (castedData != null) {\n backend.disposeData(castedData.dataId);\n }\n\n return out;\n}\n\nexport const cropAndResizeConfig: KernelConfig = {\n kernelName: CropAndResize,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: cropAndResize as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable
law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==\n */\n\nimport {backend_util, KernelConfig, KernelFunc, Cumsum, CumsumAttrs, CumsumInputs, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {CppDType} from './types';\n\nimport {transpose} from './Transpose';\n\nlet wasmCumsum: (xId: number, exclusive: number, reverse: number,\n finalDim: number, outId: number, dtype: CppDType) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmCumsum = backend.wasm.cwrap(Cumsum, null /* void */, [\n 'number', // x_id\n 'number', // exclusive\n 'number', // reverse\n 'number', // final_dim\n
'number', // out_id\n 'number' // dtype\n]);\n}\n\nexport function cumsum(\n args: {inputs: CumsumInputs, backend: BackendWasm, attrs: CumsumAttrs}):\nTensorInfo {\n const {inputs, backend, attrs} = args;\n const {x} = inputs;\n const {axis, exclusive, reverse} = attrs;\n const xRank = x.shape.length;\n\n util.assert(x.dtype === 'float32' || x.dtype === 'int32',\n () => `cumsum does not support ${x.dtype} tensors in the WASM backend`);\n // permute required axis to inner most axis\n const permutation = backend_util.getAxesPermutation([axis], xRank);\n let permutedX = x;\n if (permutation !== null) {\n permutedX = transpose({inputs: {x}, attrs: {perm: permutation}, backend});\n }\n const permutedAxis = backend_util.getInnerMostAxes(1, xRank)[0];\n backend_util.assertAxesAreInnerMostDims('cumsum', [permutedAxis], xRank);\n\n const permutedOut = backend.makeOutput(permutedX.shape, permutedX.dtype);\n const finalDim = permutedX.shape[permutedAxis];\n const permutedXId
= backend.dataIdMap.get(permutedX.dataId).id;\n const permutedOutId = backend.dataIdMap.get(permutedOut.dataId).id;\n wasmCumsum(permutedXId, exclusive ? 1 : 0, reverse ? 1 : 0,

finalDim,\n permutedOutId, CppDType[x.dtype]);\n\n // transpose data back if permuted\n let out = permutedOut;\n if (permutation !== null) {\n const undoPermutation = backend_util.getUndoAxesPermutation(permutation);\n out = transpose(\n {inputs: {x: permutedOut}, attrs: {perm: undoPermutation}, backend});\n backend.disposeData(permutedX.dataId);\n backend.disposeData(permutedOut.dataId);\n }\n return out;\n}\n\nexport const cumsumConfig: KernelConfig = {\n kernelName: Cumsum,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: cumsum as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {DepthToSpace, DepthToSpaceAttrs, DepthToSpaceInputs, KernelConfig, KernelFunc, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmDepthToSpace: (\n xId: number, blockSize: number, channelsLast: number, xStrides: Uint8Array,\n xStridesLength: number, outputShape: Uint8Array, outputStrides: Uint8Array,\n outSize: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n wasmDepthToSpace = backend.wasm.cwrap(DepthToSpace, null /*void*/, [\n 'number', // xId\n 'number', // blockSize\n 'number', // channelsLast\n 'array', // xStrides\n 'number', // xStridesLength\n 'array', // outputShape\n 'array', // outputStrides\n 'number', // outSize\n 'number', // outId\n]);\n}\n\nexport function depthToSpace(args: {\n backend: BackendWasm,\n inputs: DepthToSpaceInputs,\n attrs: DepthToSpaceAttrs\n}): TensorInfo {\n const {backend, inputs, attrs} = args;\n const {x} = inputs;\n const {blockSize, dataFormat} = attrs;\n\n const batchSize = x.shape[0];\n const inputHeight = (dataFormat === 'NHWC') ? x.shape[1] : x.shape[2];\n const inputWidth = (dataFormat === 'NHWC') ? x.shape[2] : x.shape[3];\n const inputDepth = (dataFormat === 'NHWC') ? x.shape[3] : x.shape[1];\n\n const outputHeight = inputHeight * blockSize;\n const outputWidth = inputWidth * blockSize;\n const outputDepth = inputDepth / (blockSize * blockSize);\n\n const outputShape = (dataFormat === 'NHWC') ?\n [batchSize, outputHeight, outputWidth, outputDepth] :\n [batchSize, outputDepth, outputHeight, outputWidth];\n\n const out = backend.makeOutput(outputShape, 'float32');\n\n const xData = backend.dataIdMap.get(x.dataId);\n const xId = xData.id;\n const xStridesBytes =\n new Uint8Array(new Int32Array(util.computeStrides(x.shape)).buffer);\n\n const outputShapeBytes = new Uint8Array(new Int32Array(outputShape).buffer);\n const outStridesBytes =\n new Uint8Array(new Int32Array(util.computeStrides(outputShape)).buffer);\n\n const outId = backend.dataIdMap.get(out.dataId).id;\n const channelsLast = dataFormat === 'NHWC' ? 1 : 0;\n wasmDepthToSpace(\n xId, blockSize, channelsLast, xStridesBytes, x.shape.length - 1,\n outputShapeBytes, outStridesBytes, outputShape.length, outId);\n\n return out;\n}\n\nexport const depthToSpaceConfig: KernelConfig = {\n kernelName: DepthToSpace,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: depthToSpace as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {backend_util, DepthwiseConv2dNative, DepthwiseConv2dNativeAttrs, DepthwiseConv2dNativeInputs, KernelConfig, KernelFunc, Tensor4D} from '@tensorflow/tfjs-core';\n\nimport

{BackendWasm} from
'../backend_wasm';\n\nlet wasmDepthwiseConv2d: (\n xId: number, batchSize: number, inputHeight: number, inputWidth: number,\n filterId: number, filterHeight: number, filterWidth: number, padTop: number,\n padRight: number, padBottom: number, padLeft: number, isSamePad: number,\n dilationHeight: number, dilationWidth: number, strideHeight: number,\n strideWidth: number, inputChannels: number, outputChannels: number,\n outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmDepthwiseConv2d =\n backend.wasm.cwrap(DepthwiseConv2dNative, null /* void */, [\n 'number', // xId\n 'number', // batchSize\n 'number', // inputHeight\n 'number', // inputWidth\n 'number', // filterId\n 'number', // filterHeight\n 'number', // filterWidth\n 'number', // padTop\n 'number', // padRight\n 'number', // padBottom\n 'number', // padLeft\n 'number', // isSamePad\n 'number',
// dilationHeight\n 'number', // dilationWidth\n 'number', // strideHeight\n 'number', // strideWidth\n 'number', // inputChannels\n 'number', // outputChannels\n 'number', // outId\n]);\n}\n\nfunction depthwiseConv2d(args: {\n inputs: DepthwiseConv2dNativeInputs,\n backend: BackendWasm,\n attrs: DepthwiseConv2dNativeAttrs\n}) {\n const {inputs, attrs, backend} = args;\n\n const {x, filter} = inputs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n const filterId = backend.dataIdMap.get(filter.dataId).id;\n\n const {strides, dilations, pad, dimRoundingMode} = attrs;\n\n const $dilations = dilations == null ? [1, 1] : dilations;\n\n const convInfo = backend_util.computeConv2DInfo(\n (x as Tensor4D).shape, (filter as Tensor4D).shape, strides,\n ($dilations as number | [number, number]), pad, dimRoundingMode,\n true /* depthwise */);\n\n const filterHeight = convInfo.filterHeight;\n const filterWidth
= convInfo.filterWidth;\n const padTop = convInfo.padInfo.top;\n const padRight = convInfo.padInfo.right;\n const padBottom = convInfo.padInfo.bottom;\n const padLeft = convInfo.padInfo.left;\n const dilationHeight = convInfo.dilationHeight;\n const dilationWidth = convInfo.dilationWidth;\n const strideHeight = convInfo.strideHeight;\n const strideWidth = convInfo.strideWidth;\n const inputChannels = convInfo.inChannels;\n const outputChannels = convInfo.outChannels;\n const isSamePad = convInfo.padInfo.type === 'SAME' ? 1 : 0;\n\n if (convInfo.dataFormat !== 'channelsLast') {\n throw new Error(\n `wasm backend DepthwiseConv2dNative does not support dataFormat:'` +\n `${convInfo.dataFormat}'. Please use 'channelsLast'.`);\n }\n\n const out = backend.makeOutput(convInfo.outShape, 'float32');\n const outId = backend.dataIdMap.get(out.dataId).id;\n wasmDepthwiseConv2d(\n xId, x.shape[0], x.shape[1], x.shape[2], filterId, filterHeight,\n filterWidth,
padTop, padRight, padBottom, padLeft, isSamePad,\n dilationHeight, dilationWidth, strideHeight, strideWidth, inputChannels,\n outputChannels, outId);\n return out;\n}\n\nexport const depthwiseConv2dNativeConfig: KernelConfig = {\n kernelName: DepthwiseConv2dNative,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: depthwiseConv2d as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2021 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations
under the License.\n *
==\n */\nimport {Elu, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\n\nexport const eluConfig: KernelConfig = createUnaryKernelConfig(Elu);\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for

the specific language governing permissions and\n * limitations under the License.\n *
==========\n
*/\nimport {Equal, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from
'./binary_kernel';\n\nconst supportsFullBroadcast = false;\nexport const equalConfig: KernelConfig =\n
createBinaryKernelConfig(Equal, supportsFullBroadcast, 'bool');\n","/**\n * @license\n * Copyright 2019 Google
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software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES
OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language
governing permissions and\n * limitations under the License.\n *
==========\n
*/\nimport {Exp, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from
'./unary_kernel';\n\nexport const expConfig: KernelConfig = createUnaryKernelConfig(Exp, 'float32');\n","/**\n *
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2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a
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WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for
the specific language governing permissions and\n * limitations under the License.\n *
==========\n
*/\n\nimport {ExpandDims, ExpandDimsAttrs, ExpandDimsInputs,
KernelConfig, KernelFunc, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from
'../backend_wasm';\nimport {reshape} from './Reshape';\n\nexport function expandDims(args: {\n inputs:
ExpandDimsInputs,\n attrs: ExpandDimsAttrs,\n backend: BackendWasm\n}) {\n const {inputs, attrs, backend} =
args;\n const {input} = inputs;\n const {dim} = attrs;\n\n const inputRank = input.shape.length;\n const newShape
= input.shape.slice();\n let $dim = dim;\n if (dim < 0) {\n // Negative value is counted from the tail of rank.\n
util.assert(\n -(inputRank + 1) <= dim,\n () => `Axis must be in the interval [${- (inputRank + 1)}, ${\n
inputRank}]`);\n $dim = inputRank + dim + 1;\n }\n newShape.splice($dim, 0, 1);\n\n return reshape({inputs:
{x: input}, backend, attrs: {shape: newShape}});\n}\n\nexport const expandDimsConfig: KernelConfig = {\n
kernelName: ExpandDims,\n backendName: 'wasm',\n kernelFunc: expandDims as {} as KernelFunc,\n};\n","/**\n
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copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable
law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n *
WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for
the specific language governing permissions and\n * limitations under the License.\n *
==========\n
*/\n\nimport {KernelConfig, KernelFunc} from '@tensorflow/tfjs-core';\nimport {Fill, FillAttrs} from
'@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nexport function fill(args: {attrs:
FillAttrs, backend: BackendWasm}) {\n const {attrs: {shape,
value, dtype}, backend} = args;\n const out = backend.makeOutput(shape, dtype);\n const outVals =
backend.typedArrayFromHeap(out);\n outVals.fill(value as number);\n return out;\n}\n\nexport const fillConfig:
KernelConfig = {\n kernelName: Fill,\n backendName: 'wasm',\n kernelFunc: fill as {} as
KernelFunc,\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the
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on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {FlipLeftRight, FlipLeftRightInputs, KernelConfig, KernelFunc, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmFlipLeftRight: (\n xId: number, batch: number, imageHeight: number, imageWidth: number,\n numChannels: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmFlipLeftRight = backend.wasm.cwrap(FlipLeftRight, null /* void */, [\n 'number', // xId\n 'number', // batch\n 'number', // imageHeight\n 'number', // imageWidth\n 'number', // numChannels\n 'number', // outId\n]);\n}\n\nexport function flipLeftRight(\n args: {inputs: FlipLeftRightInputs, backend: BackendWasm}): TensorInfo {\n const {inputs, backend} = args;\n const {image} = inputs;\n\n const out = backend.makeOutput(image.shape, image.dtype);\n const imageId = backend.dataIdMap.get(image.dataId).id;\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n const [batch, imageHeight, imageWidth, numChannels] = image.shape;\n\n wasmFlipLeftRight(\n imageId, batch, imageHeight, imageWidth, numChannels, outId);\n return out;\n}\n\nexport const flipLeftRightConfig: KernelConfig = {\n kernelName: FlipLeftRight,\n backendName: 'wasm',\n kernelFunc: flipLeftRight as {} as KernelFunc,\n setupFunc: setup\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the
License.\n *
==========\n */\nimport {Floor, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\nexport const floorConfig: KernelConfig = createUnaryKernelConfig(Floor);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {FloorDiv, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from './binary_kernel';\n\nconst supportsFullBroadcast = false;\nexport const floorDivConfig: KernelConfig =\n createBinaryKernelConfig(FloorDiv, supportsFullBroadcast);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {FusedBatchNorm, FusedBatchNormAttrs, FusedBatchNormInputs, KernelConfig, KernelFunc, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmBatchNorm: (\n xId: number, meanId: number, varianceId: number, offsetId: number,\n scaleId: number, varianceEpsilon: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n

wasmBatchNorm = backend.wasm.cwrap(\n FusedBatchNorm, null /* void */,\n ['number', 'number', 'number', 'number', 'number', 'number', 'number']);\n}\n\nfunction fusedBatchNorm(args: {\n backend: BackendWasm,\n inputs: FusedBatchNormInputs,\n attrs: FusedBatchNormAttrs\n}): TensorInfo {\n const {backend, inputs, attrs} = args;\n const {varianceEpsilon} = attrs;\n const {x, mean, variance, offset, scale} = inputs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n const meanId = backend.dataIdMap.get(mean.dataId).id;\n const varianceId = backend.dataIdMap.get(variance.dataId).id;\n const offsetId = offset != null ? backend.dataIdMap.get(offset.dataId).id : 0;\n const scaleId = scale != null ? backend.dataIdMap.get(scale.dataId).id : 0;\n\n const out = backend.makeOutput(x.shape, x.dtype);\n // Short-circuit zero-sized tensors.\n if (util.sizeFromShape(x.shape) === 0) {\n return out;\n }\n\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n wasmBatchNorm(\n xId, meanId, varianceId, offsetId, scaleId, varianceEpsilon, outId);\n return out;\n}\n\nexport const fusedBatchNormConfig: KernelConfig = {\n kernelName: FusedBatchNorm,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: fusedBatchNorm as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ===\n */\n\nimport {backend_util, FusedConv2D, FusedConv2DAttrs, FusedConv2DInputs, KernelConfig, KernelFunc, Tensor4D} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {FusableActivation} from './types';\n\nlet wasmFusedConv2d:\n (xId: number, batchSize: number, inputHeight: number, inputWidth: number,\n filterId: number, filterHeight: number, filterWidth: number,\n biasId: number, padTop: number, padRight: number, padBottom: number,\n padLeft: number, isSamePad: number, dilationHeight: number,\n dilationWidth:\n number, strideHeight: number, strideWidth: number,\n inputChannels: number, outputChannels: number, activation: number,\n preluActivationWeightsId: number, leakyreluAlpha: number, outId: number) =>\n void;\n\nfunction setup(backend: BackendWasm) {\n wasmFusedConv2d = backend.wasm.cwrap(FusedConv2D, null /* void */, [\n 'number', // xId\n 'number', // batchSize\n 'number', // inputHeight\n 'number', // inputWidth\n 'number', // filterId\n 'number', // filterHeight\n 'number', // filterWidth\n 'number', // biasId\n 'number', // padTop\n 'number', // padRight\n 'number', // padBottom\n 'number', // padLeft\n 'number', // isSamePad\n 'number', // dilationHeight\n 'number', // dilationWidth\n 'number', // strideHeight\n 'number', // strideWidth\n 'number', // inputChannels\n 'number', // outputChannels\n 'number', // activation\n 'number', // preluActivationWeightsId\n 'number', // leakyreluAlpha\n 'number', // outId\n]);\n}\n\nfunction fusedConv2d(args: {\n inputs: FusedConv2DInputs,\n backend: BackendWasm,\n attrs: FusedConv2DAttrs\n}) {\n const {inputs, attrs, backend} = args;\n const {x, filter, bias, preluActivationWeights} = inputs;\n const {\n strides,\n pad,\n dilations,\n dataFormat,\n dimRoundingMode,\n activation,\n leakyreluAlpha\n } = attrs;\n\n const convInfo = backend_util.computeConv2DInfo(\n (x as Tensor4D).shape, (filter as Tensor4D).shape, strides, dilations,\n pad, dimRoundingMode);\n\n const fusedActivation =\n FusableActivation[activation as {} as keyof typeof FusableActivation];\n if (fusedActivation == null) {\n throw new Error(\n `${activation} activation not yet supported for FusedConv2D ` +\n `in the wasm backend.`);\n }\n\n const xId = backend.dataIdMap.get(x.dataId).id;\n const filterId = backend.dataIdMap.get(filter.dataId).id;\n\n const outputChannels = convInfo.outChannels;\n\n\n let biasId = 0;\n if (bias != null) {\n const biasData = backend.dataIdMap.get(bias.dataId);\n if (biasData.shape.length !== 1) {\n throw new Error(\n `FusedConv2D only supports rank-1 bias but got ` +\n `rank ${biasData.shape.length}.`);\n }\n if (biasData.shape[0] !== outputChannels) {\n throw new

```
Error(\n `FusedConv2D bias shape (${biasData.shape}) does not ` +\n `match the number of output channels (${outputChannels})`);\n }\n biasId = biasData.id;\n }\n\n const filterHeight = convInfo.filterHeight;\n const filterWidth = convInfo.filterWidth;\n const padTop = convInfo.padInfo.top;\n const padRight = convInfo.padInfo.right;\n const padBottom = convInfo.padInfo.bottom;\n const padLeft = convInfo.padInfo.left;\n const dilationHeight = convInfo.dilationHeight;\n const dilationWidth = convInfo.dilationWidth;\n const strideHeight = convInfo.strideHeight;\n const strideWidth = convInfo.strideWidth;\n
 const inputChannels = convInfo.inChannels;\n const isSamePad = convInfo.padInfo.type === 'SAME' ? 1 : 0;\n const batchSize = convInfo.batchSize;\n const inHeight = convInfo.inHeight;\n const inWidth = convInfo.inWidth;\n\n if (dataFormat !== 'NHWC') {\n throw new Error(\n `wasm backend FusedConv2D does not support dataFormat:` +\n `${dataFormat}'. Please use 'NHWC'.`);\n }\n\n const out = backend.makeOutput(convInfo.outShape, 'float32');\n const outId = backend.dataIdMap.get(out.dataId).id;\n const preluActivationWeightsId = preluActivationWeights == null ?\n 0 :\n backend.dataIdMap.get(preluActivationWeights.dataId).id;\n\n wasmFusedConv2d(\n xId, batchSize, inHeight, inWidth, filterId, filterHeight, filterWidth,\n biasId, padTop, padRight, padBottom, padLeft, isSamePad, dilationHeight,\n dilationWidth, strideHeight, strideWidth, inputChannels, outputChannels,\n fusedActivation, preluActivationWeightsId, leakyreluAlpha ||
 0, outId);\n\n return out;\n}\n\nexport const fusedConv2DConfig: KernelConfig = {\n kernelName: FusedConv2D,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: fusedConv2d as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========================================================================\n
*/\n\nimport {backend_util, FusedDepthwiseConv2D, FusedDepthwiseConv2DAttrs,
 FusedDepthwiseConv2DInputs, KernelConfig, KernelFunc, Tensor4D} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {FusableActivation} from './types';\n\nlet wasmFusedDepthwiseConv2d:\n (xId: number, batchSize: number, inputHeight: number, inputWidth: number,\n filterId: number, filterHeight: number, filterWidth: number,\n biasId: number, padTop: number, padRight: number, padBottom: number,\n padLeft: number, isSamePad: number, dilationHeight: number,\n dilationWidth: number, strideHeight: number, strideWidth: number,\n inputChannels: number, outputChannels: number, activation: number,\n preluActivationWeightsId: number, leakyreluAlpha: number, outId: number) =>\n
 void;\n\nfunction setup(backend: BackendWasm) {\n wasmFusedDepthwiseConv2d =\n backend.wasm.cwrap(FusedDepthwiseConv2D, null /* void */, [\n 'number', // xId\n 'number', // batchSize\n 'number', // inputHeight\n
 'number', // inputWidth\n 'number', // filterId\n 'number', // filterHeight\n 'number', // filterWidth\n
 'number', // biasId\n 'number', // padTop\n 'number', // padRight\n 'number', // padBottom\n 'number', // padLeft\n 'number', // isSamePad\n 'number', // dilationHeight\n 'number', // dilationWidth\n 'number', // strideHeight\n 'number', // strideWidth\n 'number', // inputChannels\n 'number', // outputChannels\n 'number', // activation\n 'number', // preluActivationWeightsId\n 'number', // leakyreluAlpha\n 'number', // outId\n ]);\n}\n\nfunction fusedDepthwiseConv2d(args: {\n inputs: FusedDepthwiseConv2DInputs,\n backend: BackendWasm,\n attrs: FusedDepthwiseConv2DAttrs\n}) {\n const {inputs, attrs, backend} = args;\n const {x, filter, bias, preluActivationWeights} = inputs;\n const {\n strides,\n pad,\n dilations,\n
```

```
  dataFormat,\n  dimRoundingMode,\n  activation,\n  leakyreluAlpha\n } = attrs;\n\n const convInfo =
backend_util.computeConv2DInfo(\n    (x as Tensor4D).shape, (filter as Tensor4D).shape, strides, dilations,\n
pad, dimRoundingMode, true /* depthwise */);\n\n const fusedActivation =\n    FusableActivation[activation as {}
as keyof typeof FusableActivation];\n if (fusedActivation == null) {\n  throw new Error(\n      `${activation}
activation not yet supported for FusedDepthwiseConv2D ` +\n      `in the wasm backend.`);\n }\n\n const xId =
backend.dataIdMap.get(x.dataId).id;\n const filterId = backend.dataIdMap.get(filter.dataId).id;\n\n const
outputChannels = convInfo.outChannels;\n\n let biasId = 0;\n if (bias != null) {\n  const biasData =
backend.dataIdMap.get(bias.dataId);\n  if (biasData.shape.length !== 1) {\n    throw new Error(\n
`FusedDepthwiseConv2D only supports rank-1 bias but got ` +\n        `rank ${biasData.shape.length}.`);\n
  }\n  if (biasData.shape[0] !== outputChannels) {\n    throw new Error(\n        `FusedDepthwiseConv2D bias
shape (${biasData.shape}) does not ` +\n        `match the number of output channels (${outputChannels})`);\n  }\n
 biasId = biasData.id;\n }\n\n const filterHeight = convInfo.filterHeight;\n const filterWidth =
convInfo.filterWidth;\n const padTop = convInfo.padInfo.top;\n const padRight = convInfo.padInfo.right;\n const
padBottom = convInfo.padInfo.bottom;\n const padLeft = convInfo.padInfo.left;\n const dilationHeight =
convInfo.dilationHeight;\n const dilationWidth = convInfo.dilationWidth;\n const strideHeight =
convInfo.strideHeight;\n const strideWidth = convInfo.strideWidth;\n const inputChannels =
convInfo.inChannels;\n const isSamePad = convInfo.padInfo.type === 'SAME' ? 1 : 0;\n const batchSize =
convInfo.batchSize;\n const inHeight = convInfo.inHeight;\n const inWidth = convInfo.inWidth;\n\n if
(dataFormat !== 'NHWC') {\n  throw
 new Error(\n      `wasm backend FusedDepthwiseConv2D does not support dataFormat:` +\n      `${dataFormat}'.
Please use 'NHWC'.`);\n }\n\n const out = backend.makeOutput(convInfo.outShape, 'float32');\n const outId =
backend.dataIdMap.get(out.dataId).id;\n const preluActivationWeightsId = preluActivationWeights == null ?\n    0
:\n    backend.dataIdMap.get(preluActivationWeights.dataId).id;\n\n wasmFusedDepthwiseConv2d(\n    xId,
batchSize, inHeight, inWidth, filterId, filterHeight, filterWidth,\n    biasId, padTop, padRight, padBottom, padLeft,
isSamePad, dilationHeight,\n    dilationWidth, strideHeight, strideWidth, inputChannels, outputChannels,\n
fusedActivation, preluActivationWeightsId, leakyreluAlpha || 0, outId);\n\n return out;\n}\n\nexport const
fusedDepthwiseConv2DConfig: KernelConfig = {\n kernelName: FusedDepthwiseConv2D,\n backendName:
'wasm',\n setupFunc: setup,\n kernelFunc: fusedDepthwiseConv2d as {} as KernelFunc\n};\n","/**\n * @license\n
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agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n *
WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for
the specific language governing permissions and\n * limitations under the License.\n *
==========================================================================\n
*/\n\nimport {gather_util, GatherNd, GatherNdInputs, KernelConfig, TensorInfo} from '@tensorflow/tfjs-
core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {CppDType} from './types';\n\nlet
wasmGatherNd: (\n  xId: number, dtype: CppDType, indicesId: number, numSlices: number,\n
 sliceRank: number, sliceSize: number, strides: Uint8Array, outId: number) =>\n  void;\n\nfunction
setup(backend: BackendWasm): void {\n wasmGatherNd = backend.wasm.cwrap(GatherNd, null /*void*/, [\n
'number',  // xId\n  'number',  // dtype\n  'number',  // indicesId\n  'number',  // numSlices\n  'number',  //
sliceRank\n  'number',  // sliceSize\n  'array',  // strides\n  'number'  // outId\n ]);\n}\n\nfunction gatherNd(args:
{backend: BackendWasm, inputs: GatherNdInputs}):\n  TensorInfo {\n const {backend, inputs} = args;\n const
{params, indices} = inputs;\n\n const [resultShape, numSlices, sliceSize, strides] =\n
gather_util.prepareAndValidate(params, indices);\n\n const out = backend.makeOutput(resultShape,
params.dtype);\n if (numSlices === 0) {\n  return out;\n }\n\n const indicesShape = indices.shape;\n const
sliceRank = indicesShape[indicesShape.length - 1];\n\n const xData = backend.dataIdMap.get(params.dataId);\n
const xId = xData.id;\n
```

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  const indicesData = backend.dataIdMap.get(indices.dataId);\n  const indicesId = indicesData.id;\n\n  const stridesBytes = new Uint8Array(new Int32Array(strides).buffer);\n\n  const outId = backend.dataIdMap.get(out.dataId).id;\n  wasmGatherNd(\n      xId, CppDType[params.dtype], indicesId, numSlices, sliceRank, sliceSize,\n      stridesBytes, outId);\n\n  return out;\n}\n\nexport const gatherNdConfig: KernelConfig = {\n  kernelName: GatherNd,\n  backendName: 'wasm',\n  setupFunc: setup,\n  kernelFunc: gatherNd\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES
  OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========================================================================\n
*/\n\nimport {backend_util, GatherV2, GatherV2Attrs, GatherV2Inputs, KernelConfig, KernelFunc, Tensor, TensorInfo, TypedArray, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {reshape} from './Reshape';\nimport {CppDType} from './types';\n\nlet wasmGather: (\n    xId: number, dtype: CppDType, xStrides: Uint8Array, stridesSize: number,\n    indicesId: number, batchSize: number, outStrides: Uint8Array,\n    outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n  wasmGather = backend.wasm.cwrap('Gather', null /*void*/, [\n    'number',  // xId\n    'number',  // dtype\n    'array',  // xStrides\n    'number',  // stridesSize\n    'number',  // indicesId\n    'number',  // batchSize\n
    'array',   // outStrides\n    'number'   // outId\n  ]);\n}\n\nfunction gatherV2(\n    args: {backend: BackendWasm, inputs: GatherV2Inputs, attrs: GatherV2Attrs}):\n    TensorInfo {\n  const {backend, inputs, attrs} = args;\n  const {x, indices} = inputs;\n  const {axis, batchDims} = attrs;\n\n  // Throw error when any index is out of bound.\n  const parsedAxis = util.parseAxisParam(axis, x.shape)[0];\n  const indicesVals = backend.readSync(indices.dataId) as TypedArray;\n  const axisDim = x.shape[parsedAxis];\n  for (let i = 0; i < indicesVals.length; ++i) {\n    const index = indicesVals[i];\n    util.assert(\n        index <= axisDim - 1 && index >= 0,\n        () =>\n            `GatherV2: the index value ${index} is not in [0, ${axisDim - 1}]`);\n  }\n\n  const shapeInfo = backend_util.segment_util.collectGatherOpShapeInfo(\n      x as Tensor, indices as Tensor, parsedAxis, batchDims);\n\n  const flattenX = reshape({\n    inputs: {x},\n    attrs: {\n      shape: [\n  shapeInfo.batchSize, shapeInfo.outerSize, shapeInfo.dimSize,\n        shapeInfo.sliceSize\n      ]\n    },\n    backend\n  });\n  const indicesSize = util.sizeFromShape(indices.shape);\n  const flattenIndex = reshape({\n    inputs: {x: indices},\n    attrs: {shape: [shapeInfo.batchSize, indicesSize / shapeInfo.batchSize]},\n    backend\n  });\n  const flattenOutputShape = [\n    shapeInfo.batchSize, shapeInfo.outerSize, indicesSize / shapeInfo.batchSize,\n    shapeInfo.sliceSize\n  ];\n\n  const out = backend.makeOutput(flattenOutputShape, x.dtype);\n  if (util.sizeFromShape(x.shape) === 0) {\n    return out;\n  }\n  const stridesSize = flattenX.shape.length - 1;\n\n  const xData = backend.dataIdMap.get(flattenX.dataId);\n  const xId = xData.id;\n\n  const indicesData = backend.dataIdMap.get(flattenIndex.dataId);\n  const indicesId = indicesData.id;\n\n  const outId = backend.dataIdMap.get(out.dataId).id;\n\n  const xStridesBytes = new Uint8Array(\n      new Int32Array(util.computeStrides(flattenX.shape)).buffer);\n
  const outStridesBytes = new Uint8Array(\n      new Int32Array(util.computeStrides(flattenOutputShape)).buffer);\n\n  wasmGather(\n      xId, CppDType[x.dtype], xStridesBytes, stridesSize, indicesId,\n      shapeInfo.batchSize, outStridesBytes, outId);\n\n  backend.disposeData(flattenX.dataId);\n  backend.disposeData(flattenIndex.dataId);\n\n  // reshape\n  out.shape = shapeInfo.outputShape;\n  return out;\n}\n\nexport const gatherV2Config: KernelConfig = {\n  kernelName: GatherV2,\n  backendName: 'wasm',\n  setupFunc: setup,\n  kernelFunc: gatherV2 as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable
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under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
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*/\nimport {Greater, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from './binary_kernel';\n\nconst supportsFullBroadcast = false;\nexport const greaterConfig: KernelConfig =\n createBinaryKernelConfig(Greater, supportsFullBroadcast, 'bool');\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n
* distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
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*/\nimport {GreaterEqual, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from './binary_kernel';\n\nconst supportsFullBroadcast = false;\nexport const greaterEqualConfig: KernelConfig =\n createBinaryKernelConfig(GreaterEqual, supportsFullBroadcast, 'bool');\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in
writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
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/\n\nimport {KernelConfig, KernelFunc, LeakyRelu, LeakyReluAttrs, LeakyReluInputs, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {CppDType} from './types';\n\nlet wasmFunc: (\n xId: number, dtype: number, leakyreluAlpha: number, outId: number) => void;\n\nfunction setupFunc(backend: BackendWasm): void {\n wasmFunc = backend.wasm.cwrap(LeakyRelu, null / void */, [\n 'number', // x_id\n 'number', // dtype\n 'number', // leakyrelu_alpha\n 'number', // out_id\n]);\n}\n\nexport function leakyRelu(\n args:\n {inputs: LeakyReluInputs, attrs: LeakyReluAttrs, backend: BackendWasm}):\n TensorInfo {\n const {inputs: {x}, attrs: {alpha}, backend} = args;\n\n const xId = backend.dataIdMap.get(x.dataId).id;\n // According to TF API, LeakyRelu returns float32 when input is either float32\n // or int32.\n const out = backend.makeOutput(x.shape, 'float32');\n\n if (util.sizeFromShape(x.shape) !== 0) {\n const outId = backend.dataIdMap.get(out.dataId).id;\n wasmFunc(xId, CppDType[x.dtype], alpha, outId);\n }\n\n return out;\n}\n\nexport const leakyReluConfig: KernelConfig = {\n kernelName: LeakyRelu,\n backendName: 'wasm',\n setupFunc,\n kernelFunc: leakyRelu as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable
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*/\nimport {KernelConfig, Less} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from './binary_kernel';\nconst supportsFullBroadcast = false;\nexport const lessConfig: KernelConfig =\n createBinaryKernelConfig(Less, supportsFullBroadcast, 'bool');\n","/**\n * @license\n * Copyright 2019 Google

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(inputWasTransposed) {\n const transposedId = backend.dataIdMap.get(transposed.dataId).id;\n input = transposed;\n inputId = transposedId;\n }\n\n const inputRank = input.shape.length;\n backend_util.assertAxesAreInnerMostDims('max', axes, inputRank);\n const [outShape, reduceShape] =\n backend_util.computeOutAndReduceShapes(input.shape, axes);\n const reduceSize = util.sizeFromShape(reduceShape);\n\n const out = backend.makeOutput(outShape, x.dtype);\n if (util.sizeFromShape(input.shape) !== 0) {\n const outId = backend.dataIdMap.get(out.dataId).id;\n wasmMax(inputId, CppDType[x.dtype], reduceSize, outId);\n }\n\n if (inputWasTransposed)
 {\n // dispose of the transposed tensor.\n backend.disposeData(transposed.dataId);\n }\n\n if (keepDims) {\n // reshape\n const newShape = backend_util.expandShapeToKeepDim(out.shape, originalAxes);\n out.shape = newShape;\n }\n\n return out;\n}\n\nexport const maxConfig: KernelConfig = {\n kernelName: Max,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: max as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing
 permissions and\n * limitations under the License.\n *
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*/\nimport {KernelConfig, Maximum} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from './binary_kernel';\nconst supportsFullBroadcast = false;\nexport const maximumConfig: KernelConfig =\n createBinaryKernelConfig(Maximum, supportsFullBroadcast);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions
 and\n * limitations under the License.\n *
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/\n\nimport {backend_util, KernelConfig, KernelFunc, MaxPool, MaxPoolAttrs, MaxPoolInputs, Tensor4D, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmMaxPool: (\n xId: number, batchSize: number, inputHeight: number, inputWidth: number,\n filterHeight: number, filterWidth: number, padTop: number, padRight: number,\n padBottom: number, padLeft: number, dilationHeight: number,\n dilationWidth: number, strideHeight: number, strideWidth: number,\n inputChannels: number, outputChannels: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmMaxPool = backend.wasm.cwrap(MaxPool, null / void */, [\n 'number', // xId\n 'number', // batchSize\n 'number', // inputHeight\n 'number', // inputWidth\n 'number', // filterHeight\n 'number', // filterWidth\n 'number', // padTop\n 'number', // padRight\n 'number', // padBottom\n 'number', // padLeft\n 'number', // dilationHeight\n 'number', // dilationWidth\n 'number', // strideHeight\n 'number', // strideWidth\n 'number', // inputChannels\n 'number', // outputChannels\n 'number', // outId\n]);\n}\n\nfunction maxPool(\n args: {inputs: MaxPoolInputs, backend: BackendWasm, attrs: MaxPoolAttrs}) {\n const {inputs, attrs, backend} = args;\n\n const x = inputs.x as Tensor4D;\n const xId = backend.dataIdMap.get(x.dataId).id;\n\n // TF API supports int32 input. CPU and WebGL backend also support int32\n // input. WASM backend doesn't support it because it uses xnnpack which only\n // supports float32.\n //\n // Add the following assert only for the WASM backend instead of at core op\n // level.\n //\n // TODO: add support for int32 input.\n util.assert(\n   x.dtype === 'float32',\n   () =>\n   `Error in MaxPool: only float32 input

is supported. Got ${x.dtype}.`);\n\n const {filterSize, strides, pad, dimRoundingMode} = attrs;\n const convInfo = backend_util.computePool2DInfo(\n   x.shape, filterSize, strides, 1 /* dilations */, pad, dimRoundingMode);\n\n const filterHeight = convInfo.filterHeight;\n const filterWidth = convInfo.filterWidth;\n const padTop = convInfo.padInfo.top;\n const padRight = convInfo.padInfo.right;\n const padBottom = convInfo.padInfo.bottom;\n const padLeft = convInfo.padInfo.left;\n const dilationHeight = convInfo.dilationHeight;\n const dilationWidth = convInfo.dilationWidth;\n const strideHeight = convInfo.strideHeight;\n const strideWidth = convInfo.strideWidth;\n const inputChannels = convInfo.inChannels;\n const outputChannels = convInfo.outChannels;\n\n if (convInfo.dataFormat !== 'channelsLast') {\n   throw new Error(\n   `wasm backend does not support dataFormat:'` +\n   `${convInfo.dataFormat}'. Please use 'channelsLast'.`);\n }\n\n const out =
 backend.makeOutput(convInfo.outShape, 'float32');\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n wasmMaxPool(\n   xId, x.shape[0], x.shape[1], x.shape[2], filterHeight, filterWidth,\n   padTop, padRight, padBottom, padLeft, dilationHeight, dilationWidth,\n   strideHeight, strideWidth, inputChannels, outputChannels, outId);\n return out;\n}\n\nexport const maxPoolConfig: KernelConfig = {\n kernelName: MaxPool,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: maxPool as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES
 OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
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*/\n\nimport {backend_util, KernelConfig, KernelFunc, Mean, MeanAttrs, MeanInputs, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\nimport {cast} from './Cast';\n\nimport {permuteAxesAndTranspose} from './kernel_utils';\n\nlet wasmMean: (xId: number, reduceSize: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n wasmMean =\n backend.wasm.cwrap(Mean, null /*void*/, ['number, number, number']);\n}\n\nexport function mean(\n   args: {backend: BackendWasm, inputs: MeanInputs, attrs: MeanAttrs}):\n   TensorInfo {\n const {backend, inputs, attrs} = args;\n const {axis, keepDims} = attrs;\n const {x} = inputs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n
  let inputId = xId;\n let input = x;\n\n const {transposed, axes, originalAxes, inputWasTransposed} =\n permuteAxesAndTranspose(x, axis, backend);\n\n let reductionAxes = axes;\n if (inputWasTransposed) {\n   const transposedId = backend.dataIdMap.get(transposed.dataId).id;\n   if (transposedId !== xId) {\n   // transpose was not a no-op. We will need to dispose of this\n   // once we are done.\n   input = transposed;\n   inputId = transposedId;\n   reductionAxes = backend_util.getInnerMostAxes(\n   reductionAxes.length, input.shape.length);\n   }\n }\n\n backend_util.assertAxesAreInnerMostDims(\n   'mean', reductionAxes, input.shape.length);\n const [outShape, reduceShape] =\n backend_util.computeOutAndReduceShapes(input.shape, reductionAxes);\n const reduceSize = util.sizeFromShape(reduceShape);\n let castedInput = input;\n if (input.dtype !== 'float32') {\n   castedInput =\n cast({backend, inputs: {x: input}, attrs: {dtype:
 'float32'}});\n   inputId = backend.dataIdMap.get(castedInput.dataId).id;\n }\n\n const out =
backend.makeOutput(outShape, 'float32');\n if (util.sizeFromShape(input.shape) !== 0) {\n   const outId = backend.dataIdMap.get(out.dataId).id;\n   wasmMean(inputId, reduceSize, outId);\n }\n\n if (inputWasTransposed) {\n   // dispose of the transposed tensor.\n   backend.disposeData(transposed.dataId);\n }\n\n if (keepDims) {\n   // reshape\n   const newShape = backend_util.expandShapeToKeepDim(out.shape, originalAxes);\n   out.shape = newShape;\n }\n\n if (input.dtype !== 'float32') {\n backend.disposeData(castedInput.dataId);\n }\n\n return out;\n}\n\nexport const meanConfig: KernelConfig = {\n

kernelName: Mean,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: mean as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this
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*/\n\nimport {backend_util, KernelConfig, KernelFunc, Min, MinAttrs, MinInputs, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {permuteAxesAndTranspose} from './kernel_utils';\nimport {CppDType} from './types';\n\nlet wasmMin: (xId: number, dtype: number, reduceSize: number, outId: number) =>\n   void;\n\nfunction setup(backend: BackendWasm): void {\n wasmMin = backend.wasm.cwrap(Min,
 null /*void*/, [\n   'number', // x_id\n   'number', // dtype\n   'number', // reduce_size\n   'number', // out_id\n]);\n}\n\nfunction min(args: {backend: BackendWasm, inputs: MinInputs, attrs: MinAttrs}):\n   TensorInfo {\n const {backend, inputs, attrs} = args;\n const {axis, keepDims} = attrs;\n const {x} = inputs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n let inputId = xId;\n let input = x;\n\n const {transposed, axes, originalAxes, inputWasTransposed} =\n   permuteAxesAndTranspose(x, axis, backend);\n\n if (inputWasTransposed) {\n const transposedId = backend.dataIdMap.get(transposed.dataId).id;\n   if (transposedId !== xId) {\n   // transpose was not a no-op. We will need to dispose of this\n   // once we are done.\n   input = transposed;\n   inputId = transposedId;\n   }\n }\n\n const inputRank = input.shape.length;\n\n backend_util.assertAxesAreInnerMostDims('min', axes, inputRank);\n const [outShape, reduceShape] =\n   backend_util.computeOutAndReduceShapes(input.shape, axes);\n const reduceSize = util.sizeFromShape(reduceShape);\n\n const out = backend.makeOutput(outShape, input.dtype);\n if (util.sizeFromShape(input.shape) !== 0) {\n   const outId = backend.dataIdMap.get(out.dataId).id;\n wasmMin(inputId, CppDType[x.dtype], reduceSize, outId);\n }\n\n if (inputWasTransposed) {\n   // dispose of the transposed tensor.\n   backend.disposeData(transposed.dataId);\n }\n\n if (keepDims) {\n   // reshape\n   const newShape = backend_util.expandShapeToKeepDim(out.shape, originalAxes);\n   out.shape = newShape;\n }\n\n return out;\n}\n\nexport const minConfig: KernelConfig = {\n kernelName: Min,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: min as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n
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*/\nimport {KernelConfig, Minimum} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from './binary_kernel';\nconst supportsFullBroadcast = false;\nexport const minimumConfig: KernelConfig =\n createBinaryKernelConfig(Minimum, supportsFullBroadcast);\n","/**\n * @license\n * Copyright 2021 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n
 * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
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*/\n\nimport {KernelConfig, KernelFunc, MirrorPad, MirrorPadAttrs, MirrorPadInputs} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {CppDType} from './types';\n\n// Must match enum in MirrorPad.cc\nenum MirrorPaddingMode {\n reflect = 0,\n symmetric = 1\n}\n\nlet wasmMirrorPad: (\n xId: number, xShapeBytes: Uint8Array, xShapeLength: number, xDtype: number,\n   prePaddingsBytes: Uint8Array, postPaddingsBytes: Uint8Array, mode: number,\n
outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmMirrorPad = backend.wasm.cwrap(MirrorPad, null /* void */, [\n   'number', // xId\n   'array',   // x.shape\n   'number', // x.shape.length\n   'number', // x.dtype\n   'array',   // pre-paddings\n   'array',   // post-paddings\n   'number', // mode\n   'number', // outId\n]);\n}\n\nfunction mirrorPad(args: {\n inputs: MirrorPadInputs,\n backend: BackendWasm,\n attrs: MirrorPadAttrs\n}) {\n const {inputs: {x}, backend, attrs: {paddings, mode}} = args;\n\n const outShape = paddings.map(\n   (p, i) => p[0] /* beforePad */ + x.shape[i] + p[1] /* afterPad */);\n const xId = backend.dataIdMap.get(x.dataId).id;\n const out = backend.makeOutput(outShape, x.dtype);\n const outId = backend.dataIdMap.get(out.dataId).id;\n const xShapeBytes = new Uint8Array(new Int32Array(x.shape).buffer);\n\n const prePaddingsFlat = paddings.map(padTuple => padTuple[0]);\n const postPaddingsFlat = paddings.map(padTuple
=> padTuple[1]);\n const prePaddingsBytes =\n   new Uint8Array(new Int32Array(prePaddingsFlat).buffer);\n const postPaddingsBytes =\n   new Uint8Array(new Int32Array(postPaddingsFlat).buffer);\n\n wasmMirrorPad(\n   xId, xShapeBytes, x.shape.length, CppDType[x.dtype], prePaddingsBytes,\n postPaddingsBytes, MirrorPaddingMode[mode], outId);\n return out;\n}\n\nexport const mirrorPadConfig: KernelConfig = {\n kernelName: MirrorPad,\n backendName: 'wasm',\n kernelFunc: mirrorPad as {} as KernelFunc,\n setupFunc: setup\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\"
BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
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*/\n\nimport {KernelConfig, Multiply} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from './binary_kernel';\n\nconst supportsFullBroadcast = true;\nexport const multiplyConfig: KernelConfig =\n createBinaryKernelConfig(Multiply, supportsFullBroadcast);\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\"
BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
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*/\nimport {KernelConfig, Neg} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\nexport const negConfig: KernelConfig = createUnaryKernelConfig(Neg);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n
* See the License for the specific language governing permissions and\n * limitations under the License.\n *
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*/\n\nimport {BackendWasm} from '../backend_wasm';\n\n// Analogous to `struct Result` in

`non_max_suppression_impl.h`.\ninterface Result {\n pSelectedIndices: number;\n selectedSize: number;\n pSelectedScores: number;\n pValidOutputs: number;\n}\n/**\n * Parse the result of the c++ method, which has the shape equivalent to\n * `Result`.\n */\nexport function parseResultStruct(\n   backend: BackendWasm, resOffset: number): Result {\n const result = new Int32Array(backend.wasm.HEAPU8.buffer, resOffset, 4);\n const pSelectedIndices = result[0];\n const selectedSize = result[1];\n const pSelectedScores = result[2];\n const pValidOutputs = result[3];\n // Since the result was allocated on the heap, we have to delete it.\n backend.wasm._free(resOffset);\n return {pSelectedIndices, selectedSize,
 pSelectedScores, pValidOutputs};\n}\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n *
http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
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*/\n\nimport {KernelConfig, KernelFunc, NonMaxSuppressionV3, NonMaxSuppressionV3Attrs, NonMaxSuppressionV3Inputs, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {parseResultStruct} from
 './NonMaxSuppression_util';\n\nlet wasmFunc: (\n   boxesId: number, scoresId: number, maxOutputSize: number,\n   iouThreshold: number, scoreThreshold: number) => number;\n\nfunction setup(backend: BackendWasm): void {\n wasmFunc = backend.wasm.cwrap(\n   NonMaxSuppressionV3,\n   'number', // Result*\n   [\n   'number', // boxesId\n   'number', // scoresId\n   'number', // maxOutputSize\n   'number', // iouThreshold\n   'number', // scoreThreshold\n   ]);\n}\n\nfunction kernelFunc(args: {\n backend: BackendWasm,\n inputs: NonMaxSuppressionV3Inputs,\n attrs: NonMaxSuppressionV3Attrs\n}): TensorInfo {\n const {backend, inputs, attrs} = args;\n const {iouThreshold, maxOutputSize, scoreThreshold} = attrs;\n const {boxes, scores} = inputs;\n\n const boxesId = backend.dataIdMap.get(boxes.dataId).id;\n const scoresId = backend.dataIdMap.get(scores.dataId).id;\n\n const resOffset =\n   wasmFunc(boxesId, scoresId, maxOutputSize, iouThreshold,
 scoreThreshold);\n\n const {pSelectedIndices, selectedSize, pSelectedScores, pValidOutputs} =\n   parseResultStruct(backend, resOffset);\n\n // Since we are not using scores for V3, we have to delete it from the heap.\n backend.wasm._free(pSelectedScores);\n backend.wasm._free(pValidOutputs);\n\n const selectedIndicesTensor =\n   backend.makeOutput([selectedSize], 'int32', pSelectedIndices);\n\n return selectedIndicesTensor;\n}\n\nexport const nonMaxSuppressionV3Config: KernelConfig = {\n kernelName: NonMaxSuppressionV3,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: kernelFunc as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed
 to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
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/\n\nimport {KernelConfig, KernelFunc, NonMaxSuppressionV4, NonMaxSuppressionV4Attrs, NonMaxSuppressionV4Inputs, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {parseResultStruct} from './NonMaxSuppression_util';\n\nlet wasmFunc: (\n boxesId: number, scoresId: number, maxOutputSize: number,\n   iouThreshold: number, scoreThreshold: number,\n padToMaxOutputSize: boolean) => number;\n\nfunction setup(backend: BackendWasm): void {\n wasmFunc = backend.wasm.cwrap(\n   NonMaxSuppressionV4,\n   'number', // Result\n   [\n   'number', // boxesId\n

'number',
// scoresId\n 'number', // maxOutputSize\n 'number', // iouThreshold\n 'number', // scoreThreshold\n 'bool', // padToMaxOutputSize\n]);\n}\n\nfunction nonMaxSuppressionV4(args: {\n backend: BackendWasm,\n inputs: NonMaxSuppressionV4Inputs,\n attrs: NonMaxSuppressionV4Attrs\n}): TensorInfo[] {\n const {backend, inputs, attrs} = args;\n const {iouThreshold, maxOutputSize, scoreThreshold, padToMaxOutputSize} =\n attrs;\n const {boxes, scores} = inputs;\n\n const boxesId = backend.dataIdMap.get(boxes.dataId).id;\n const scoresId = backend.dataIdMap.get(scores.dataId).id;\n\n const resOffset = wasmFunc(\n boxesId, scoresId, maxOutputSize, iouThreshold, scoreThreshold,\n padToMaxOutputSize);\n\n const {pSelectedIndices, selectedSize, pSelectedScores, pValidOutputs} =\n parseResultStruct(backend, resOffset);\n\n // Since we are not using scores for V4, we have to delete it from the heap.\n backend.wasm._free(pSelectedScores);\n\n
const selectedIndicesTensor =\n backend.makeOutput([selectedSize], 'int32', pSelectedIndices);\n\n const validOutputsTensor = backend.makeOutput([], 'int32', pValidOutputs);\n\n return [selectedIndicesTensor, validOutputsTensor];\n}\n\nexport const nonMaxSuppressionV4Config: KernelConfig = {\n kernelName: NonMaxSuppressionV4,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: nonMaxSuppressionV4 as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See
the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n*/\n\nimport {KernelConfig, KernelFunc, NonMaxSuppressionV5, NonMaxSuppressionV5Attrs, NonMaxSuppressionV5Inputs, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {parseResultStruct} from './NonMaxSuppression_util';\n\nlet wasmFunc:\n(boxesId: number, scoresId: number, maxOutputSize: number,\n iouThreshold: number, scoreThreshold: number, softNmsSigma: number) =>\n number;\n\nfunction setup(backend: BackendWasm): void {\n wasmFunc = backend.wasm.cwrap(\n NonMaxSuppressionV5,\n 'number', // Result*\n [\n 'number', // boxesId\n 'number', // scoresId\n 'number', // maxOutputSize\n 'number', // iouThreshold\n 'number', // scoreThreshold\n 'number', // softNmsSigma\n]);\n}\n\nfunction
kernelFunc(args: {\n backend: BackendWasm,\n inputs: NonMaxSuppressionV5Inputs,\n attrs: NonMaxSuppressionV5Attrs\n}): TensorInfo[] {\n const {backend, inputs, attrs} = args;\n const {iouThreshold, maxOutputSize, scoreThreshold, softNmsSigma} = attrs;\n const {boxes, scores} = inputs;\n\n const boxesId = backend.dataIdMap.get(boxes.dataId).id;\n const scoresId = backend.dataIdMap.get(scores.dataId).id;\n\n const resOffset = wasmFunc(\n boxesId, scoresId, maxOutputSize, iouThreshold, scoreThreshold,\n softNmsSigma);\n\n const {pSelectedIndices, selectedSize, pSelectedScores, pValidOutputs} =\n parseResultStruct(backend, resOffset);\n\n // Since we are not using validOutputs for V5, we have to delete it from the\n // heap.\n backend.wasm._free(pValidOutputs);\n\n const selectedIndicesTensor =\n backend.makeOutput([selectedSize], 'int32', pSelectedIndices);\n const selectedScoresTensor =\n backend.makeOutput([selectedSize], 'float32', pSelectedScores);\n\n
return [selectedIndicesTensor, selectedScoresTensor];\n}\n\nexport const nonMaxSuppressionV5Config: KernelConfig = {\n kernelName: NonMaxSuppressionV5,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: kernelFunc as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES

OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
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*/\nimport
{KernelConfig, NotEqual} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from
'./binary_kernel';\nconst supportsFullBroadcast = false;\nexport const notEqualConfig: KernelConfig =\n
createBinaryKernelConfig(NotEqual, supportsFullBroadcast, 'bool');\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n *
http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
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*/\n\nimport
{KernelConfig, KernelFunc, OneHot, OneHotAttrs, OneHotInputs} from '@tensorflow/tfjs-core';\n\nimport
{BackendWasm} from '../backend_wasm';\n\nlet wasmOneHot: (\n indicesId: number, depth: number, onValue: number, offValue: number,\n outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmOneHot = backend.wasm.cwrap(OneHot, null /* void */, [\n 'number', // indices_id\n 'number', // depth,\n
'number', // onValue\n 'number', // offValue\n 'number' // out_id\n]);\n}\n\nfunction oneHot(\n args: {inputs: OneHotInputs, attrs: OneHotAttrs, backend: BackendWasm}) {\n const {inputs, backend, attrs} = args;\n const {indices} = inputs;\n const {depth, onValue, offValue} = attrs;\n\n const out = backend.makeOutput([...indices.shape, depth], 'int32');\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n const indicesData = backend.dataIdMap.get(indices.dataId);\n const indicesId = indicesData.id;\n\n wasmOneHot(indicesId, depth,
onValue, offValue, outId);\n\n return out;\n}\n\nexport const oneHotConfig: KernelConfig = {\n kernelName: OneHot,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: oneHot as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
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*/\n\nimport {KernelConfig, KernelFunc, OnesLike, OnesLikeInputs} from
'@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nfunction onesLike(args: {inputs: OnesLikeInputs, backend: BackendWasm}) {\n const {inputs: {x}, backend} = args;\n const out = backend.makeOutput(x.shape, x.dtype);\n const outVals = backend.typedArrayFromHeap(out);\n outVals.fill(1);\n return out;\n}\n\nexport const onesLikeConfig: KernelConfig = {\n kernelName: OnesLike,\n backendName: 'wasm',\n kernelFunc: onesLike as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n *
http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express
or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
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*/\n\nimport {KernelConfig, KernelFunc, Pack, PackAttrs, PackInputs, TensorInfo, util} from '@tensorflow/tfjs-core';\nimport {BackendWasm} from '../backend_wasm';\n\nimport {concat} from './Concat';\nimport {expandDims} from './ExpandDims';\n\nexport function pack(\n args: {inputs: PackInputs, backend: BackendWasm, attrs: PackAttrs}):\n TensorInfo {\n const {inputs, backend, attrs} = args;\n const {axis} = attrs;\n\n if (inputs.length === 1) {\n   return expandDims(\n   {inputs: {input: inputs[0]}, backend, attrs: {dim: axis}});\n }\n\n const shape = inputs[0].shape;\n const dtype = inputs[0].dtype;\n\n inputs.forEach(t => {\n   util.assertShapesMatch(\n   shape, t.shape,\n   'All tensors passed to stack must have matching shapes');\n   util.assert(\n   dtype === t.dtype,\n   () => 'All tensors passed to stack must have matching dtypes');\n });\n\n const intermediateTensorInfos: TensorInfo[] = [];\n const expandedTensors = inputs.map(t => {\n   const expandedT =\n   expandDims({inputs: {input: t}, backend, attrs: {dim: axis}});\n   intermediateTensorInfos.push(expandedT);\n   return expandedT;\n });\n\n const result = concat({inputs: expandedTensors, backend, attrs: {axis}});\n\n intermediateTensorInfos.forEach(t => backend.disposeData(t.dataId));\n\n return result;\n}\n\nexport const packConfig: KernelConfig = {\n kernelName: Pack,\n backendName: 'wasm',\n kernelFunc: pack as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ===\n */\n\nimport {KernelConfig, KernelFunc, PadV2, PadV2Attrs, PadV2Inputs, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {fill} from './Fill';\n\nimport {CppDType} from './types';\n\nlet wasmPadV2: (\n   xId: number, xShapeBytes: Uint8Array, xShapeLength: number, xDtype: number,\n   prePaddingsBytes: Uint8Array, postPaddingsBytes: Uint8Array,\n   constantValue: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmPadV2 = backend.wasm.cwrap(PadV2, null /* void */, [\n   'number', // xId\n   'array',   // x.shape\n   'number', // x.shape.length\n   'number', // x.dtype\n   'array',   // pre-paddings\n   'array',   // post-paddings\n   'number', // constantValue\n   'number', // outId\n]);\n}\n\nfunction pad(\n   args: {inputs: PadV2Inputs, backend: BackendWasm, attrs: PadV2Attrs}) {\n const {inputs: {x}, backend, attrs: {paddings, constantValue}} = args;\n\n const outShape = paddings.map(\n   (p, i) => p[0] /* beforePad */ + x.shape[i] + p[1] /* afterPad */);\n\n if (util.sizeFromShape(x.shape) === 0) {\n   // Short-circuit the computation, since x doesn't have value, only\n   // the shape is used to compute output shape to pad.\n   return fill({\n   backend,\n   attrs: {shape: outShape, value: constantValue, dtype: x.dtype}\n   });\n }\n\n const xId = backend.dataIdMap.get(x.dataId).id;\n const out = backend.makeOutput(outShape, x.dtype);\n const outTensorData = backend.dataIdMap.get(out.dataId);\n const outId = outTensorData.id;\n\n const xShapeBytes =\n   new Uint8Array(new Int32Array(x.shape).buffer);\n\n const prePaddingsFlat = paddings.map(padTuple => padTuple[0]);\n const postPaddingsFlat = paddings.map(padTuple => padTuple[1]);\n const prePaddingsBytes =\n   new Uint8Array(new Int32Array(prePaddingsFlat).buffer);\n const postPaddingsBytes =\n   new Uint8Array(new Int32Array(postPaddingsFlat).buffer);\n\n wasmPadV2(\n   xId, xShapeBytes, x.shape.length, CppDType[x.dtype], prePaddingsBytes,\n   postPaddingsBytes, constantValue, outId);\n return out;\n}\n\nexport const padV2Config: KernelConfig = {\n kernelName: PadV2,\n backendName: 'wasm',\n kernelFunc: pad as {} as KernelFunc,\n setupFunc: setup\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n *

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done.\n input = transposed;\n inputId = transposedId;\n reductionAxes = backend_util.getInnerMostAxes(\n reductionAxes.length, input.shape.length);\n }\n }\n\n backend_util.assertAxesAreInnerMostDims(\n 'prod', reductionAxes, input.shape.length);\n const [outShape, reduceShape]
=\n backend_util.computeOutAndReduceShapes(input.shape, reductionAxes);\n const reduceSize = util.sizeFromShape(reduceShape);\n\n const out = backend.makeOutput(outShape, input.dtype);\n if (util.sizeFromShape(input.shape) !== 0) {\n const outId = backend.dataIdMap.get(out.dataId).id;\n wasmProd(inputId, reduceSize, CppDType[out.dtype], outId);\n }\n\n if (inputWasTransposed) {\n // dispose of the transposed tensor.\n backend.disposeData(transposed.dataId);\n }\n\n if (keepDims) {\n // reshape\n const newShape = backend_util.expandShapeToKeepDim(out.shape, originalAxes);\n out.shape = newShape;\n }\n\n return out;\n}\n\nexport const prodConfig: KernelConfig = {\n kernelName: Prod,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: prod as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in
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==\n */\n\nimport {KernelConfig, KernelFunc, Range, RangeAttrs, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\nimport {rangeImplCPU} from '../kernel_utils/shared';\n\nexport const range =\n (args: {backend: BackendWasm, attrs: RangeAttrs}): TensorInfo => {\n const {backend, attrs} = args;\n const {start, stop, step, dtype} = attrs;\n const values = rangeImplCPU(start, stop, step, dtype);\n\n const
out = backend.makeOutput([values.length], dtype);\n const outVals = backend.typedArrayFromHeap(out);\n outVals.set(values);\n return out;\n};\n\nexport const rangeConfig: KernelConfig = {\n kernelName: Range,\n backendName: 'wasm',\n kernelFunc: range as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n */\n\nimport {KernelConfig, RealDiv} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from './binary_kernel';\n\nconst supportsFullBroadcast = true;\nexport const realDivConfig: KernelConfig =\n createBinaryKernelConfig(RealDiv, supportsFullBroadcast);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n */\nimport {KernelConfig, Relu} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\nexport const reluConfig: KernelConfig = createUnaryKernelConfig(Relu);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the

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{identity} from './Identity';\nimport {reshape} from './Reshape';\n\nlet wasmReverse: (\n xId: number, axes: Uint8Array, axesLength: number, outShape: Uint8Array,\n outShapeLength: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmReverse = backend.wasm.cwrap(Reverse, null, [\n 'number', // x_id\n 'array', // axes\n 'number', // axes_length\n 'array', // out_shape\n 'number', // out_shape_length\n 'number' // out_id\n]);\n}\n\nexport function reverse(\n args: {inputs: ReverseInputs, backend: BackendWasm, attrs: ReverseAttrs}):\n TensorInfo {\n const {inputs, backend, attrs} = args;\n const {x} = inputs;\n const {dims} = attrs;\n\n const axes = util.parseAxisParam(dims, x.shape);\n\n if (x.shape.length === 0) {\n return identity({inputs: {x}, backend});\n }\n\n const out = backend.makeOutput(x.shape, x.dtype);\n const xId = backend.dataIdMap.get(x.dataId).id;\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n const axesBytes = new Uint8Array(new Int32Array(axes).buffer);\n const outShapeBytes = new Uint8Array(new Int32Array(x.shape).buffer);\n\n wasmReverse(\n xId, axesBytes, axes.length, outShapeBytes, x.shape.length, outId);\n\n const reshaped =\n reshape({inputs: {x: out}, attrs: {shape: x.shape}, backend});\n\n backend.disposeData(out.dataId);\n return reshaped;\n}\n\nexport const reverseConfig: KernelConfig = {\n kernelName: Reverse,\n backendName: 'wasm',\n kernelFunc: reverse as {} as KernelFunc,\n setupFunc: setup\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {KernelConfig, KernelFunc, RotateWithOffset, RotateWithOffsetAttrs, RotateWithOffsetInputs, TensorInfo} from '@tensorflow/tfjs-core';\nimport {backend_util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmRotate: (\n xId: number, batch: number, imageHeight: number, imageWidth: number,\n numChannels: number, radians: number, centerX: number, centerY: number,\n fillBytes: Uint8Array, fillLength: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmRotate = backend.wasm.cwrap(RotateWithOffset, null /* void */, [\n 'number', // xId\n 'number', // batch\n 'number', // imageHeight\n 'number', // imageWidth\n 'number', // numChannels\n 'number', // radians\n 'number', // centerX\n 'number', // centerY\n 'array', // fillBytes\n 'number', // fillLength\n 'number', // outId\n]);\n}\n\nexport function rotateWithOffset(args: {\n inputs: RotateWithOffsetInputs,\n backend: BackendWasm,\n attrs: RotateWithOffsetAttrs\n}): TensorInfo {\n const {inputs, backend, attrs} = args;\n const {image} = inputs;\n const {radians, fillValue, center} = attrs;\n\n const out = backend.makeOutput(image.shape, image.dtype);\n const imageId = backend.dataIdMap.get(image.dataId).id;\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n const [batch, imageHeight, imageWidth, numChannels] = image.shape;\n\n const [centerX, centerY] =\n backend_util.getImageCenter(center, imageHeight, imageWidth);\n\n const fillIsBlack = fillValue === 0;\n const fullOpacityValue = 255;\n\n const fillValues = typeof fillValue === 'number' ?\n [fillValue, fillValue, fillValue, fillIsBlack ? 0 : fullOpacityValue] :\n [...fillValue, fullOpacityValue];\n const fillBytes = new Uint8Array(new Int32Array(fillValues).buffer);\n\n wasmRotate(\n imageId, batch, imageHeight, imageWidth, numChannels, radians, centerX,\n centerY, fillBytes, fillValues.length, outId);\n return out;\n}\n\nexport const rotateWithOffsetConfig: KernelConfig = {\n kernelName: RotateWithOffset,\n backendName: 'wasm',\n kernelFunc: rotateWithOffset as {} as KernelFunc,\n setupFunc: setup\n};\n","/**\n * @license\n * Copyright 2021 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS

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==========\n */\nimport {KernelConfig, Round} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\n\nexport const roundConfig: KernelConfig = createUnaryKernelConfig(Round);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific
language governing permissions and\n * limitations under the License.\n *
==========\n */\nimport {KernelConfig, Rsqrt} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\nexport const rsqrtConfig: KernelConfig = createUnaryKernelConfig(Rsqrt);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {KernelConfig, KernelFunc, scatter_util, ScatterNd, ScatterNdAttrs, ScatterNdInputs, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {CppDType} from './types';\n\nlet wasmScatterNd: (\n indicesId: number, updatesId: number, dtype: CppDType, sliceRank: number,\n numUpdates: number, sliceSize: number, strides: Uint8Array,\n outputSize: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n wasmScatterNd = backend.wasm.cwrap(ScatterNd, null /*void*/, [\n 'number', // indicesId\n 'number', // updatesId\n 'number', // dtype\n 'number', // sliceRank\n 'number', // numUpdates\n 'number', // sliceSize\n 'array', // strides\n 'number', // outputSize\n 'number' // outId\n]);\n}\n\nfunction scatterNd(\n args:\n {backend: BackendWasm, inputs:
ScatterNdInputs, attrs:
ScatterNdAttrs}):\n TensorInfo {\n const {backend, inputs, attrs} = args;\n const {indices, updates} = inputs;\n const {shape} = attrs;\n\n const out = backend.makeOutput(shape, updates.dtype);\n if (util.sizeFromShape(shape) === 0) {\n return out;\n }\n\n const {sliceRank, numUpdates, sliceSize, strides, outputSize} =\n scatter_util.calculateShapes(updates, indices, shape);\n\n const indicesData = backend.dataIdMap.get(indices.dataId);\n const indicesId = indicesData.id;\n\n const updatesData = backend.dataIdMap.get(updates.dataId);\n const updatesId = updatesData.id;\n\n const stridesBytes = new Uint8Array(new Int32Array(strides).buffer);\n\n const outId = backend.dataIdMap.get(out.dataId).id;\n wasmScatterNd(\n indicesId, updatesId, CppDType[updates.dtype], sliceRank, numUpdates,\n sliceSize, stridesBytes, outputSize, outId);\n\n return out;\n}\n\nexport const scatterNdConfig: KernelConfig = {\n kernelName: ScatterNd,\n backendName: 'wasm',\n
setupFunc: setup,\n kernelFunc: scatterNd as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *

==========\n*/\n\nimport {KernelConfig, KernelFunc, Select, SelectInputs, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmSelect: (\n conditionId: number, tId: number, eId: number, offset: number,\n outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmSelect = backend.wasm.cwrap('SelectV2', null, [\n 'number', // conditionId\n 'number', // tId\n 'number', // eId\n 'number', // offset\n 'number', // outId\n]);\n}\n\nfunction select(args: {inputs: SelectInputs, backend: BackendWasm}) {\n const {inputs, backend} = args;\n const {condition, t, e} = inputs;\n\n const conditionId = backend.dataIdMap.get(condition.dataId).id;\n const tId = backend.dataIdMap.get(t.dataId).id;\n const eId = backend.dataIdMap.get(e.dataId).id;\n const out = backend.makeOutput(t.shape, t.dtype);\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n const cRank = condition.shape.length;\n const tRank = t.shape.length;\n\n const offset = cRank === 0 || cRank > 1 || tRank === 1 ?\n 1 :\n util.sizeFromShape(t.shape.slice(1));\n\n wasmSelect(conditionId, tId, eId, offset, outId);\n return out;\n}\n\nexport const selectConfig: KernelConfig = {\n kernelName: Select,\n backendName: 'wasm',\n kernelFunc: select as {} as KernelFunc,\n setupFunc: setup\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n==========\n*/\n\nimport {KernelConfig, KernelFunc, Sigmoid, SigmoidInputs, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmFunc: (xId: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n wasmFunc = backend.wasm.cwrap(Sigmoid, null /* void */, ['number', 'number']);\n}\n\nfunction sigmoid(args: {backend: BackendWasm, inputs: SigmoidInputs}):\n TensorInfo {\n const {backend, inputs: {x}} = args;\n const xId = backend.dataIdMap.get(x.dataId).id;\n const out = backend.makeOutput(x.shape, x.dtype);\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n // Short-circuit zero-sized tensors.\n if (util.sizeFromShape(out.shape) === 0) {\n return out;\n }\n\n wasmFunc(xId, outId);\n return out;\n}\n\nexport const sigmoidConfig: KernelConfig = {\n kernelName: 'Sigmoid',\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: sigmoid as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except\n in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n==========\n*/\nimport {KernelConfig, Sin} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\nexport const sinConfig: KernelConfig = createUnaryKernelConfig(Sin);\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n *\n http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language

governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {KernelConfig, KernelFunc, Softmax, SoftmaxAttrs, SoftmaxInputs, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmFunc: (xId: number, outId: number, channels: number, batch: number) =>\n void;\n\nfunction setup(backend: BackendWasm): void {\n wasmFunc = backend.wasm.cwrap(Softmax, null /* void */, [\n 'number', // xId\n 'number', // outId\n 'number', // channels\n 'number' // batch\n]);\n}\n\nfunction softmax(\n args: {backend: BackendWasm, inputs: SoftmaxInputs, attrs: SoftmaxAttrs}):\n TensorInfo {\n const {backend, inputs: {logits}, attrs: {dim}} = args;\n const xId = backend.dataIdMap.get(logits.dataId).id;\n const out = backend.makeOutput(logits.shape, logits.dtype);\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n const channels = logits.shape[dim];\n const batch = util.sizeFromShape(logits.shape) / channels;\n\n // Short-circuit zero-sized tensors.\n if (util.sizeFromShape(out.shape) === 0) {\n return out;\n }\n\n wasmFunc(xId, outId, channels, batch);\n return out;\n}\n\nexport const softmaxConfig: KernelConfig = {\n kernelName: Softmax,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: softmax as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2021 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {backend_util, KernelConfig, KernelFunc, ReshapeAttrs, ReshapeInputs, SpaceToBatchND, SpaceToBatchNDAttrs, SpaceToBatchNDInputs, TensorInfo, TransposeAttrs, TransposeInputs, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {padV2Config} from './PadV2';\nimport {reshape} from './Reshape';\nimport {transpose} from './Transpose';\n\nfunction spaceToBatchND(args: {\n inputs: SpaceToBatchNDInputs,\n backend: BackendWasm,\n attrs: SpaceToBatchNDAttrs\n}) {\n const {inputs, backend, attrs} = args;\n const {x} = inputs;\n const {blockShape, paddings} = attrs;\n\n const prod = util.sizeFromShape(blockShape);\n\n const completePaddings: Array<[number, number]> = [[0, 0]];\n completePaddings.push(...(paddings as Array<[number, number]>));\n\n for (let i = 1 + blockShape.length; i < x.shape.length; ++i) {\n completePaddings.push([0, 0]);\n }\n\n const paddedX = padV2Config.kernelFunc({\n inputs: {x},\n backend,\n attrs: {paddings: completePaddings, constantValue: 0}\n }) as TensorInfo;\n\n const reshapedPaddedShape =\n backend_util.getReshaped(paddedX.shape, blockShape, prod, false);\n\n const permutedReshapedPaddedPermutation = backend_util.getPermuted(\n reshapedPaddedShape.length, blockShape.length, false);\n\n const flattenShape =\n backend_util.getReshapedPermuted(paddedX.shape, blockShape, prod, false);\n\n const reshapeInputs: ReshapeInputs = {x: paddedX};\n const reshapeAttrs: ReshapeAttrs = {shape: reshapedPaddedShape};\n const paddedXReshaped =\n reshape({inputs: reshapeInputs, backend, attrs: reshapeAttrs});\n\n const transposeInputs: TransposeInputs = {x: paddedXReshaped};\n const transposeAttrs:\n TransposeAttrs = {perm: permutedReshapedPaddedPermutation};\n const paddedXT =\n transpose({inputs: transposeInputs, backend, attrs: transposeAttrs});\n\n const resultReshapeInputs: ReshapeInputs = {x: paddedXT};\n const resultReshapeAttrs: ReshapeAttrs = {shape: flattenShape};\n const result = reshape(\n {inputs: resultReshapeInputs, backend, attrs: resultReshapeAttrs});\n\n backend.disposeData(paddedX.dataId);\n backend.disposeData(paddedXReshaped.dataId);\n backend.disposeData(paddedXT.dataId);\n\n return result;\n}\n\nexport const spaceToBatchNDConfig: KernelConfig = {\n kernelName: SpaceToBatchND,\n backendName: 'wasm',\n kernelFunc: spaceToBatchND as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under

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attrs, backend} = args;\n const {x} = inputs;\n const {numOrSizeSplits, axis} = attrs;\n\n const $axis = util.parseAxisParam(axis, x.shape)[0];\n\n const splitSizes = backend_util.prepareSplitSize(x, numOrSizeSplits, $axis);\n const begin = new Array(x.shape.length).fill(0);\n const size = x.shape.slice();\n return splitSizes.map(s => {\n const xSliceSize = [...size];\n xSliceSize[$axis] = s;\n const xSlice =\n slice({inputs: {x}, attrs: {begin, size: xSliceSize}, backend});\n begin[$axis] += s;\n return xSlice;\n });\n}\n\nexport const splitVConfig: KernelConfig = {\n kernelName: SplitV,\n backendName: 'wasm',\n kernelFunc: splitV as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n==========\n*/\n\nimport {KernelConfig, Sqrt} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\n\nexport const sqrtConfig: KernelConfig = createUnaryKernelConfig(Sqrt);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n
* distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n==========\n*/\nimport {KernelConfig, Square} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\n\nexport const squareConfig: KernelConfig = createUnaryKernelConfig(Square);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT
WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n==========\n*/\nimport {KernelConfig, SquaredDifference} from '@tensorflow/tfjs-core';\nimport {createBinaryKernelConfig} from './binary_kernel';\nconst supportsFullBroadcast = true;\nexport const squaredDifferenceConfig: KernelConfig =\n createBinaryKernelConfig(SquaredDifference, supportsFullBroadcast);\n","/**\n * @license\n * Copyright

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'float32');\n\n const xId = backend.dataIdMap.get(x.dataId).id;\n const xStridesBytes =\n   new Uint8Array(new Int32Array(util.computeStrides(x.shape)).buffer);\n const beginBytes = new Uint8Array(new Int32Array($begin).buffer);\n const endBytes = new Uint8Array(new Int32Array($end).buffer);\n const stridesBytes = new Uint8Array(new Int32Array($strides).buffer);\n\n const outputShapeBytes =\n   new Uint8Array(new Int32Array(finalShapeSparse).buffer);\n const outStridesBytes = new Uint8Array(\n   new Int32Array(util.computeStrides(finalShapeSparse)).buffer);\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n wasmStridedSlice(\n   xId, xStridesBytes, x.shape.length, beginBytes, endBytes, stridesBytes,\n   outputShapeBytes, outStridesBytes, finalShapeSparse.length, outId);\n\n result = reshape({inputs: {x: out}, backend, attrs: {shape: finalShape}});\n\n backend.disposeData(out.dataId);\n}\n\n return result;\n}\n\nexport const stridedSliceConfig: KernelConfig = {\n kernelName: StridedSlice,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: stridedSlice as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\nimport {KernelConfig, Sub} from '@tensorflow/tfjs-core';\nimport {createBinaryKernelConfig} from './binary_kernel';\nconst supportsFullBroadcast = true;\nexport const subConfig: KernelConfig =\n createBinaryKernelConfig(Sub, supportsFullBroadcast);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {backend_util, KernelConfig, KernelFunc, Sum, SumAttrs, SumInputs, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {permuteAxesAndTranspose} from './kernel_utils';\nimport {CppDType} from './types';\n\nlet wasmSum: (xId: number, reduceSize: number, dtype: number, outId: number) =>\n   void;\n\nfunction setup(backend: BackendWasm): void {\n wasmSum = backend.wasm.cwrap(Sum, null /*void*/, [\n   'number', // input_id\n   'number', // reduce_size\n   'number', // dtype\n   'number', // out_id\n]);\n}\n\nfunction sum(args: {backend: BackendWasm, inputs: SumInputs, attrs: SumAttrs}):\n   TensorInfo {\n const {backend, inputs, attrs} = args;\n const {axis, keepDims} = attrs;\n const {x} = inputs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n let inputId = xId;\n let input = x;\n\n const {transposed, axes, originalAxes, inputWasTransposed} =\n   permuteAxesAndTranspose(x, axis, backend);\n\n let reductionAxes = axes;\n if (inputWasTransposed) {\n   const transposedId = backend.dataIdMap.get(transposed.dataId).id;\n   if (transposedId !== xId) {\n   // transpose was not a no-op. We will need to dispose of this\n   // once we are done.\n   input = transposed;\n   inputId = transposedId;\n   reductionAxes = backend_util.getInnerMostAxes(\n   reductionAxes.length, input.shape.length);\n   }\n }\n\n backend_util.assertAxesAreInnerMostDims(\n   'sum', reductionAxes, input.shape.length);\n const [outShape, reduceShape]\n =\n   backend_util.computeOutAndReduceShapes(input.shape, reductionAxes);\n const reduceSize = util.sizeFromShape(reduceShape);\n\n const out = backend.makeOutput(outShape, input.dtype);\n if

(util.sizeFromShape(input.shape) !== 0) {\n const outId = backend.dataIdMap.get(out.dataId).id;\n wasmSum(inputId, reduceSize, CppDType[out.dtype], outId);\n }\n\n if (inputWasTransposed) {\n // dispose of the transposed tensor.\n backend.disposeData(transposed.dataId);\n }\n\n if (keepDims) {\n // reshape\n const newShape = backend_util.expandShapeToKeepDim(out.shape, originalAxes);\n out.shape = newShape;\n }\n\n return out;\n}\n\nexport const sumConfig: KernelConfig = {\n kernelName: Sum,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: sum as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2021 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except
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==\n */\nimport {KernelConfig, Tan} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\nexport const tanConfig: KernelConfig = createUnaryKernelConfig(Tan);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n *
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==\n */\nimport {KernelConfig, Tanh} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\nexport const tanhConfig: KernelConfig = createUnaryKernelConfig(Tanh);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law
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==\n */\n\nimport {KernelConfig, KernelFunc, Tile, TileAttrs, TileInputs} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {CppDType} from './types';\n\nlet wasmTile: (\n xId: number, xShape: Uint8Array, xShapeSize: number, newShape: Uint8Array,\n newShapeSize: number, dtype: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmTile = backend.wasm.cwrap(Tile, null /* void */, [\n 'number', // x_id\n 'array', // x_shape\n 'number', // x_shape.length\n 'array', // new_shape\n 'number', // new_shape.length\n 'number' // out_id\n]);\n}\n\nfunction tile(\n args: {inputs: TileInputs, backend: BackendWasm, attrs: TileAttrs}) {\n const {inputs, backend, attrs} = args;\n const {x} = inputs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n const {reps} = attrs;\n\n const newShape: number[] = new Array(x.shape.length);\n for (let i = 0; i < newShape.length; i++) {\n newShape[i] = x.shape[i] * reps[i];\n }\n const xShapeBytes = new Uint8Array(new Int32Array(x.shape).buffer);\n const newShapeBytes = new Uint8Array(new Int32Array(newShape).buffer);\n\n const out = backend.makeOutput(newShape, x.dtype);\n const outId = backend.dataIdMap.get(out.dataId).id;\n wasmTile(\n xId, xShapeBytes, x.shape.length, newShapeBytes, newShape.length,\n CppDType[out.dtype], outId);\n return out;\n}\n\nexport const tileConfig: KernelConfig = {\n kernelName: Tile,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: tile as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All

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==========\n */\n\nimport {KernelConfig, KernelFunc, TensorInfo, TopK, TopKAttrs, TopKInputs} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\nimport {CppDType} from './types';\n\nlet wasmTopK: (\n    xId: number, xShapeBytes: Uint8Array, xShapeLength: number,\n    xDtype: CppDType, k: number, sorted: boolean, outValuesId:
 number,\n    outIndicesId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n  wasmTopK = backend.wasm.cwrap(TopK, null /* void */, [\n    'number',  // xId\n    'array',   // x.shape\n    'number',  // x.shape.length\n    'number',  // x.dtype\n    'number',  // k\n    'bool',    // sorted\n    'number',  // outValuesId\n    'number',  // outIndicesId\n  ]);\n}\n\nexport const topk:\n    (args: {inputs: TopKInputs, backend: BackendWasm, attrs: TopKAttrs}) =>\n        TensorInfo[] | TensorInfo = ({inputs, backend, attrs}) => {\n          const {x} = inputs;\n          const {k, sorted} = attrs;\n\n          const xId = backend.dataIdMap.get(x.dataId).id;\n          const xShapeBytes = new Uint8Array(new Int32Array(x.shape).buffer);\n          const outputShape = x.shape.slice();\n          outputShape[outputShape.length - 1] = k;\n          const outValues = backend.makeOutput(outputShape, x.dtype);\n          const outValuesId = backend.dataIdMap.get(outValues.dataId).id;\n
          const outIndices = backend.makeOutput(outputShape, 'int32');\n          const outIndicesId = backend.dataIdMap.get(outIndices.dataId).id;\n\n          wasmTopK(\n              xId, xShapeBytes, x.shape.length, CppDType[x.dtype], k, sorted,\n              outValuesId, outIndicesId);\n\n          return [outValues, outIndices];\n        };\n\nexport const topKConfig: KernelConfig = {\n  kernelName: TopK,\n  backendName: 'wasm',\n  setupFunc: setup,\n  kernelFunc: topk as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2021 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS
 OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {KernelConfig, KernelFunc, TensorInfo, Transform, TransformAttrs, TransformInputs, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmTransform: (\n    imageId: number, transformsId: number, isBatchTransform: boolean,\n    batch: number, outHeight: number, outWidth: number, numChannels: number,\n    imageWidth: number, imageHeight: number, strides: Uint8Array,\n    stridesLength: number, interpolationModeId: number, fillModeId: number,\n    fillValue: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n  wasmTransform = backend.wasm.cwrap(Transform, null /*void*/, [\n    'number',  // imageId\n    'number',  // transformsId\n    'bool',    // isBatchTransform\n    'number',  // batch\n    'number',  // outHeight\n    'number',  // outWidth\n    'number',  // numChannels\n    'number',  // imageWidth\n    'number',  // imageHeight\n    'array',   // strides\n    'number',  // stridesLength\n    'number',  // interpolationModeId\n    'number',  // fillModeId\n    'number',  // fillValue\n    'number'   // outId\n  ]);\n}\n\nfunction transform(\n    args:\n        {backend: BackendWasm, inputs: TransformInputs, attrs: TransformAttrs}):\n    TensorInfo {\n  const {backend, inputs, attrs} = args;\n  const {image, transforms} = inputs;\n  const {interpolation, fillMode, fillValue, outputShape} = attrs;\n\n  const [batch, imageHeight, imageWidth, numChannels] = image.shape;\n  const [outHeight, outWidth] =\n      outputShape != null ? outputShape : [imageHeight, imageWidth];\n  const outShape =\n      [batch, outHeight, outWidth,\n       numChannels] as
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[number, number, number, number];\n const strides =\n   new Uint8Array(new Int32Array(util.computeStrides(image.shape)).buffer);\n\n const out = backend.makeOutput(outShape, image.dtype);\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n const imageData = backend.dataIdMap.get(image.dataId);\n const imageId = imageData.id;\n\n const transformsData = backend.dataIdMap.get(transforms.dataId);\n const transformsId = transformsData.id;\n\n const interpolationModeId = interpolation === 'nearest' ? 1 : 2;\n let fillModeId;\n switch (fillMode) {\n   case 'constant':\n   fillModeId = 1;\n   break;\n   case 'reflect':\n   fillModeId = 2;\n   break;\n   case 'wrap':\n   fillModeId = 3;\n   break;\n   case 'nearest':\n   fillModeId = 4;\n   break;\n   default:\n   fillModeId = 1;\n   break;\n }\n\n wasmTransform(\n   imageId, transformsId, (transforms.shape[0] > 1), batch, outHeight,\n   outWidth, numChannels, imageWidth, imageHeight, strides,\n   image.shape.length - 1, interpolationModeId, fillModeId, fillValue,\n   outId);\n\n return out;\n}\n\nexport const transformConfig: KernelConfig = {\n kernelName: Transform,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: transform as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==\n */\n\nimport {KernelConfig, KernelFunc, TensorInfo, Unpack, UnpackAttrs, UnpackInputs} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {slice} from './Slice';\n\nfunction unpack(\n   args: {inputs: UnpackInputs, backend: BackendWasm, attrs: UnpackAttrs}):\n   TensorInfo[] {\n const {inputs, backend, attrs} = args;\n const {value} = inputs;\n let {axis} = attrs;\n\n if (axis < 0) {\n   axis += value.shape.length;\n }\n\n const numOutputs = value.shape[axis];\n const rank = value.shape.length;\n const outShape: number[] = new Array(rank - 1);\n let outIndex = 0;\n for (let i = 0; i < rank; i++) {\n   if (i !== axis) {\n   outShape[outIndex++] = value.shape[i];\n   }\n }\n const outs: TensorInfo[] = new Array(numOutputs);\n const begin = new Array(rank).fill(0);\n const size = value.shape.slice();\n size[axis] = 1;\n for (let i = 0; i < outs.length; i++) {\n   begin[axis] = i;\n   outs[i] = slice({inputs: {x: value}, attrs: {begin, size}, backend});\n }\n return outs.map(({dataId, dtype}) => ({dataId, dtype, shape: outShape}));\n}\n\nexport const unpackConfig: KernelConfig = {\n kernelName: Unpack,\n backendName: 'wasm',\n kernelFunc: unpack as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==\n */\n\nimport {KernelConfig, KernelFunc, ZerosLike, ZerosLikeInputs} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nfunction zerosLike(args: {inputs: ZerosLikeInputs, backend: BackendWasm}) {\n const {inputs: {x}, backend} = args;\n const out = backend.makeOutput(x.shape, x.dtype);\n const outVals = backend.typedArrayFromHeap(out);\n outVals.fill(0);\n return out;\n}\n\nexport const zerosLikeConfig: KernelConfig = {\n kernelName: ZerosLike,\n backendName: 'wasm',\n kernelFunc: zerosLike as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n *

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the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n//
We explicitly import the modular kernels so they get registered in the\n// global registry when we compile the library. A modular build would replace\n// the contents of this file and import only the kernels that are needed.\nimport {KernelConfig, registerKernel} from '@tensorflow/tfjs-core';\n\nimport {fusedMatMulConfig} from './kernels/_FusedMatMul';\nimport {absConfig} from './kernels/Abs';\nimport {addConfig} from './kernels/Add';\nimport {addNConfig} from './kernels/AddN';\nimport {allConfig} from './kernels/All';\nimport {anyConfig} from './kernels/Any';\nimport {argMaxConfig} from './kernels/ArgMax';\nimport {avgPoolConfig} from './kernels/AvgPool';\nimport {batchMatMulConfig} from './kernels/BatchMatMul';\nimport {batchToSpaceNDConfig} from './kernels/BatchToSpaceND';\nimport {castConfig} from './kernels/Cast';\nimport {ceilConfig} from './kernels/Ceil';\nimport {clipByValueConfig} from './kernels/ClipByValue';\nimport {concatConfig} from './kernels/Concat';\nimport {conv2DConfig} from './kernels/Conv2D';\nimport {conv2DBackpropInputConfig} from './kernels/Conv2DBackpropInput';\nimport {cosConfig} from './kernels/Cos';\nimport {coshConfig} from './kernels/Cosh';\nimport {cropAndResizeConfig} from './kernels/CropAndResize';\nimport {cumsumConfig} from './kernels/Cumsum';\nimport {depthToSpaceConfig} from './kernels/DepthToSpace';\nimport {depthwiseConv2dNativeConfig} from './kernels/DepthwiseConv2dNative';\nimport {eluConfig} from './kernels/Elu';\nimport {equalConfig} from './kernels/Equal';\nimport {expConfig} from './kernels/Exp';\nimport {expandDimsConfig} from './kernels/ExpandDims';\nimport {fillConfig} from './kernels/Fill';\nimport {flipLeftRightConfig} from './kernels/FlipLeftRight';\nimport {floorConfig} from './kernels/Floor';\nimport {floorDivConfig} from './kernels/FloorDiv';\nimport {fusedBatchNormConfig} from './kernels/FusedBatchNorm';\nimport {fusedConv2DConfig} from './kernels/FusedConv2D';\nimport {fusedDepthwiseConv2DConfig} from './kernels/FusedDepthwiseConv2D';\nimport {gatherNdConfig} from './kernels/GatherNd';\nimport {gatherV2Config} from './kernels/GatherV2';\nimport {greaterConfig} from './kernels/Greater';\nimport {greaterEqualConfig} from './kernels/GreaterEqual';\nimport {identityConfig} from './kernels/Identity';\nimport {leakyReluConfig} from './kernels/LeakyRelu';\nimport {lessConfig} from './kernels/Less';\nimport {lessEqualConfig} from './kernels/LessEqual';\nimport {logConfig} from './kernels/Log';\nimport {logicalAndConfig} from './kernels/LogicalAnd';\nimport {maxConfig} from './kernels/Max';\nimport {maximumConfig} from './kernels/Maximum';\nimport {maxPoolConfig} from './kernels/MaxPool';\nimport {meanConfig} from './kernels/Mean';\nimport {minConfig} from './kernels/Min';\nimport {minimumConfig} from './kernels/Minimum';\nimport {mirrorPadConfig} from './kernels/MirrorPad';\nimport {multiplyConfig} from './kernels/Multiply';\nimport {negConfig} from './kernels/Neg';\nimport {nonMaxSuppressionV3Config} from './kernels/NonMaxSuppressionV3';\nimport {nonMaxSuppressionV4Config} from './kernels/NonMaxSuppressionV4';\nimport {nonMaxSuppressionV5Config} from './kernels/NonMaxSuppressionV5';\nimport {notEqualConfig} from './kernels/NotEqual';\nimport {oneHotConfig} from './kernels/OneHot';\nimport {onesLikeConfig} from './kernels/OnesLike';\nimport {packConfig} from './kernels/Pack';\nimport {padV2Config} from './kernels/PadV2';\nimport {powConfig} from './kernels/Pow';\nimport {preluConfig} from './kernels/Prelu';\nimport {prodConfig} from './kernels/Prod';\nimport {rangeConfig} from './kernels/Range';\nimport {realDivConfig} from './kernels/RealDiv';\nimport {reluConfig} from './kernels/Relu';\nimport {relu6Config} from './kernels/Relu6';\nimport {reshapeConfig} from './kernels/Reshape';\nimport {resizeBilinearConfig} from './kernels/ResizeBilinear';\nimport {reverseConfig} from './kernels/Reverse';\nimport {rotateWithOffsetConfig} from './kernels/RotateWithOffset';\nimport {roundConfig} from

'./kernels/Round';\nimport {rsqrtConfig} from './kernels/Rsqrt';\nimport {scatterNdConfig} from
'./kernels/ScatterNd';\nimport {selectConfig} from './kernels/Select';\nimport {sigmoidConfig} from
'./kernels/Sigmoid';\nimport {sinConfig} from './kernels/Sin';\nimport {sliceConfig} from './kernels/Slice';\nimport
{softmaxConfig} from './kernels/Softmax';\nimport {spaceToBatchNDConfig} from
'./kernels/SpaceToBatchND';\nimport {splitVConfig} from './kernels/SplitV';\nimport {sqrtConfig} from
'./kernels/Sqrt';\nimport {squareConfig} from './kernels/Square';\nimport {squaredDifferenceConfig} from
'./kernels/SquaredDifference';\nimport {stepConfig} from './kernels/Step';\nimport {stridedSliceConfig} from
'./kernels/StridedSlice';\nimport {subConfig} from './kernels/Sub';\nimport {sumConfig} from
'./kernels/Sum';\nimport
{tanConfig} from './kernels/Tan';\nimport {tanhConfig} from './kernels/Tanh';\nimport {tileConfig} from
'./kernels/Tile';\nimport {topKConfig} from './kernels/TopK';\nimport {transformConfig} from
'./kernels/Transform';\nimport {transposeConfig} from './kernels/Transpose';\nimport {unpackConfig} from
'./kernels/Unpack';\nimport {zerosLikeConfig} from './kernels/ZerosLike';\n\n// List all kernel configs here\nconst
kernelConfigs: KernelConfig[] = [\n absConfig,\n addConfig,\n addNConfig,\n allConfig,\n anyConfig,\n
argMaxConfig,\n avgPoolConfig,\n batchMatMulConfig,\n batchToSpaceNDConfig,\n castConfig,\n
ceilConfig,\n clipByValueConfig,\n concatConfig,\n conv2DConfig,\n conv2DBackpropInputConfig,\n
cosConfig,\n coshConfig,\n cropAndResizeConfig,\n cumsumConfig,\n depthToSpaceConfig,\n
depthwiseConv2dNativeConfig,\n eluConfig,\n equalConfig,\n expConfig,\n expandDimsConfig,\n fillConfig,\n
flipLeftRightConfig,\n floorConfig,\n floorDivConfig,\n fusedMatMulConfig,\n
fusedBatchNormConfig,\n fusedConv2DConfig,\n fusedDepthwiseConv2DConfig,\n gatherNdConfig,\n
gatherV2Config,\n greaterConfig,\n greaterEqualConfig,\n identityConfig,\n leakyReluConfig,\n lessConfig,\n
lessEqualConfig,\n logConfig,\n logicalAndConfig,\n maxConfig,\n maximumConfig,\n maxPoolConfig,\n
meanConfig,\n minConfig,\n minimumConfig,\n mirrorPadConfig,\n multiplyConfig,\n negConfig,\n
nonMaxSuppressionV3Config,\n nonMaxSuppressionV4Config,\n nonMaxSuppressionV5Config,\n
notEqualConfig,\n oneHotConfig,\n onesLikeConfig,\n packConfig,\n padV2Config,\n powConfig,\n
preluConfig,\n prodConfig,\n rangeConfig,\n realDivConfig,\n reluConfig,\n relu6Config,\n reshapeConfig,\n
resizeBilinearConfig,\n reverseConfig,\n rotateWithOffsetConfig,\n rsqrtConfig,\n roundConfig,\n
scatterNdConfig,\n selectConfig,\n sigmoidConfig,\n sinConfig,\n sliceConfig,\n softmaxConfig,\n
spaceToBatchNDConfig,\n splitVConfig,\n sqrtConfig,\n
squareConfig,\n squaredDifferenceConfig,\n stepConfig,\n stridedSliceConfig,\n subConfig,\n sumConfig,\n
tanConfig,\n tanhConfig,\n tileConfig,\n topKConfig,\n transformConfig,\n transposeConfig,\n unpackConfig,\n
zerosLikeConfig\n];\n\nfor (const kernelConfig of kernelConfigs) {\n registerKernel(kernelConfig);\n}\n","/**\n *
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WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for
the specific language governing permissions and\n * limitations under the License.\n *
==\n
*/\n\nimport {env} from '@tensorflow/tfjs-core';\n\nconst ENV = env();\n\n/**\n * True if SIMD is supported.\n
*/\n// From: https://github.com/GoogleChromeLabs/wasm-feature-detect\nENV.registerFlag(\n // This typed array
passed in to WebAssembly.validate is WebAssembly binary\n // code. In this case it is a small program that
contains SIMD\n // instructions.\n 'WASM_HAS_SIMD_SUPPORT', async () => WebAssembly.validate(new
Uint8Array([\n 0, 97, 115, 109, 1, 0, 0, 0, 1, 4, 1, 96, 0, 0, 3,\n 2, 1, 0, 10, 9, 1, 7, 0, 65, 0, 253, 15, 26,
11\n])));\n\n/**\n * True if threads are supported.\n */\n// From: https://github.com/GoogleChromeLabs/wasm-
feature-detect\nENV.registerFlag('WASM_HAS_MULTITHREAD_SUPPORT', async () => {\n //
TODO(annxingyuan): Enable node support once this is resolved:\n //
https://github.com/tensorflow/tfjs/issues/3830\n if (ENV.get('IS_NODE')) {\n return false;\n }\n\n try {\n

// Test for transferability of SABs (needed for Firefox)\n // https://groups.google.com/forum/#!msg/mozilla.dev.platform/IHkBZlHETpA/dwsMNchWEQAJ\n new MessageChannel().port1.postMessage(new SharedArrayBuffer(1));\n // This typed array is a WebAssembly program containing threaded\n // instructions.\n return WebAssembly.validate(new Uint8Array([\n 0, 97, 115, 109, 1, 0, 0, 0, 1, 4, 1, 96, 0, 0, 3, 2, 1, 0, 5,\n 4, 1, 3, 1, 1, 10, 11, 1, 9, 0, 65, 0, 254, 16, 2, 0, 26, 11\n]));\n } catch (e) {\n return false;\n }\n});\n","\nvar WasmBackendModuleThreadedSimd = (function() {\n var _scriptDir = typeof document !== 'undefined' && document.currentScript ? document.currentScript.src : undefined;\n if (typeof __filename !== 'undefined') _scriptDir = _scriptDir || __filename;\n return (\nfunction(WasmBackendModuleThreadedSimd) {\n WasmBackendModuleThreadedSimd = WasmBackendModuleThreadedSimd || {};\n\n\nfunction GROWABLE_HEAP_I8(){if(wasmMemory.buffer!=buffer){updateGlobalBufferAndViews(wasmMemory.buffer)}return HEAP8}function GROWABLE_HEAP_U8(){if(wasmMemory.buffer!=buffer){updateGlobalBufferAndViews(wasmMemory.buffer)}return HEAPU8}function GROWABLE_HEAP_I32(){if(wasmMemory.buffer!=buffer){updateGlobalBufferAndViews(wasmMemory.buffer)}return HEAP32}function GROWABLE_HEAP_U32(){if(wasmMemory.buffer!=buffer){updateGlobalBufferAndViews(wasmMemory.buffer)}return HEAPU32}function GROWABLE_HEAP_F64(){if(wasmMemory.buffer!=buffer){updateGlobalBufferAndViews(wasmMemory.buffer)}return HEAPF64}var Module=typeof WasmBackendModuleThreadedSimd!==\"undefined\"?WasmBackendModuleThreadedSimd:{};var readyPromiseResolve,readyPromiseReject;Module[\"ready\"]=new Promise(function(resolve,reject){readyPromiseResolve=resolve;readyPromiseReject=reject});var moduleOverrides={};var key;for(key in Module){if(Module.hasOwnProperty(key)){moduleOverrides[key]=Module[key]}}var arguments_=[];var thisProgram=\"./this.program\";var quit_=function(status,toThrow){throw toThrow};var ENVIRONMENT_IS_WEB=false;var ENVIRONMENT_IS_WORKER=false;var ENVIRONMENT_IS_NODE=false;var ENVIRONMENT_IS_SHELL=false;ENVIRONMENT_IS_WEB=typeof window===\"object\";ENVIRONMENT_IS_WORKER=typeof importScripts===\"function\";ENVIRONMENT_IS_NODE=typeof process===\"object\"&&typeof process.versions===\"object\"&&typeof process.versions.node===\"string\";ENVIRONMENT_IS_SHELL=!ENVIRONMENT_IS_WEB&&!ENVIRONMENT_IS_NODE&&!ENVIRONMENT_IS_WORKER;var ENVIRONMENT_IS_PTHREAD=Module[\"ENVIRONMENT_IS_PTHREAD\"]||false;if(ENVIRONMENT_IS_PTHREAD){buffer=Module[\"buffer\"]}var scriptDirectory=\"\";function locateFile(path){if(Module[\"locateFile\"]){return Module[\"locateFile\"](path,scriptDirectory)}return scriptDirectory+path}var read_,readAsync,readBinary,setWindowTitle;var nodeFS;var nodePath;if(ENVIRONMENT_IS_NODE){if(ENVIRONMENT_IS_WORKER){scriptDirectory=require(\"path\").dirname(scriptDirectory)+\"/\"}else{scriptDirectory=__dirname+\"/\"}read_=function shell_read(filename,binary){if(!nodeFS)nodeFS=require(\"fs\");if(!nodePath)nodePath=require(\"path\");filename=nodePath[\"normalize\"](filename);return nodeFS[\"readFileSync\"](filename,binary?null:\"utf8\")};readBinary=function readBinary(filename){var ret=read_(filename,true);if(!ret.buffer){ret=new Uint8Array(ret)}assert(ret.buffer);return ret};if(process[\"argv\"].length>1){thisProgram=process[\"argv\"][1].replace(/\\\\/g,\"/\")}arguments_=process[\"argv\"].slice(2);process[\"on\"](\"uncaughtException\",function(ex){if(!(ex instanceof ExitStatus)){throw ex}});process[\"on\"](\"unhandledRejection\",abort);quit_=function(status){process[\"exit\"](status)};Module[\"inspect\"]=function(){return\"[Emscripten Module object]\"};var

nodeWorkerThreads;try{nodeWorkerThreads=require(\"worker_threads\")}catch(e){console.error('The \"worker_threads\" module is not supported in this node.js build - perhaps a newer version is needed?');throw e}global.Worker=nodeWorkerThreads.Worker}else if(ENVIRONMENT_IS_SHELL){if(typeof read!=\"undefined\"){read_=function shell_read(f){return read(f)}}readBinary=function readBinary(f){var data;if(typeof readbuffer===\"function\"){return new Uint8Array(readbuffer(f))}data=read(f,\"binary\");assert(typeof data===\"object\");return data};if(typeof scriptArgs!=\"undefined\"){arguments_=scriptArgs}else if(typeof arguments!=\"undefined\"){arguments_=arguments}if(typeof quit===\"function\"){quit_=function(status){quit(status)}}if(typeof print!==\"undefined\"){if(typeof console===\"undefined\")console={};console.log=print;console.warn=console.error=typeof printErr!==\"undefined\"?printErr:print}}else if(ENVIRONMENT_IS_WEB||ENVIRONMENT_IS_WORKER){if(ENVIRONMENT_IS_WORKER){scriptDirectory=self.location.href}else if(typeof document!==\"undefined\"&&document.currentScript){scriptDirectory=document.currentScript.src}if(typeof _scriptDir !== \"undefined\" && _scriptDir){scriptDirectory=_scriptDir}if(scriptDirectory.indexOf(\"blob:\")!==0){scriptDirectory=scriptDirectory.substr(0,scriptDirectory.lastIndexOf(\"/\")+1)}else{scriptDirectory=\"\"}if(ENVIRONMENT_IS_NODE){read_=function shell_read(filename,binary){if(!nodeFS)nodeFS=require(\"fs\");if(!nodePath)nodePath=require(\"path\");filename=nodePath[\"normalize\"](filename);return nodeFS[\"readFileSync\"](filename,binary?null:\"utf8\")};readBinary=function readBinary(filename){var ret=read_(filename,true);if(!ret.buffer){ret=new Uint8Array(ret)}assert(ret.buffer);return ret}}else{read_=function(url){var xhr=new XMLHttpRequest;xhr.open(\"GET\",url,false);xhr.send(null);return xhr.responseText};if(ENVIRONMENT_IS_WORKER){readBinary=function(url){var xhr=new XMLHttpRequest;xhr.open(\"GET\",url,false);xhr.responseType=\"arraybuffer\";xhr.send(null);return new Uint8Array(xhr.response)}}readAsync=function(url,onload,onerror){var xhr=new XMLHttpRequest;xhr.open(\"GET\",url,true);xhr.responseType=\"arraybuffer\";xhr.onload=function(){if(xhr.status==200||xhr.status==0&&xhr.response){onload(xhr.response);return}onerror()};xhr.onerror=onerror;xhr.send(null)}}setWindowTitle=function(title){document.title=title}}else{}if(ENVIRONMENT_IS_NODE){if(typeof performance===\"undefined\"){global.performance=require(\"perf_hooks\").performance}}var out=Module[\"print\"]||console.log.bind(console);var err=Module[\"printErr\"]||console.warn.bind(console);for(key in moduleOverrides){if(moduleOverrides.hasOwnProperty(key)){Module[key]=moduleOverrides[key]}}moduleOverrides=null;if(Module[\"arguments\"])arguments_=Module[\"arguments\"];if(Module[\"thisProgram\"])thisProgram=Module[\"thisProgram\"];if(Module[\"quit\"])quit_=Module[\"quit\"];function warnOnce(text){if(!warnOnce.shown)warnOnce.shown={};if(!warnOnce.shown[text]){warnOnce.shown[text]=1;err(text)}}var Atomics_load=Atomics.load;var Atomics_store=Atomics.store;var Atomics_compareExchange=Atomics.compareExchange;var wasmBinary;if(Module[\"wasmBinary\"])wasmBinary=Module[\"wasmBinary\"];var noExitRuntime=Module[\"noExitRuntime\"]||true;if(typeof WebAssembly!==\"object\"){abort(\"no native wasm support detected\")}var wasmMemory;var wasmModule;var ABORT=false;var EXITSTATUS;function assert(condition,text){if(!condition){abort(\"Assertion failed: \"+text)}}function getCFunc(ident){var func=Module[\"_\"+ident];assert(func,\"Cannot call unknown function \"+ident+\", make sure it is exported\");return func}function ccall(ident,returnType,argTypes,args,opts){var toC={\"string\":function(str){var ret=0;if(str!==null&&str!==undefined&&str!==0){var len=(str.length<<2)+1;ret=stackAlloc(len);stringToUTF8(str,ret,len)}return ret},\"array\":function(arr){var ret=stackAlloc(arr.length);writeArrayToMemory(arr,ret);return ret}};function convertReturnValue(ret){if(returnType===\"string\")return UTF8ToString(ret);if(returnType===\"boolean\")return

Boolean(ret);return ret}var func=getCFunc(ident);var cArgs=[];var stack=0;if(args){for(var i=0;i<args.length;i++){var converter=toC[argTypes[i]];if(converter){if(stack===0)stack=stackSave();cArgs[i]=converter(args[i])}else{cArgs[i]=args[i]}}}var ret=func.apply(null,cArgs);ret=convertReturnValue(ret);if(stack!==0)stackRestore(stack);return ret}function cwrap(ident,returnType,argTypes,opts){argTypes=argTypes||[];var numericArgs=argTypes.every(function(type){return type===\"number\"});var numericRet=returnType!==\"string\";if(numericRet&&numericArgs&&!opts){return getCFunc(ident)}return function(){return ccall(ident,returnType,argTypes,arguments,opts)}}function UTF8ArrayToString(heap,idx,maxBytesToRead){var endIdx=idx+maxBytesToRead;var str=\"\";while(!(idx>=endIdx)){var u0=heap[idx++];if(!u0)return str;if(!(u0&128)){str+=String.fromCharCode(u0);continue}var u1=heap[idx++]&63;if((u0&224)==192){str+=String.fromCharCode((u0&31)<<6|u1);continue}var u2=heap[idx++]&63;if((u0&240)==224){u0=(u0&15)<<12|u1<<6|u2}else{u0=(u0&7)<<18|u1<<12|u2<<6|heap[idx++]&63}if(u0<65536){str+=String.fromCharCode(u0)}else{var ch=u0-65536;str+=String.fromCharCode(55296|ch>>10,56320|ch&1023)}}return str}function UTF8ToString(ptr,maxBytesToRead){return ptr?UTF8ArrayToString(GROWABLE_HEAP_U8(),ptr,maxBytesToRead):\"\"}function stringToUTF8Array(str,heap,outIdx,maxBytesToWrite){if(!(maxBytesToWrite>0))return 0;var startIdx=outIdx;var endIdx=outIdx+maxBytesToWrite-1;for(var i=0;i<str.length;++i){var u=str.charCodeAt(i);if(u>=55296&&u<=57343){var u1=str.charCodeAt(++i);u=65536+((u&1023)<<10)|u1&1023}if(u<=127){if(outIdx>=endIdx)break;heap[outIdx++]=u}else if(u<=2047){if(outIdx+1>=endIdx)break;heap[outIdx++]=192|u>>6;heap[outIdx++]=128|u&63}else if(u<=65535){if(outIdx+2>=endIdx)break;heap[outIdx++]=224|u>>12;heap[outIdx++]=128|u>>6&63;heap[outIdx++]=128|u&63}else{if(outIdx+3>=endIdx)break;heap[outIdx++]=240|u>>18;heap[outIdx++]=128|u>>12&63;heap[outIdx++]=128|u>>6&63;heap[outIdx++]=128|u&63}}heap[outIdx]=0;return outIdx-startIdx}function stringToUTF8(str,outPtr,maxBytesToWrite){return stringToUTF8Array(str,GROWABLE_HEAP_U8(),outPtr,maxBytesToWrite)}function lengthBytesUTF8(str){var len=0;for(var i=0;i<str.length;++i){var u=str.charCodeAt(i);if(u>=55296&&u<=57343)u=65536+((u&1023)<<10)|str.charCodeAt(++i)&1023;if(u<=127)++len;else if(u<=2047)len+=2;else if(u<=65535)len+=3;else len+=4}return len}function writeArrayToMemory(array,buffer){GROWABLE_HEAP_I8().set(array,buffer)}function alignUp(x,multiple){if(x%multiple>0){x+=multiple-x%multiple}return x}var buffer,HEAP8,HEAPU8,HEAP16,HEAPU16,HEAP32,HEAPU32,HEAPF32,HEAPF64;function updateGlobalBufferAndViews(buf){buffer=buf;Module[\"HEAP8\"]=HEAP8=new Int8Array(buf);Module[\"HEAP16\"]=HEAP16=new Int16Array(buf);Module[\"HEAP32\"]=HEAP32=new Int32Array(buf);Module[\"HEAPU8\"]=HEAPU8=new Uint8Array(buf);Module[\"HEAPU16\"]=HEAPU16=new Uint16Array(buf);Module[\"HEAPU32\"]=HEAPU32=new Uint32Array(buf);Module[\"HEAPF32\"]=HEAPF32=new Float32Array(buf);Module[\"HEAPF64\"]=HEAPF64=new Float64Array(buf)}var INITIAL_MEMORY=Module[\"INITIAL_MEMORY\"]||16777216;if(ENVIRONMENT_IS_PTHREAD){wasmMemory=Module[\"wasmMemory\"];buffer=Module[\"buffer\"]}else{if(Module[\"wasmMemory\"]){wasmMemory=Module[\"wasmMemory\"]}else{wasmMemory=new WebAssembly.Memory({\"initial\":INITIAL_MEMORY/65536,\"maximum\":2147483648/65536,\"shared\":true});if(!(wasmMemory.buffer instanceof SharedArrayBuffer)){err(\"requested a shared WebAssembly.Memory but the returned buffer is not a SharedArrayBuffer, indicating that while the browser has SharedArrayBuffer it does not have WebAssembly threads support - you may need to set a flag\");if(ENVIRONMENT_IS_NODE){console.log(\"(on node you may need: --experimental-wasm-threads --

experimental-wasm-bulk-memory and also use a recent version)\")}throw Error(\"bad memory\")}}}if(wasmMemory){buffer=wasmMemory.buffer}INITIAL_MEMORY=buffer.byteLength;updateGlobalBufferAndViews(buffer);var wasmTable;var __ATPRERUN__=[];var __ATINIT__=[];var __ATMAIN__=[];var __ATEXIT__=[];var __ATPOSTRUN__=[];var runtimeInitialized=false;var runtimeExited=false;if(!ENVIRONMENT_IS_PTHREAD)__ATINIT__.push({func:function(){___wasm_call_ctors()}});function preRun(){if(ENVIRONMENT_IS_PTHREAD)return;if(Module[\"preRun\"]){if(typeof Module[\"preRun\"]==\"function\")Module[\"preRun\"]=[Module[\"preRun\"]];while(Module[\"preRun\"].length){addOnPreRun(Module[\"preRun\"].shift())}}callRuntimeCallbacks(__ATPRERUN__)}function initRuntime(){runtimeInitialized=true;if(ENVIRONMENT_IS_PTHREAD)return;callRuntimeCallbacks(__ATINIT__)}function preMain(){if(ENVIRONMENT_IS_PTHREAD)return;callRuntimeCallbacks(__ATMAIN__)}function exitRuntime(){if(ENVIRONMENT_IS_PTHREAD)return;runtimeExited=true}function postRun(){if(ENVIRONMENT_IS_PTHREAD)return;if(Module[\"postRun\"]){if(typeof Module[\"postRun\"]==\"function\")Module[\"postRun\"]=[Module[\"postRun\"]];while(Module[\"postRun\"].length){addOnPostRun(Module[\"postRun\"].shift())}}callRuntimeCallbacks(__ATPOSTRUN__)}function addOnPreRun(cb){__ATPRERUN__.unshift(cb)}function addOnPostRun(cb){__ATPOSTRUN__.unshift(cb)}var runDependencies=0;var runDependencyWatcher=null;var dependenciesFulfilled=null;function addRunDependency(id){assert(!ENVIRONMENT_IS_PTHREAD,\"addRunDependency cannot be used in a pthread worker\");runDependencies++;if(Module[\"monitorRunDependencies\"]){Module[\"monitorRunDependencies\"](runDependencies)}}function removeRunDependency(id){runDependencies--;if(Module[\"monitorRunDependencies\"]){Module[\"monitorRunDependencies\"](runDependencies)}if(runDependencies==0){if(runDependencyWatcher!==null){clearInterval(runDependencyWatcher);runDependencyWatcher=null}if(dependenciesFulfilled){var callback=dependenciesFulfilled;dependenciesFulfilled=null;callback()}}}Module[\"preloadedImages\"]={};Module[\"preloadedAudios\"]={};function abort(what){if(Module[\"onAbort\"]){Module[\"onAbort\"](what)}if(ENVIRONMENT_IS_PTHREAD)console.error(\"Pthread aborting at \"+(new Error).stack);what+=\"\";err(what);ABORT=true;EXITSTATUS=1;what=\"abort(\"+what+\"). Build with -s ASSERTIONS=1 for more info.\";var e=new WebAssembly.RuntimeError(what);readyPromiseReject(e);throw e}function hasPrefix(str,prefix){return String.prototype.startsWith?str.startsWith(prefix):str.indexOf(prefix)===0}var dataURIPrefix=\"data:application/octet-stream; base64,\";function isDataURI(filename){return hasPrefix(filename,dataURIPrefix)}var fileURIPrefix=\"file://\";function isFileURI(filename){return hasPrefix(filename,fileURIPrefix)}var wasmBinaryFile=\"tfjs-backend-wasm-threaded-simd.wasm\";if(!isDataURI(wasmBinaryFile)){wasmBinaryFile=locateFile(wasmBinaryFile)}function getBinary(file){try{if(file==wasmBinaryFile&&wasmBinary){return new Uint8Array(wasmBinary)}if(readBinary){return readBinary(file)}else{throw\"both async and sync fetching of the wasm failed\"}}catch(err){abort(err)}}function getBinaryPromise(){if(!wasmBinary&&(ENVIRONMENT_IS_WEB||ENVIRONMENT_IS_WORKER)){if(typeof fetch===\"function\"&&!isFileURI(wasmBinaryFile)){return fetch(wasmBinaryFile,{credentials:\"same-origin\"}).then(function(response){if(!response[\"ok\"]){throw\"failed to load wasm binary file at '\"+wasmBinaryFile+\"'\"}return response[\"arrayBuffer\"]()}).catch(function(){return getBinary(wasmBinaryFile)})}else{if(readAsync){return new Promise(function(resolve,reject){readAsync(wasmBinaryFile,function(response){resolve(new Uint8Array(response))},reject)})}}}return Promise.resolve().then(function(){return getBinary(wasmBinaryFile)})}function createWasm(){var info={\"a\":asmLibraryArg};function

receiveInstance(instance,module){var exports=instance.exports;Module[\"asm\"]=exports;wasmTable=Module[\"asm\"][\"I\"];wasmModule=module;if(!ENVIRONMENT_IS_PTHREAD){var numWorkersToLoad=PThread.unusedWorkers.length;PThread.unusedWorkers.forEach(function(w){PThread.loadWasmModuleToWorker(w,function(){if(!--numWorkersToLoad)removeRunDependency(\"wasm-instantiate\")})})}if(!ENVIRONMENT_IS_PTHREAD){addRunDependency(\"wasm-instantiate\")}function receiveInstantiatedSource(output){receiveInstance(output[\"instance\"],output[\"module\"])}function instantiateArrayBuffer(receiver){return getBinaryPromise().then(function(binary){return WebAssembly.instantiate(binary,info)}).then(receiver,function(reason){err(\"failed to asynchronously prepare wasm: \"+reason);abort(reason)})}function instantiateAsync(){if(!wasmBinary&&typeof WebAssembly.instantiateStreaming===\"function\"&&!isDataURI(wasmBinaryFile)&&!isFileURI(wasmBinaryFile)&&typeof fetch===\"function\"){return fetch(wasmBinaryFile,{credentials:\"same-origin\"}).then(function(response){var result=WebAssembly.instantiateStreaming(response,info);return result.then(receiveInstantiatedSource,function(reason){err(\"wasm streaming compile failed: \"+reason);err(\"falling back to ArrayBuffer instantiation\");return instantiateArrayBuffer(receiveInstantiatedSource)})})}else{return instantiateArrayBuffer(receiveInstantiatedSource)}}if(Module[\"instantiateWasm\"]){try{var exports=Module[\"instantiateWasm\"](info,receiveInstance);return exports}catch(e){err(\"Module.instantiateWasm callback failed with error: \"+e);return false}}instantiateAsync().catch(readyPromiseReject);return{}}var ASM_CONSTS={10520:function(){throw\"Canceled!\"},10538:function($0,$1){setTimeout(function(){__emscripten_do_dispatch_to_thread($0,$1)},0)}};function initPthreadsJS(){PThread.initRuntime()}function callRuntimeCallbacks(callbacks){while(callbacks.length>0){var callback=callbacks.shift();if(typeof callback==\"function\"){callback(Module);continue}var func=callback.func;if(typeof func===\"number\"){if(callback.arg===undefined){wasmTable.get(func)()}else{wasmTable.get(func)(callback.arg)}}else{func(callback.arg===undefined?null:callback.arg)}}}var ERRNO_CODES={EPERM:63,ENOENT:44,ESRCH:71,EINTR:27,EIO:29,ENXIO:60,E2BIG:1,ENOEXEC:45,EBADF:8,ECHILD:12,EAGAIN:6,EWOULDBLOCK:6,ENOMEM:48,EACCES:2,EFAULT:21,ENOTBLK:105,EBUSY:10,EEXIST:20,EXDEV:75,ENODEV:43,ENOTDIR:54,EISDIR:31,EINVAL:28,ENFILE:41,EMFILE:33,ENOTTY:59,ETXTBSY:74,EFBIG:22,ENOSPC:51,ESPIPE:70,EROFS:69,EMLINK:34,EPIPE:64,EDOM:18,ERANGE:68,ENOMSG:49,EIDRM:24,ECHRNG:106,EL2NSYNC:156,EL3HLT:107,EL3RST:108,ELNRNG:109,EUNATCH:110,ENOCSI:111,EL2HLT:112,EDEADLK:16,ENOLCK:46,EBADE:113,EBADR:114,EXFULL:115,ENOANO:104,EBADRQC:103,EBADSLT:102,EDEADLOCK:16,EBFONT:101,ENOSTR:100,ENODATA:116,ETIME:117,ENOSR:118,ENONET:119,ENOPKG:120,EREMOTE:121,ENOLINK:47,EADV:122,ESRMNT:123,ECOMM:124,EPROTO:65,EMULTIHOP:36,EDOTDOT:125,EBADMSG:9,ENOTUNIQ:126,EBADFD:127,EREMCHG:128,ELIBACC:129,ELIBBAD:130,ELIBSCN:131,ELIBMAX:132,ELIBEXEC:133,ENOSYS:52,ENOTEMPTY:55,ENAMETOOLONG:37,ELOOP:32,EOPNOTSUPP:138,EPFNOSUPPORT:139,ECONNRESET:15,ENOBUFS:42,EAFNOSUPPORT:5,EPROTOTYPE:67,ENOTSOCK:57,ENOPROTOOPT:50,ESHUTDOWN:140,ECONNREFUSED:14,EADDRINUSE:3,ECONNABORTED:13,ENETUNREACH:40,ENETDOWN:38,ETIMEDOUT:73,EHOSTDOWN:142,EHOSTUNREACH:23,EINPROGRESS:26,EALREADY:7,EDESTADDRREQ:17,EMSGSIZE:35,EPROTONOSUPPORT:66,ESOCKTNOSUPPORT:137,EADDRNOTAVAIL:4,ENETRESET:39,EISCONN:30,ENOTCONN:53,ETOOMANYREFS:141,EUSERS:136,EDQUOT:19,ESTALE:72,ENOTSUP:138,ENOMEDIUM:148,EILSEQ:25,EOVERFLOW:61,ECANCELED:11,ENOTRECOVERABLE:56,EOWNERDEAD:62,ESTRPIPE:135};function _emscripten_futex_wake(addr,count){if(addr<=0||addr>GROWABLE_HEAP_I8().length||addr&3!=0||count<0)return-28;if(count==0)return 0;if(count>=2147483647)count=Infinity;var mainThreadWaitAddress=Atomics.load(GROWABLE_HEAP_I32(),__emscripten_main_thread_futex>>2);var mainThreadWoken=0;if(mainThreadWaitAddress==addr){var loadedAddr=Atomics.compareExchange(GROWABLE_HEAP_I32(),__emscripten_main_thread_futex>>2,mainThreadWaitAddress,0);if(loadedAddr==mainThreadWaitAddress){--count;mainThreadWoken=1;if(count<=0)return

1}}var ret=Atomics.notify(GROWABLE_HEAP_I32(),addr>>2,count);if(ret>=0)return ret+mainThreadWoken;throw\"Atomics.notify returned an unexpected value \"+ret}Module[\"_emscripten_futex_wake\"]=_emscripten_futex_wake;function killThread(pthread_ptr){if(ENVIRONMENT_IS_PTHREAD)throw\"Internal Error! killThread() can only ever be called from main application thread!\";if(!pthread_ptr)throw\"Internal Error! Null pthread_ptr in killThread!\";GROWABLE_HEAP_I32()[pthread_ptr+12>>2]=0;var pthread=PThread.pthreads[pthread_ptr];pthread.worker.terminate();PThread.freeThreadData(pthread);PThread.runningWorkers.splice(PThread.runningWorkers.indexOf(pthread.worker),1);pthread.worker.pthread=undefined}function cancelThread(pthread_ptr){if(ENVIRONMENT_IS_PTHREAD)throw\"Internal Error! cancelThread() can only ever be called from main application thread!\";if(!pthread_ptr)throw\"Internal Error! Null pthread_ptr in cancelThread!\";var pthread=PThread.pthreads[pthread_ptr];pthread.worker.postMessage({\"cmd\":\"cancel\"})}function cleanupThread(pthread_ptr){if(ENVIRONMENT_IS_PTHREAD)throw\"Internal Error! cleanupThread() can only ever be called from main application thread!\";if(!pthread_ptr)throw\"Internal Error! Null pthread_ptr in cleanupThread!\";var pthread=PThread.pthreads[pthread_ptr];if(pthread){GROWABLE_HEAP_I32()[pthread_ptr+12>>2]=0;var worker=pthread.worker;PThread.returnWorkerToPool(worker)}}var PThread={unusedWorkers:[],runningWorkers:[],initMainThreadBlock:function(){var pthreadPoolSize=8;for(var i=0;i<pthreadPoolSize;++i){PThread.allocateUnusedWorker()}},initRuntime:function(){var tb=_malloc(228);for(var i=0;i<228/4;++i)GROWABLE_HEAP_U32()[tb/4+i]=0;GROWABLE_HEAP_I32()[tb+12>>2]=tb;var headPtr=tb+152;GROWABLE_HEAP_I32()[headPtr>>2]=headPtr;var tlsMemory=_malloc(512);for(var i=0;i<128;++i)GROWABLE_HEAP_U32()[tlsMemory/4+i]=0;Atomics.store(GROWABLE_HEAP_U32(),tb+100>>2,tlsMemory);Atomics.store(GROWABLE_HEAP_U32(),tb+40>>2,tb);__emscripten_thread_init(tb,!ENVIRONMENT_IS_WORKER,1);_emscripten_register_main_browser_thread_id(tb)},initWorker:function(){},pthreads:{},threadExitHandlers:[],setThreadStatus:function(){},runExitHandlers:function(){while(PThread.threadExitHandlers.length>0){PThread.threadExitHandlers.pop()()}if(ENVIRONMENT_IS_PTHREAD&&_pthread_self())___pthread_tsd_run_dtors()},runExitHandlersAndDeinitThread:function(tb,exitCode){Atomics.store(GROWABLE_HEAP_U32(),tb+56>>2,1);Atomics.store(GROWABLE_HEAP_U32(),tb+60>>2,0);PThread.runExitHandlers();Atomics.store(GROWABLE_HEAP_U32(),tb+4>>2,exitCode);Atomics.store(GROWABLE_HEAP_U32(),tb+0>>2,1);_emscripten_futex_wake(tb+0,2147483647);__emscripten_thread_init(0,0,0)},threadExit:function(exitCode){var tb=_pthread_self();if(tb){PThread.runExitHandlersAndDeinitThread(tb,exitCode);if(ENVIRONMENT_IS_PTHREAD){postMessage({\"cmd\":\"exit\"})}}},threadCancel:function(){PThread.runExitHandlersAndDeinitThread(_pthread_self(),-1);postMessage({\"cmd\":\"cancelDone\"})},terminateAllThreads:function(){for(var t in PThread.pthreads){var pthread=PThread.pthreads[t];if(pthread&&pthread.worker){PThread.returnWorkerToPool(pthread.worker)}}PThread.pthreads={};for(var i=0;i<PThread.unusedWorkers.length;++i){var worker=PThread.unusedWorkers[i];worker.terminate()}PThread.unusedWorkers=[];for(var i=0;i<PThread.runningWorkers.length;++i){var worker=PThread.runningWorkers[i];var pthread=worker.pthread;PThread.freeThreadData(pthread);worker.terminate()}PThread.runningWorkers=[]},freeThreadData:function(pthread){if(!pthread)return;if(pthread.threadInfoStruct){var tlsMemory=GROWABLE_HEAP_I32()[pthread.threadInfoStruct+100>>2];GROWABLE_HEAP_I32()[pthread.threadInfoStruct+100>>2]=0;_free(tlsMemory);_free(pthread.threadInfoStruct)}pthread.threadInfoStruct=0;if(pthread.allocatedOwnStack&&pthread.stackBase)_free(pthread.stackBase);pthread.stackBase=0;if(pthread.worker)pthread.worker.pthread=null},returnWorkerToPool:function(worker){PThread.runWithoutMainThreadQueuedCalls(function(){delete PThread.pthreads[worker.pthread.threadInfoStruct];PThread.unusedWorkers.push(worker);PThread.runningWorker

s.splice(PThread.runningWorkers.indexOf(worker),1);PThread.freeThreadData(worker.pthread);worker.pthread=undefined})},runWithoutMainThreadQueuedCalls:function(func){GROWABLE_HEAP_I32()[__emscripten_allow_main_runtime_queued_calls>>2]=0;try{func()}finally{GROWABLE_HEAP_I32()[__emscripten_allow_main_runtime_queued_calls>>2]=1}},receiveObjectTransfer:function(data){},loadWasmModuleToWorker:function(worker,onFinishedLoading){worker.onmessage=function(e){var
d=e[\"data\"];var
cmd=d[\"cmd\"];if(worker.pthread)PThread.currentProxiedOperationCallerThread=worker.pthread.threadInfoStruct;if(d[\"targetThread\"]&&d[\"targetThread\"]!=_pthread_self()){var
thread=PThread.pthreads[d.targetThread];if(thread){thread.worker.postMessage(e.data,d[\"transferList\"])}else{console.error('Internal error! Worker sent a message \"'+cmd+'\" to target pthread '+d[\"targetThread\"]+\", but that thread no longer
exists!\")}PThread.currentProxiedOperationCallerThread=undefined;return}if(cmd===\"processQueuedMainThreadWork\"){_emscripten_main_thread_process_queued_calls()}else
if(cmd===\"spawnThread\"){spawnThread(e.data)}else
if(cmd===\"cleanupThread\"){cleanupThread(d[\"thread\"])}else
if(cmd===\"killThread\"){killThread(d[\"thread\"])}else
if(cmd===\"cancelThread\"){cancelThread(d[\"thread\"])}else
if(cmd===\"loaded\"){worker.loaded=true;if(onFinishedLoading)onFinishedLoading(worker);if(worker.runPthread){worker.runPthread();delete
worker.runPthread}}else if(cmd===\"print\"){out(\"Thread \"+d[\"threadId\"]+\": \"+d[\"text\"])}else
if(cmd===\"printErr\"){err(\"Thread \"+d[\"threadId\"]+\": \"+d[\"text\"])}else if(cmd===\"alert\"){alert(\"Thread \"+d[\"threadId\"]+\": \"+d[\"text\"])}else if(cmd===\"exit\"){var
detached=worker.pthread&&Atomics.load(GROWABLE_HEAP_U32(),worker.pthread.threadInfoStruct+64>>2);if(detached){PThread.returnWorkerToPool(worker)}}else
if(cmd===\"exitProcess\"){try{exit(d[\"returnCode\"])}catch(e){if(e instanceof ExitStatus)return;throw e}}else
if(cmd===\"cancelDone\"){PThread.returnWorkerToPool(worker)}else
if(cmd===\"objectTransfer\"){PThread.receiveObjectTransfer(e.data)}else
if(e.data.target===\"setimmediate\"){worker.postMessage(e.data)}else{err(\"worker sent an unknown command \"+cmd)}PThread.currentProxiedOperationCallerThread=undefined};worker.onerror=function(e){err(\"pthread sent an error! \"+e.filename+\":\"+e.lineno+\":
\"+e.message)};if(ENVIRONMENT_IS_NODE){worker.on(\"message\",function(data){worker.onmessage({data:data})});worker.on(\"error\",function(data){worker.onerror(data)});worker.on(\"exit\",function(data){})}worker.postMessage({\"cmd\":\"load\",\"urlOrBlob\":Module[\"mainScriptUrlOrBlob\"]||_scriptDir,\"wasmMemory\":wasmMemory,\"wasmModule\":wasmModule})},allocateUnusedWorker:function(){var
pthreadMainJs=locateFile(\"tfjs-backend-wasm-threaded-simd.worker.js\");PThread.unusedWorkers.push(new Worker(pthreadMainJs))},getNewWorker:function(){if(PThread.unusedWorkers.length==0){PThread.allocateUnusedWorker();PThread.loadWasmModuleToWorker(PThread.unusedWorkers[0])}if(PThread.unusedWorkers.length>0)return PThread.unusedWorkers.pop();else return null},busySpinWait:function(msecs){var
t=performance.now()+msecs;while(performance.now()<t){}}};function
establishStackSpace(stackTop,stackMax){_emscripten_stack_set_limits(stackTop,stackMax);stackRestore(stackTop)}Module[\"establishStackSpace\"]=establishStackSpace;function getNoExitRuntime(){return
noExitRuntime}Module[\"getNoExitRuntime\"]=getNoExitRuntime;function invokeEntryPoint(ptr,arg){return
wasmTable.get(ptr)(arg)}Module[\"invokeEntryPoint\"]=invokeEntryPoint;function
___assert_fail(condition,filename,line,func){abort(\"Assertion failed: \"+UTF8ToString(condition)+\", at:
\"+[filename?UTF8ToString(filename):\"unknown filename\",line,func?UTF8ToString(func):\"unknown function\"])}function ___call_main(argc,argv){var returnCode=_main(argc,argv)}var
_emscripten_get_now;if(ENVIRONMENT_IS_NODE){_emscripten_get_now=function(){var
t=process[\"hrtime\"]();return t[0]*1e3+t[1]/1e6}}else

if(ENVIRONMENT_IS_PTHREAD){_emscripten_get_now=function(){return performance.now()-Module[\"__performance_now_clock_drift\"]}}else if(typeof dateNow!==\"undefined\"){_emscripten_get_now=dateNow}else _emscripten_get_now=function(){return performance.now()};function setErrNo(value){GROWABLE_HEAP_I32()[___errno_location()>>2]=value;return value}function _atexit(func,arg){if(ENVIRONMENT_IS_PTHREAD)return _emscripten_proxy_to_main_thread_js(1,1,func,arg)}function __emscripten_notify_thread_queue(targetThreadId,mainThreadId){if(targetThreadId==mainThreadId){postMessage({\"cmd\":\"processQueuedMainThreadWork\"})}else if(ENVIRONMENT_IS_PTHREAD){postMessage({\"targetThread\":targetThreadId,\"cmd\":\"processThreadQueue\"})}else{var pthread=PThread.pthreads[targetThreadId];var worker=pthread&&pthread.worker;if(!worker){return}worker.postMessage({\"cmd\":\"processThreadQueue\"})}return 1}function _abort(){abort()}function _emscripten_asm_const_int(code,sigPtr,argbuf){var args=readAsmConstArgs(sigPtr,argbuf);return ASM_CONSTS[code].apply(null,args)}function _emscripten_conditional_set_current_thread_status(expectedStatus,newStatus){}function _emscripten_futex_wait(addr,val,timeout){if(addr<=0||addr>GROWABLE_HEAP_I8().length||addr&3!=0)return-28;if(!ENVIRONMENT_IS_WEB){var ret=Atomics.wait(GROWABLE_HEAP_I32(),addr>>2,val,timeout);if(ret===\"timed-out\")return-73;if(ret===\"not-equal\")return-6;if(ret===\"ok\")return 0;throw\"Atomics.wait returned an unexpected value \"+ret}else{if(Atomics.load(GROWABLE_HEAP_I32(),addr>>2)!=val){return-6}var tNow=performance.now();var tEnd=tNow+timeout;var lastAddr=Atomics.exchange(GROWABLE_HEAP_I32(),__emscripten_main_thread_futex>>2,addr);while(1){tNow=performance.now();if(tNow>tEnd){lastAddr=Atomics.exchange(GROWABLE_HEAP_I32(),__emscripten_main_thread_futex>>2,0);return-73}lastAddr=Atomics.exchange(GROWABLE_HEAP_I32(),__emscripten_main_thread_futex>>2,0);if(lastAddr==0){break}_emscripten_main_thread_process_queued_calls();if(Atomics.load(GROWABLE_HEAP_I32(),addr>>2)!=val){return-6}lastAddr=Atomics.exchange(GROWABLE_HEAP_I32(),__emscripten_main_thread_futex>>2,addr)}return 0}}function _emscripten_memcpy_big(dest,src,num){GROWABLE_HEAP_U8().copyWithin(dest,src,src+num)}function _emscripten_num_logical_cores(){if(ENVIRONMENT_IS_NODE)return require(\"os\").cpus().length;return navigator[\"hardwareConcurrency\"]}function _emscripten_proxy_to_main_thread_js(index,sync){var numCallArgs=arguments.length-2;var stack=stackSave();var serializedNumCallArgs=numCallArgs;var args=stackAlloc(serializedNumCallArgs*8);var b=args>>3;for(var i=0;i<numCallArgs;i++){var arg=arguments[2+i];GROWABLE_HEAP_F64()[b+i]=arg}var ret=_emscripten_run_in_main_runtime_thread_js(index,serializedNumCallArgs,args,sync);stackRestore(stack);return ret}var _emscripten_receive_on_main_thread_js_callArgs=[];var readAsmConstArgsArray=[];function readAsmConstArgs(sigPtr,buf){readAsmConstArgsArray.length=0;var ch;buf>>=2;while(ch=GROWABLE_HEAP_U8()[sigPtr++]){var double=ch<105;if(double&&buf&1)buf++;readAsmConstArgsArray.push(double?GROWABLE_HEAP_F64()[buf++>>1]:GROWABLE_HEAP_I32()[buf]);++buf}return readAsmConstArgsArray}function _emscripten_receive_on_main_thread_js(index,numCallArgs,args){_emscripten_receive_on_main_thread_js_callArgs.length=numCallArgs;var b=args>>3;for(var i=0;i<numCallArgs;i++){_emscripten_receive_on_main_thread_js_callArgs[i]=GROWABLE_HEAP_F64()[b+i]}var isEmAsmConst=index<0;var func=!isEmAsmConst?proxiedFunctionTable[index]:ASM_CONSTS[-index-1];return func.apply(null,_emscripten_receive_on_main_thread_js_callArgs)}function _emscripten_get_heap_size(){return GROWABLE_HEAP_U8().length}function

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emscripten_realloc_buffer(size){try{wasmMemory.grow(size-
buffer.byteLength+65535>>>16);updateGlobalBufferAndViews(wasmMemory.buffer);return
1}catch(e){}}function _emscripten_resize_heap(requestedSize){var
oldSize=_emscripten_get_heap_size();if(requestedSize<=oldSize){return false}var
maxHeapSize=2147483648;if(requestedSize>maxHeapSize){return false}for(var
cutDown=1;cutDown<=4;cutDown*=2){var
overGrownHeapSize=oldSize*(1+.2/cutDown);overGrownHeapSize=Math.min(overGrownHeapSize,requestedSize
+100663296);var
newSize=Math.min(maxHeapSize,alignUp(Math.max(requestedSize,overGrownHeapSize),65536));var
replacement=emscripten_realloc_buffer(newSize);if(replacement){return true}}return false}var
JSEvents={inEventHandler:0,removeAllEventListeners:function(){for(var
 i=JSEvents.eventHandlers.length-1;i>=0;--
i){JSEvents._removeHandler(i)}JSEvents.eventHandlers=[];JSEvents.deferredCalls=[]},registerRemoveEventListen
ers:function(){if(!JSEvents.removeEventListenersRegistered){__ATEXIT__.push(JSEvents.removeAllEventListene
rs);JSEvents.removeEventListenersRegistered=true}},deferredCalls:[],deferCall:function(targetFunction,precedence
,argsList){function arraysHaveEqualContent(arrA,arrB){if(arrA.length!=arrB.length)return false;for(var i in
arrA){if(arrA[i]!=arrB[i])return false}return true}for(var i in JSEvents.deferredCalls){var
call=JSEvents.deferredCalls[i];if(call.targetFunction==targetFunction&&arraysHaveEqualContent(call.argsList,args
List)){return}}JSEvents.deferredCalls.push({targetFunction:targetFunction,precedence:precedence,argsList:argsList
});JSEvents.deferredCalls.sort(function(x,y){return
x.precedence<y.precedence})},removeDeferredCalls:function(targetFunction){for(var
i=0;i<JSEvents.deferredCalls.length;++i){if(JSEvents.deferredCalls[i].targetFunction==targetFunction){JSEvents.d
eferredCalls.splice(i,1);--i}}},canPerformEventHandlerRequests:function(){return
JSEvents.inEventHandler&&JSEvents.currentEventHandler.allowsDeferredCalls},runDeferredCalls:function(){if(!J
SEvents.canPerformEventHandlerRequests()){return}for(var i=0;i<JSEvents.deferredCalls.length;++i){var
call=JSEvents.deferredCalls[i];JSEvents.deferredCalls.splice(i,1);--
i;call.targetFunction.apply(null,call.argsList)}},eventHandlers:[],removeAllHandlersOnTarget:function(target,event
TypeString){for(var
i=0;i<JSEvents.eventHandlers.length;++i){if(JSEvents.eventHandlers[i].target==target&&(!eventTypeString||event
TypeString==JSEvents.eventHandlers[i].eventTypeString)){JSEvents._removeHandler(i--
)}}},_removeHandler:function(i){var
h=JSEvents.eventHandlers[i];h.target.removeEventListener(h.eventTypeString,h.eventListenerFunc,h.useCapture);J
SEvents.eventHandlers.splice(i,1)},registerOrRemoveHandler:function(eventHandler){var
 jsEventHandler=function
jsEventHandler(event){++JSEvents.inEventHandler;JSEvents.currentEventHandler=eventHandler;JSEvents.runDef
erredCalls();eventHandler.handlerFunc(event);JSEvents.runDeferredCalls();--
JSEvents.inEventHandler};if(eventHandler.callbackfunc){eventHandler.eventListenerFunc=jsEventHandler;eventH
andler.target.addEventListener(eventHandler.eventTypeString,jsEventHandler,eventHandler.useCapture);JSEvents.e
ventHandlers.push(eventHandler);JSEvents.registerRemoveEventListeners()}else{for(var
i=0;i<JSEvents.eventHandlers.length;++i){if(JSEvents.eventHandlers[i].target==eventHandler.target&&JSEvents.e
ventHandlers[i].eventTypeString==eventHandler.eventTypeString){JSEvents._removeHandler(i--
)}}}},queueEventHandlerOnThread_iiii:function(targetThread,eventHandlerFunc,eventTypeId,eventData,userData)
{var stackTop=stackSave();var
varargs=stackAlloc(12);GROWABLE_HEAP_I32()[varargs>>2]=eventTypeId;GROWABLE_HEAP_I32()[varargs
+4>>2]=eventData;GROWABLE_HEAP_I32()[varargs+8>>2]=userData;__emscripten_call_on_thread(0,targetThr
ead,637534208,eventHandlerFunc,eventData,varargs);stackRestore(stackTop)},getTargetThreadForEventCallback:f
unction(targetThread){switch(targetThread){case
```

1:return 0;case 2:return PThread.currentProxiedOperationCallerThread;default:return targetThread}},getNodeNameForTarget:function(target){if(!target)return\"\";if(target==window)return\"#window\";if(target==screen)return\"#screen\";return target&&target.nodeName?target.nodeName:\"\"},fullscreenEnabled:function(){return document.fullscreenEnabled||document.webkitFullscreenEnabled}};function stringToNewUTF8(jsString){var length=lengthBytesUTF8(jsString)+1;var cString=_malloc(length);stringToUTF8(jsString,cString,length);return cString}function _emscripten_set_offscreencanvas_size_on_target_thread_js(targetThread,targetCanvas,width,height){var stackTop=stackSave();var varargs=stackAlloc(12);var targetCanvasPtr=0;if(targetCanvas){targetCanvasPtr=stringToNewUTF8(targetCanvas)}GROWABLE_HEAP_I32()[varargs>>2]=targetCanvasPtr;GROWABLE_HEAP_I32()[varargs+4>>2]=width;GROWABLE_HEAP_I32()[varargs+8>>2]=height;__emscripten_call_on_thread(0,targetThread,657457152,0,targetCanvasPtr,varargs);stackRestore(stackTop)}function _emscripten_set_offscreencanvas_size_on_target_thread(targetThread,targetCanvas,width,height){targetCanvas=targetCanvas?UTF8ToString(targetCanvas):\"\";_emscripten_set_offscreencanvas_size_on_target_thread_js(targetThread,targetCanvas,width,height)}function maybeCStringToJsString(cString){return cString>2?UTF8ToString(cString):cString}var specialHTMLTargets=[0,typeof document!==\"undefined\"?document:0,typeof window!==\"undefined\"?window:0];function findEventTarget(target){target=maybeCStringToJsString(target);var domElement=specialHTMLTargets[target]||(typeof document!==\"undefined\"?document.querySelector(target):undefined);return domElement}function findCanvasEventTarget(target){return findEventTarget(target)}function _emscripten_set_canvas_element_size_calling_thread(target,width,height){var canvas=findCanvasEventTarget(target);if(!canvas)return-4;if(canvas.canvasSharedPtr){GROWABLE_HEAP_I32()[canvas.canvasSharedPtr>>2]=width;GROWABLE_HEAP_I32()[canvas.canvasSharedPtr+4>>2]=height}if(canvas.offscreenCanvas||!canvas.controlTransferredOffscreen){if(canvas.offscreenCanvas)canvas=canvas.offscreenCanvas;var autoResizeViewport=false;if(canvas.GLctxObject&&canvas.GLctxObject.GLctx){var prevViewport=canvas.GLctxObject.GLctx.getParameter(2978);autoResizeViewport=prevViewport[0]===0&&prevViewport[1]===0&&prevViewport[2]===canvas.width&&prevViewport[3]===canvas.height}canvas.width=width;canvas.height=height;if(autoResizeViewport){canvas.GLctxObject.GLctx.viewport(0,0,width,height)}}else if(canvas.canvasSharedPtr){var targetThread=GROWABLE_HEAP_I32()[canvas.canvasSharedPtr+8>>2];_emscripten_set_offscreencanvas_size_on_target_thread(targetThread,target,width,height);return 1}else{return-4}return 0}function _emscripten_set_canvas_element_size_main_thread(target,width,height){if(ENVIRONMENT_IS_PTHREAD)return _emscripten_proxy_to_main_thread_js(2,1,target,width,height);return _emscripten_set_canvas_element_size_calling_thread(target,width,height)}function _emscripten_set_canvas_element_size(target,width,height){var canvas=findCanvasEventTarget(target);if(canvas){return _emscripten_set_canvas_element_size_calling_thread(target,width,height)}else{return _emscripten_set_canvas_element_size_main_thread(target,width,height)}}function _emscripten_set_current_thread_status(newStatus){}function _emscripten_set_thread_name(threadId,name){}function __webgl_enable_ANGLE_instanced_arrays(ctx){var ext=ctx.getExtension(\"ANGLE_instanced_arrays\");if(ext){ctx[\"vertexAttribDivisor\"]=function(index,divisor){ext[\"vertexAttribDivisorANGLE\"](index,divisor)};ctx[\"drawArraysInstanced\"]=function(mode,first,count,primcount){ext[\"drawArraysInstancedANGLE\"](mode,first,count,primcount)};ctx[\"drawElementsInstanced\"]=function(mode,count,type,indices,primcount){ext[\"drawElementsInstancedANGLE\"](mode,count,type,indices,primcount)};

return
1}}function __webgl_enable_OES_vertex_array_object(ctx){var
ext=ctx.getExtension(\"OES_vertex_array_object\");if(ext){ctx[\"createVertexArray\"]=function(){return
ext[\"createVertexArrayOES\"]()};ctx[\"deleteVertexArray\"]=function(vao){ext[\"deleteVertexArrayOES\"](vao)};
ctx[\"bindVertexArray\"]=function(vao){ext[\"bindVertexArrayOES\"](vao)};ctx[\"isVertexArray\"]=function(vao)
{return ext[\"isVertexArrayOES\"](vao)};return 1}}function __webgl_enable_WEBGL_draw_buffers(ctx){var
ext=ctx.getExtension(\"WEBGL_draw_buffers\");if(ext){ctx[\"drawBuffers\"]=function(n,bufs){ext[\"drawBuffers
WEBGL\"](n,bufs)};return 1}}function
__webgl_enable_WEBGL_multi_draw(ctx){return!!(ctx.multiDrawWebgl=ctx.getExtension(\"WEBGL_multi_dra
w\"))}var
GL={counter:1,buffers:[],programs:[],framebuffers:[],renderbuffers:[],textures:[],uniforms:[],shaders:[],vaos:[],cont
exts:{},offscreenCanvases:{},timerQueriesEXT:[],programInfos:{},stringCache:{},unpackAlignment:4,recordError:
function
recordError(errorCode){if(!GL.lastError){GL.lastError=errorCode}},getNewId:function(table){var
ret=GL.counter++;for(var i=table.length;i<ret;i++){table[i]=null}return
ret},getSource:function(shader,count,string,length){var source=\"\";for(var i=0;i<count;++i){var
len=length?GROWABLE_HEAP_I32()[length+i*4>>2]:-
1;source+=UTF8ToString(GROWABLE_HEAP_I32()[string+i*4>>2],len<0?undefined:len)}return
source},createContext:function(canvas,webGLContextAttributes){var
ctx=canvas.getContext(\"webgl\",webGLContextAttributes);if(!ctx)return 0;var
handle=GL.registerContext(ctx,webGLContextAttributes);return
handle},registerContext:function(ctx,webGLContextAttributes){var
handle=_malloc(8);GROWABLE_HEAP_I32()[handle+4>>2]=_pthread_self();var
context={handle:handle,attributes:webGLContextAttributes,version:webGLContextAttributes.majorVersion,GLctx:
ctx};if(ctx.canvas)ctx.canvas.GLctxObject=context;GL.contexts[handle]=context;if(typeof
webGLContextAttributes.enableExtensionsByDefault===\"undefined\"||webGLContextAttributes.enableExtensions
ByDefault){GL.initExtensions(context)}return
handle},makeContextCurrent:function(contextHandle){GL.currentContext=GL.contexts[contextHandle];Module.ctx
=GLctx=GL.currentContext&&GL.currentContext.GLctx;return!(contextHandle&&!GLctx)},getContext:function(c
ontextHandle){return
GL.contexts[contextHandle]},deleteContext:function(contextHandle){if(GL.currentContext===GL.contexts[context
Handle])GL.currentContext=null;if(typeof
JSEvents===\"object\")JSEvents.removeAllHandlersOnTarget(GL.contexts[contextHandle].GLctx.canvas);if(GL.co
ntexts[contextHandle]&&GL.contexts[contextHandle].GLctx.canvas)GL.contexts[contextHandle].GLctx.canvas.GL
ctxObject=undefined;_free(GL.contexts[contextHandle].handle);GL.contexts[contextHandle]=null},initExtensions:f
unction(context){if(!context)context=GL.currentContext;if(context.initExtensionsDone)return;context.initExtension
sDone=true;var
GLctx=context.GLctx;__webgl_enable_ANGLE_instanced_arrays(GLctx);__webgl_enable_OES_vertex_array_obj
ect(GLctx);__webgl_enable_WEBGL_draw_buffers(GLctx);GLctx.disjointTimerQueryExt=GLctx.getExtension(\"
EXT_disjoint_timer_query\");__webgl_enable_WEBGL_multi_draw(GLctx);var
exts=GLctx.getSupportedExtensions()||[];exts.forEach(function(ext){if(ext.indexOf(\"lose_context\")<0&&ext.inde
xOf(\"debug\")<0){GLctx.getExtension(ext)}})},populateUniformTable:function(program){var
p=GL.programs[program];var
ptable=GL.programInfos[program]={uniforms:{},maxUniformLength:0,maxAttributeLength:-
1,maxUniformBlockNameLength:-1};var utable=ptable.uniforms;var
numUniforms=GLctx.getProgramParameter(p,35718);for(var i=0;i<numUniforms;++i){var
u=GLctx.getActiveUniform(p,i);var
name=u.name;ptable.maxUniformLength=Math.max(ptable.maxUniformLength,name.length+1);if(name.slice(-

1)==\"]\"){name=name.slice(0,name.lastIndexOf(\"[\"))}var loc=GLctx.getUniformLocation(p,name);if(loc){var id=GL.getNewId(GL.uniforms);utable[name]=[u.size,id];GL.uniforms[id]=loc;for(var j=1;j<u.size;++j){var n=name+\"[\"+j+\"]\";loc=GLctx.getUniformLocation(p,n);id=GL.getNewId(GL.uniforms);GL.uniforms[id]=loc}}}};var __emscripten_webgl_power_preferences=[\"default\",\"low-power\",\"high-performance\"];function _emscripten_webgl_do_create_context(target,attributes){var a=attributes>>2;var powerPreference=GROWABLE_HEAP_I32()[a+(24>>2)];var contextAttributes={\"alpha\":!!GROWABLE_HEAP_I32()[a+(0>>2)],\"depth\":!!GROWABLE_HEAP_I32()[a+(4>>2)],\"stencil\":!!GROWABLE_HEAP_I32()[a+(8>>2)],\"antialias\":!!GROWABLE_HEAP_I32()[a+(12>>2)],\"premultipliedAlpha\":!!GROWABLE_HEAP_I32()[a+(16>>2)],\"preserveDrawingBuffer\":!!GROWABLE_HEAP_I32()[a+(20>>2)],\"powerPreference\":__emscripten_webgl_power_preferences[powerPreference],\"failIfMajorPerformanceCaveat\":!!GROWABLE_HEAP_I32()[a+(28>>2)],majorVersion:GROWABLE_HEAP_I32()[a+(32>>2)],minorVersion:GROWABLE_HEAP_I32()[a+(36>>2)],enableExtensionsByDefault:GROWABLE_HEAP_I32()[a+(40>>2)],explicitSwapControl:GROWABLE_HEAP_I32()[a+(44>>2)],proxyContextToMainThread:GROWABLE_HEAP_I32()[a+(48>>2)],renderViaOffscreenBackBuffer:GROWABLE_HEAP_I32()[a+(52>>2)]};var canvas=findCanvasEventTarget(target);if(!canvas){return 0}if(contextAttributes.explicitSwapControl){return 0}var contextHandle=GL.createContext(canvas,contextAttributes);return contextHandle}function _emscripten_webgl_create_context(a0,a1){return _emscripten_webgl_do_create_context(a0,a1)}var SYSCALLS={mappings:{},buffers:[null,[],[]],printChar:function(stream,curr){var buffer=SYSCALLS.buffers[stream];if(curr===0||curr===10){(stream===1?out:err)(UTF8ArrayToString(buffer,0));buffer.length=0}else{buffer.push(curr)}},varargs:undefined,get:function(){SYSCALLS.varargs+=4;var ret=GROWABLE_HEAP_I32()[SYSCALLS.varargs-4>>2];return ret},getStr:function(ptr){var ret=UTF8ToString(ptr);return ret},get64:function(low,high){return low}};function _fd_close(fd){if(ENVIRONMENT_IS_PTHREAD)return _emscripten_proxy_to_main_thread_js(3,1,fd);return 0}function _fd_seek(fd,offset_low,offset_high,whence,newOffset){if(ENVIRONMENT_IS_PTHREAD)return _emscripten_proxy_to_main_thread_js(4,1,fd,offset_low,offset_high,whence,newOffset)}function _fd_write(fd,iov,iovcnt,pnum){if(ENVIRONMENT_IS_PTHREAD)return _emscripten_proxy_to_main_thread_js(5,1,fd,iov,iovcnt,pnum);var num=0;for(var i=0;i<iovcnt;i++){var ptr=GROWABLE_HEAP_I32()[iov+i*8>>2];var len=GROWABLE_HEAP_I32()[iov+(i*8+4)>>2];for(var j=0;j<len;j++){SYSCALLS.printChar(fd,GROWABLE_HEAP_U8()[ptr+j])}num+=len}GROWABLE_HEAP_I32()[pnum>>2]=num;return 0}function _pthread_cleanup_pop(execute){var routine=PThread.threadExitHandlers.pop();if(execute)routine()}function _pthread_cleanup_push(routine,arg){PThread.threadExitHandlers.push(function(){wasmTable.get(routine)(arg)})}function spawnThread(threadParams){if(ENVIRONMENT_IS_PTHREAD)throw\"Internal Error! spawnThread() can only ever be called from main application thread!\";var worker=PThread.getNewWorker();if(worker.pthread!==undefined)throw\"Internal error!\";if(!threadParams.pthread_ptr)throw\"Internal error, no pthread ptr!\";PThread.runningWorkers.push(worker);var tlsMemory=_malloc(128*4);for(var i=0;i<128;++i){GROWABLE_HEAP_I32()[tlsMemory+i*4>>2]=0}var stackHigh=threadParams.stackBase+threadParams.stackSize;var pthread=PThread.pthreads[threadParams.pthread_ptr]={worker:worker,stackBase:threadParams.stackBase,stackSize:threadParams.stackSize,allocatedOwnStack:threadParams.allocatedOwnStack,threadInfoStruct:threadParams.pthread_ptr};var tis=pthread.threadInfoStruct>>2;Atomics.store(GROWABLE_HEAP_U32(),tis+(64>>2),threadParams.detached);Atomics.store(GROWABLE_HEAP_U32(),tis+(100>>2),tlsMemory);Atomics.store(GROWABLE_HEAP_U32(),tis+(40>>2),pthread.threadInfoStruct);Atomics.store(GROWABLE_HEAP_U32(),tis+(80>>2),threadParams.stackSize);Atomics.store(GROWABLE_HEAP_U32(),tis+(76>>2),stackHigh);Atomics.store(GROWABLE_HEAP_U32(),tis+(104>>2),threadParams.stackSize);Atomics.store(GROWABLE_HEAP_U32(),tis+(104+8>>2),stackHigh);Atom

ics.store(GROWABLE_HEAP_U32(),tis+(104+12>>2),threadParams.detached);var
global_libc=_emscripten_get_global_libc();var
global_locale=global_libc+40;Atomics.store(GROWABLE_HEAP_U32(),tis+(172>>2),global_locale);worker.pthr
ead=pthread;var
msg={\"cmd\":\"run\",\"start_routine\":threadParams.startRoutine,\"arg\":threadParams.arg,\"threadInfoStruct\":thre
adParams.pthread_ptr,\"stackBase\":threadParams.stackBase,\"stackSize\":threadParams.stackSize};worker.runPthre
ad=function(){msg.time=performance.now();worker.postMessage(msg,threadParams.transferList)};if(worker.loaded
){worker.runPthread();delete worker.runPthread}}function
_pthread_create(pthread_ptr,attr,start_routine,arg){if(typeof SharedArrayBuffer===\"undefined\"){err(\"Current
environment does not support SharedArrayBuffer, pthreads are not available!\");return
6}if(!pthread_ptr){err(\"pthread_create called with a null thread pointer!\");return 28}var transferList=[];var
error=0;if(ENVIRONMENT_IS_PTHREAD&&(transferList.length===0||error)){return
_emscripten_sync_run_in_main_thread_4(687865856,pthread_ptr,attr,start_routine,arg)}if(error)return
error;var stackSize=0;var stackBase=0;var detached=0;if(attr&&attr!=-
1){stackSize=GROWABLE_HEAP_I32()[attr>>2];stackSize+=81920;stackBase=GROWABLE_HEAP_I32()[attr+
8>>2];detached=GROWABLE_HEAP_I32()[attr+12>>2]!==0}else{stackSize=2097152}var
allocatedOwnStack=stackBase==0;if(allocatedOwnStack){stackBase=_memalign(16,stackSize)}else{stackBase-
=stackSize;assert(stackBase>0)}var threadInfoStruct=_malloc(228);for(var
i=0;i<228>>2;++i)GROWABLE_HEAP_U32()[(threadInfoStruct>>2)+i]=0;GROWABLE_HEAP_I32()[pthread_p
tr>>2]=threadInfoStruct;GROWABLE_HEAP_I32()[threadInfoStruct+12>>2]=threadInfoStruct;var
headPtr=threadInfoStruct+152;GROWABLE_HEAP_I32()[headPtr>>2]=headPtr;var
threadParams={stackBase:stackBase,stackSize:stackSize,allocatedOwnStack:allocatedOwnStack,detached:detached
,startRoutine:start_routine,pthread_ptr:threadInfoStruct,arg:arg,transferList:transferList};if(ENVIRONMENT_IS_P
THREAD){threadParams.cmd=\"spawnThread\";postMessage(threadParams,transferList)}else{spawnThread(thread
Params)}return
0}function __pthread_testcancel_js(){if(!ENVIRONMENT_IS_PTHREAD)return;var
tb=_pthread_self();if(!tb)return;var
cancelDisabled=Atomics.load(GROWABLE_HEAP_U32(),tb+56>>2);if(cancelDisabled)return;var
canceled=Atomics.load(GROWABLE_HEAP_U32(),tb+0>>2);if(canceled==2)throw\"Canceled!\"}function
_emscripten_check_blocking_allowed(){if(ENVIRONMENT_IS_NODE)return;if(ENVIRONMENT_IS_WORKE
R)return;warnOnce(\"Blocking on the main thread is very dangerous, see
https://emscripten.org/docs/porting/pthreads.html#blocking-on-the-main-browser-thread\")}function
__emscripten_do_pthread_join(thread,status,block){if(!thread){err(\"pthread_join attempted on a null thread
pointer!\");return
ERRNO_CODES.ESRCH}if(ENVIRONMENT_IS_PTHREAD&&_pthread_self()==thread){err(\"PThread
\"+thread+\" is attempting to join to itself!\");return ERRNO_CODES.EDEADLK}else
if(!ENVIRONMENT_IS_PTHREAD&&_emscripten_main_browser_thread_id()==thread){err(\"Main
thread \"+thread+\" is attempting to join to itself!\");return ERRNO_CODES.EDEADLK}var
self=GROWABLE_HEAP_I32()[thread+12>>2];if(self!==thread){err(\"pthread_join attempted on thread
\"+thread+\", which does not point to a valid thread, or does not exist anymore!\");return
ERRNO_CODES.ESRCH}var
detached=Atomics.load(GROWABLE_HEAP_U32(),thread+64>>2);if(detached){err(\"Attempted to join thread
\"+thread+\", which was already detached!\");return
ERRNO_CODES.EINVAL}if(block){_emscripten_check_blocking_allowed()}for(;;){var
threadStatus=Atomics.load(GROWABLE_HEAP_U32(),thread+0>>2);if(threadStatus==1){var
threadExitCode=Atomics.load(GROWABLE_HEAP_U32(),thread+4>>2);if(status)GROWABLE_HEAP_I32()[sta
tus>>2]=threadExitCode;Atomics.store(GROWABLE_HEAP_U32(),thread+64>>2,1);if(!ENVIRONMENT_IS_PT
HREAD)cleanupThread(thread);else postMessage({\"cmd\":\"cleanupThread\",\"thread\":thread});return

0}if(!block){return
ERRNO_CODES.EBUSY}__pthread_testcancel_js();if(!ENVIRONMENT_IS_PTHREAD)_emscripten_main_thread_process_queued_calls();_emscripten_futex_wait(thread+0,threadStatus,ENVIRONMENT_IS_PTHREAD?100:1)}}function
_pthread_join(thread,status){return __emscripten_do_pthread_join(thread,status,true)}function
_sysconf(name){if(ENVIRONMENT_IS_PTHREAD)return
_emscripten_proxy_to_main_thread_js(6,1,name);switch(name){case 30:return 16384;case 85:var
maxHeapSize=2147483648;return maxHeapSize/16384;case 132:case 133:case 12:case 137:case 138:case 15:case
235:case 16:case 17:case 18:case 19:case 20:case 149:case 13:case 10:case 236:case 153:case 9:case 21:case 22:case
159:case 154:case 14:case 77:case 78:case 139:case 82:case 68:case 67:case 164:case 11:case 29:case 47:case
48:case 95:case 52:case 51:case 46:return 200809;case 27:case 246:case 127:case 128:case 23:case 24:case 160:case
161:case 181:case 182:case 242:case 183:case 184:case 243:case 244:case 245:case 165:case 178:case 179:case
49:case 50:case 168:case 169:case 175:case 170:case 171:case 172:case
97:case 76:case 32:case 173:case 35:case 80:case 81:case 79:return-1;case 176:case 177:case 7:case 155:case 8:case
157:case 125:case 126:case 92:case 93:case 129:case 130:case 131:case 94:case 91:return 1;case 74:case 60:case
69:case 70:case 4:return 1024;case 31:case 42:case 72:return 32;case 87:case 26:case 33:return 2147483647;case
34:case 1:return 47839;case 38:case 36:return 99;case 43:case 37:return 2048;case 0:return 2097152;case 3:return
65536;case 28:return 32768;case 44:return 32767;case 75:return 16384;case 39:return 1e3;case 89:return 700;case
71:return 256;case 40:return 255;case 2:return 100;case 180:return 64;case 25:return 20;case 5:return 16;case
6:return 6;case 73:return 4;case 84:{if(typeof navigator===\"object\")return
navigator[\"hardwareConcurrency\"]||1;return 1}}setErrNo(28);return-
1}if(!ENVIRONMENT_IS_PTHREAD)PThread.initMainThreadBlock();var GLctx;var
proxiedFunctionTable=[null,_atexit,_emscripten_set_canvas_element_size_main_thread,_fd_close,_fd_seek,_fd_write,_sysconf];var
asmLibraryArg={\"e\":___assert_fail,\"r\":___call_main,\"x\":__emscripten_notify_thread_queue,\"b\":_abort,\"y\":_emscripten_asm_const_int,\"j\":_emscripten_conditional_set_current_thread_status,\"d\":_emscripten_futex_wait,\"c\":_emscripten_futex_wake,\"f\":_emscripten_get_now,\"p\":_emscripten_memcpy_big,\"A\":_emscripten_num_logical_cores,\"u\":_emscripten_receive_on_main_thread_js,\"q\":_emscripten_resize_heap,\"v\":_emscripten_set_canvas_element_size,\"i\":_emscripten_set_current_thread_status,\"s\":_emscripten_set_thread_name,\"w\":_emscripten_webgl_create_context,\"l\":_fd_close,\"n\":_fd_seek,\"g\":_fd_write,\"o\":initPthreadsJS,\"a\":wasmMemory||Module[\"wasmMemory\"],\"z\":_pthread_cleanup_pop,\"k\":_pthread_cleanup_push,\"h\":_pthread_create,\"m\":_pthread_join,\"t\":_sysconf};var asm=createWasm();var
___wasm_call_ctors=Module[\"___wasm_call_ctors\"]=function(){return(___wasm_call_ctors=Module[\"___wasm_call_ctors\"]=Module[\"asm\"][\"B\"]).apply(null,arguments)};var
_init=Module[\"_init\"]=function(){return(_init=Module[\"_init\"]=Module[\"asm\"][\"C\"]).apply(null,arguments)};var
_init_with_threads_count=Module[\"_init_with_threads_count\"]=function(){return(_init_with_threads_count=Module[\"_init_with_threads_count\"]=Module[\"asm\"][\"D\"]).apply(null,arguments)};var
_get_threads_count=Module[\"_get_threads_count\"]=function(){return(_get_threads_count=Module[\"_get_threads_count\"]=Module[\"asm\"][\"E\"]).apply(null,arguments)};var
_register_tensor=Module[\"_register_tensor\"]=function(){return(_register_tensor=Module[\"_register_tensor\"]=Module[\"asm\"][\"F\"]).apply(null,arguments)};var
_dispose_data=Module[\"_dispose_data\"]=function(){return(_dispose_data=Module[\"_dispose_data\"]=Module[\"asm\"][\"G\"]).apply(null,arguments)};var
_dispose=Module[\"_dispose\"]=function(){return(_dispose=Module[\"_dispose\"]=Module[\"asm\"][\"H\"]).apply(null,arguments)};var
_Abs=Module[\"_Abs\"]=function(){return(_Abs=Module[\"_Abs\"]=Module[\"asm\"][\"J\"]).apply(null,arguments)};var

_Add=Module[\"_Add\"]=function(){return(_Add=Module[\"_Add\"]=Module[\"asm\"][\"K\"]).apply(null,arguments)};var
_AddN=Module[\"_AddN\"]=function(){return(_AddN=Module[\"_AddN\"]=Module[\"asm\"][\"L\"]).apply(null,arguments)};var
_All=Module[\"_All\"]=function(){return(_All=Module[\"_All\"]=Module[\"asm\"][\"M\"]).apply(null,arguments)};var
_Any=Module[\"_Any\"]=function(){return(_Any=Module[\"_Any\"]=Module[\"asm\"][\"N\"]).apply(null,arguments)};var
_ArgMax=Module[\"_ArgMax\"]=function(){return(_ArgMax=Module[\"_ArgMax\"]=Module[\"asm\"][\"O\"]).apply(null,arguments)};var
_AvgPool=Module[\"_AvgPool\"]=function(){return(_AvgPool=Module[\"_AvgPool\"]=Module[\"asm\"][\"P\"]).apply(null,arguments)};var
_BatchMatMul=Module[\"_BatchMatMul\"]=function(){return(_BatchMatMul=Module[\"_BatchMatMul\"]=Module[\"asm\"][\"Q\"]).apply(null,arguments)};var
_Ceil=Module[\"_Ceil\"]=function(){return(_Ceil=Module[\"_Ceil\"]=Module[\"asm\"][\"R\"]).apply(null,arguments)};var
_ClipByValue=Module[\"_ClipByValue\"]=function(){return(_ClipByValue=Module[\"_ClipByValue\"]=Module[\"asm\"][\"S\"]).apply(null,arguments)};var
_Conv2D=Module[\"_Conv2D\"]=function(){return(_Conv2D=Module[\"_Conv2D\"]=Module[\"asm\"][\"T\"]).apply(null,arguments)};var
_Conv2DBackpropInput=Module[\"_Conv2DBackpropInput\"]=function(){return(_Conv2DBackpropInput=Module[\"_Conv2DBackpropInput\"]=Module[\"asm\"][\"U\"]).apply(null,arguments)};var
_Cos=Module[\"_Cos\"]=function(){return(_Cos=Module[\"_Cos\"]=Module[\"asm\"][\"V\"]).apply(null,arguments)};var
_Cosh=Module[\"_Cosh\"]=function(){return(_Cosh=Module[\"_Cosh\"]=Module[\"asm\"][\"W\"]).apply(null,arguments)};var
_CropAndResize=Module[\"_CropAndResize\"]=function(){return(_CropAndResize=Module[\"_CropAndResize\"]=Module[\"asm\"][\"X\"]).apply(null,arguments)};var
_Cumsum=Module[\"_Cumsum\"]=function(){return(_Cumsum=Module[\"_Cumsum\"]=Module[\"asm\"][\"Y\"]).apply(null,arguments)};var
_DepthToSpace=Module[\"_DepthToSpace\"]=function(){return(_DepthToSpace=Module[\"_DepthToSpace\"]=Module[\"asm\"][\"Z\"]).apply(null,arguments)};var
_DepthwiseConv2dNative=Module[\"_DepthwiseConv2dNative\"]=function(){return(_DepthwiseConv2dNative=Module[\"_DepthwiseConv2dNative\"]=Module[\"asm\"][\"_\"]).apply(null,arguments)};var
_Elu=Module[\"_Elu\"]=function(){return(_Elu=Module[\"_Elu\"]=Module[\"asm\"][\"$\"]).apply(null,arguments)};var
_Equal=Module[\"_Equal\"]=function(){return(_Equal=Module[\"_Equal\"]=Module[\"asm\"][\"aa\"]).apply(null,arguments)};var
_Exp=Module[\"_Exp\"]=function(){return(_Exp=Module[\"_Exp\"]=Module[\"asm\"][\"ba\"]).apply(null,arguments)};var
_FlipLeftRight=Module[\"_FlipLeftRight\"]=function(){return(_FlipLeftRight=Module[\"_FlipLeftRight\"]=Module[\"asm\"][\"ca\"]).apply(null,arguments)};var
_Floor=Module[\"_Floor\"]=function(){return(_Floor=Module[\"_Floor\"]=Module[\"asm\"][\"da\"]).apply(null,arguments)};var
_FloorDiv=Module[\"_FloorDiv\"]=function(){return(_FloorDiv=Module[\"_FloorDiv\"]=Module[\"asm\"][\"ea\"]).apply(null,arguments)};var
_FusedBatchNorm=Module[\"_FusedBatchNorm\"]=function(){return(_FusedBatchNorm=Module[\"_FusedBatchNorm\"]=Module[\"asm\"][\"fa\"]).apply(null,arguments)};var

_FusedConv2D=Module[\"_FusedConv2D\"]=function(){return(_FusedConv2D=Module[\"_FusedConv2D\"]=Module[\"asm\"][\"ga\"]).apply(null,arguments)};var
_FusedDepthwiseConv2D=Module[\"_FusedDepthwiseConv2D\"]=function(){return(_FusedDepthwiseConv2D=Module[\"_FusedDepthwiseConv2D\"]=Module[\"asm\"][\"ha\"]).apply(null,arguments)};var
_Gather=Module[\"_Gather\"]=function(){return(_Gather=Module[\"_Gather\"]=Module[\"asm\"][\"ia\"]).apply(null,arguments)};var
_GatherNd=Module[\"_GatherNd\"]=function(){return(_GatherNd=Module[\"_GatherNd\"]=Module[\"asm\"][\"ja\"]).apply(null,arguments)};var
_Greater=Module[\"_Greater\"]=function(){return(_Greater=Module[\"_Greater\"]=Module[\"asm\"][\"ka\"]).apply(null,arguments)};var
_GreaterEqual=Module[\"_GreaterEqual\"]=function(){return(_GreaterEqual=Module[\"_GreaterEqual\"]=Module[\"asm\"][\"la\"]).apply(null,arguments)};var
_LeakyRelu=Module[\"_LeakyRelu\"]=function(){return(_LeakyRelu=Module[\"_LeakyRelu\"]=Module[\"asm\"][\"ma\"]).apply(null,arguments)};var
_Less=Module[\"_Less\"]=function(){return(_Less=Module[\"_Less\"]=Module[\"asm\"][\"na\"]).apply(null,arguments)};var
_LessEqual=Module[\"_LessEqual\"]=function(){return(_LessEqual=Module[\"_LessEqual\"]=Module[\"asm\"][\"oa\"]).apply(null,arguments)};var
_Log=Module[\"_Log\"]=function(){return(_Log=Module[\"_Log\"]=Module[\"asm\"][\"pa\"]).apply(null,arguments)};var
_LogicalAnd=Module[\"_LogicalAnd\"]=function(){return(_LogicalAnd=Module[\"_LogicalAnd\"]=Module[\"asm\"][\"qa\"]).apply(null,arguments)};var
_Max=Module[\"_Max\"]=function(){return(_Max=Module[\"_Max\"]=Module[\"asm\"][\"ra\"]).apply(null,arguments)};var
_MaxPool=Module[\"_MaxPool\"]=function(){return(_MaxPool=Module[\"_MaxPool\"]=Module[\"asm\"][\"sa\"]).apply(null,arguments)};var
_Maximum=Module[\"_Maximum\"]=function(){return(_Maximum=Module[\"_Maximum\"]=Module[\"asm\"][\"ta\"]).apply(null,arguments)};var
_Mean=Module[\"_Mean\"]=function(){return(_Mean=Module[\"_Mean\"]=Module[\"asm\"][\"ua\"]).apply(null,arguments)};var
_Min=Module[\"_Min\"]=function(){return(_Min=Module[\"_Min\"]=Module[\"asm\"][\"va\"]).apply(null,arguments)};var
_Minimum=Module[\"_Minimum\"]=function(){return(_Minimum=Module[\"_Minimum\"]=Module[\"asm\"][\"wa\"]).apply(null,arguments)};var
_MirrorPad=Module[\"_MirrorPad\"]=function(){return(_MirrorPad=Module[\"_MirrorPad\"]=Module[\"asm\"][\"xa\"]).apply(null,arguments)};var
_Multiply=Module[\"_Multiply\"]=function(){return(_Multiply=Module[\"_Multiply\"]=Module[\"asm\"][\"ya\"]).apply(null,arguments)};var
_Neg=Module[\"_Neg\"]=function(){return(_Neg=Module[\"_Neg\"]=Module[\"asm\"][\"za\"]).apply(null,arguments)};var
_NonMaxSuppressionV3=Module[\"_NonMaxSuppressionV3\"]=function(){return(_NonMaxSuppressionV3=Module[\"_NonMaxSuppressionV3\"]=Module[\"asm\"][\"Aa\"]).apply(null,arguments)};var
_NonMaxSuppressionV4=Module[\"_NonMaxSuppressionV4\"]=function(){return(_NonMaxSuppressionV4=Module[\"_NonMaxSuppressionV4\"]=Module[\"asm\"][\"Ba\"]).apply(null,arguments)};var
_NonMaxSuppressionV5=Module[\"_NonMaxSuppressionV5\"]=function(){return(_NonMaxSuppressionV5=Module[\"_NonMaxSuppressionV5\"]=Module[\"asm\"][\"Ca\"]).apply(null,arguments)};var
_NotEqual=Module[\"_NotEqual\"]=function(){return(_NotEqual=Module[\"_NotEqual\"]=Module[\"asm\"][\"Da\"]).apply(null,arguments)};var

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_OneHot=Module[\"_OneHot\"]=function(){return(_OneHot=Module[\"_OneHot\"]=Module[\"asm\"][\"Ea\"]).appl
y(null,arguments)};var
_PadV2=Module[\"_PadV2\"]=function(){return(_PadV2=Module[\"_PadV2\"]=Module[\"asm\"][\"Fa\"]).apply(nu
ll,arguments)};var
_Pow=Module[\"_Pow\"]=function(){return(_Pow=Module[\"_Pow\"]=Module[\"asm\"][\"Ga\"]).apply(null,argume
nts)};var
_Prelu=Module[\"_Prelu\"]=function(){return(_Prelu=Module[\"_Prelu\"]=Module[\"asm\"][\"Ha\"]).apply(null,arg
uments)};var
_Prod=Module[\"_Prod\"]=function(){return(_Prod=Module[\"_Prod\"]=Module[\"asm\"][\"Ia\"]).apply(null,argum
ents)};var
_RealDiv=Module[\"_RealDiv\"]=function(){return(_RealDiv=Module[\"_RealDiv\"]=Module[\"asm\"][\"Ja\"]).app
ly(null,arguments)};var
_Relu=Module[\"_Relu\"]=function(){return(_Relu=Module[\"_Relu\"]=Module[\"asm\"][\"Ka\"]).apply(null,argum
ents)};var
_Relu6=Module[\"_Relu6\"]=function(){return(_Relu6=Module[\"_Relu6\"]=Module[\"asm\"][\"La\"]).apply(null,a
rguments)};var
_ResizeBilinear=Module[\"_ResizeBilinear\"]=function(){return(_ResizeBilinear=Module[\"_ResizeBilinear\"]=Mo
dule[\"asm\"][\"Ma\"]).apply(null,arguments)};var
_Reverse=Module[\"_Reverse\"]=function(){return(_Reverse=Module[\"_Reverse\"]=Module[\"asm\"][\"Na\"]).app
ly(null,arguments)};var
_RotateWithOffset=Module[\"_RotateWithOffset\"]=function(){return(_RotateWithOffset=Module[\"_RotateWith
Offset\"]=Module[\"asm\"][\"Oa\"]).apply(null,arguments)};var
_Round=Module[\"_Round\"]=function(){return(_Round=Module[\"_Round\"]=Module[\"asm\"][\"Pa\"]).apply(nul
l,arguments)};var
_Rsqrt=Module[\"_Rsqrt\"]=function(){return(_Rsqrt=Module[\"_Rsqrt\"]=Module[\"asm\"][\"Qa\"]).apply(null,arg
uments)};var
_ScatterNd=Module[\"_ScatterNd\"]=function(){return(_ScatterNd=Module[\"_ScatterNd\"]=Module[\"asm\"][\"Ra
\"]).apply(null,arguments)};var
_SelectV2=Module[\"_SelectV2\"]=function(){return(_SelectV2=Module[\"_SelectV2\"]=Module[\"asm\"][\"Sa\"]).
apply(null,arguments)};var
_Sigmoid=Module[\"_Sigmoid\"]=function(){return(_Sigmoid=Module[\"_Sigmoid\"]=Module[\"asm\"][\"Ta\"]).ap
ply(null,arguments)};var
_Sin=Module[\"_Sin\"]=function(){return(_Sin=Module[\"_Sin\"]=Module[\"asm\"][\"Ua\"]).apply(null,arguments)
};var
_Softmax=Module[\"_Softmax\"]=function(){return(_Softmax=Module[\"_Softmax\"]=Module[\"asm\"][\"Va\"]).a
pply(null,arguments)};var
_Sqrt=Module[\"_Sqrt\"]=function(){return(_Sqrt=Module[\"_Sqrt\"]=Module[\"asm\"][\"Wa\"]).apply(null,argume
nts)};var
_Square=Module[\"_Square\"]=function(){return(_Square=Module[\"_Square\"]=Module[\"asm\"][\"Xa\"]).apply(n
ull,arguments)};var
_SquaredDifference=Module[\"_SquaredDifference\"]=function(){return(_SquaredDifference=Module[\"_Squared
Difference\"]=Module[\"asm\"][\"Ya\"]).apply(null,arguments)};var
_Step=Module[\"_Step\"]=function(){return(_Step=Module[\"_Step\"]=Module[\"asm\"][\"Za\"]).apply(null,argume
nts)};var
_StridedSlice=Module[\"_StridedSlice\"]=function(){return(_StridedSlice=Module[\"_StridedSlice\"]=Module[\"as
m\"][\"_a\"]).apply(null,arguments)};var
_Sub=Module[\"_Sub\"]=function(){return(_Sub=Module[\"_Sub\"]=Module[\"asm\"][\"$a\"]).apply(null,argument
s)};var
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_Sum=Module[\"_Sum\"]=function(){return(_Sum=Module[\"_Sum\"]=Module[\"asm\"][\"ab\"]).apply(null,arguments)};var
_Tan=Module[\"_Tan\"]=function(){return(_Tan=Module[\"_Tan\"]=Module[\"asm\"][\"bb\"]).apply(null,arguments)};var
_Tanh=Module[\"_Tanh\"]=function(){return(_Tanh=Module[\"_Tanh\"]=Module[\"asm\"][\"cb\"]).apply(null,arguments)};var
_Tile=Module[\"_Tile\"]=function(){return(_Tile=Module[\"_Tile\"]=Module[\"asm\"][\"db\"]).apply(null,arguments)};var
_TopK=Module[\"_TopK\"]=function(){return(_TopK=Module[\"_TopK\"]=Module[\"asm\"][\"eb\"]).apply(null,arguments)};var
_Transform=Module[\"_Transform\"]=function(){return(_Transform=Module[\"_Transform\"]=Module[\"asm\"][\"fb\"]).apply(null,arguments)};var
_Transpose=Module[\"_Transpose\"]=function(){return(_Transpose=Module[\"_Transpose\"]=Module[\"asm\"][\"gb\"]).apply(null,arguments)};var
__FusedMatMul=Module[\"__FusedMatMul\"]=function(){return(__FusedMatMul=Module[\"__FusedMatMul\"]=Module[\"asm\"][\"hb\"]).apply(null,arguments)};var
_malloc=Module[\"_malloc\"]=function(){return(_malloc=Module[\"_malloc\"]=Module[\"asm\"][\"ib\"]).apply(null,arguments)};var
_free=Module[\"_free\"]=function(){return(_free=Module[\"_free\"]=Module[\"asm\"][\"jb\"]).apply(null,arguments)};var
___errno_location=Module[\"___errno_location\"]=function(){return(___errno_location=Module[\"___errno_location\"]=Module[\"asm\"][\"kb\"]).apply(null,arguments)};var
_emscripten_get_global_libc=Module[\"_emscripten_get_global_libc\"]=function(){return(_emscripten_get_global_libc=Module[\"_emscripten_get_global_libc\"]=Module[\"asm\"][\"lb\"]).apply(null,arguments)};var
_pthread_self=Module[\"_pthread_self\"]=function(){return(_pthread_self=Module[\"_pthread_self\"]=Module[\"asm\"][\"mb\"]).apply(null,arguments)};var
___pthread_tsd_run_dtors=Module[\"___pthread_tsd_run_dtors\"]=function(){return(___pthread_tsd_run_dtors=Module[\"___pthread_tsd_run_dtors\"]=Module[\"asm\"][\"nb\"]).apply(null,arguments)};var
_emscripten_main_thread_process_queued_calls=Module[\"_emscripten_main_thread_process_queued_calls\"]=function(){return(_emscripten_main_thread_process_queued_calls=Module[\"_emscripten_main_thread_process_queued_calls\"]=Module[\"asm\"][\"ob\"]).apply(null,arguments)};var
_emscripten_current_thread_process_queued_calls=Module[\"_emscripten_current_thread_process_queued_calls\"]=function(){return(_emscripten_current_thread_process_queued_calls=Module[\"_emscripten_current_thread_process_queued_calls\"]=Module[\"asm\"][\"pb\"]).apply(null,arguments)};var
_emscripten_register_main_browser_thread_id=Module[\"_emscripten_register_main_browser_thread_id\"]=function(){return(_emscripten_register_main_browser_thread_id=Module[\"_emscripten_register_main_browser_thread_id\"]=Module[\"asm\"][\"qb\"]).apply(null,arguments)};var
_emscripten_main_browser_thread_id=Module[\"_emscripten_main_browser_thread_id\"]=function(){return(_emscripten_main_browser_thread_id=Module[\"_emscripten_main_browser_thread_id\"]=Module[\"asm\"][\"rb\"]).apply(null,arguments)};var
__emscripten_do_dispatch_to_thread=Module[\"__emscripten_do_dispatch_to_thread\"]=function(){return(__emscripten_do_dispatch_to_thread=Module[\"__emscripten_do_dispatch_to_thread\"]=Module[\"asm\"][\"sb\"]).apply(null,arguments)};var
_emscripten_sync_run_in_main_thread_4=Module[\"_emscripten_sync_run_in_main_thread_4\"]=function(){return(_emscripten_sync_run_in_main_thread_4=Module[\"_emscripten_sync_run_in_main_thread_4\"]=Module[\"asm\"][\"tb\"]).apply(null,arguments)};var
_emscripten_run_in_main_runtime_thread_js=Module[\"_emscripten_run_in_main_runtime_thread_js\"]=function(){return(_emscripten_run_in_main_runtime_thread_js=Module[\"_emscripten_run_in_main_runtime_thread_js\"]=

Module[\"asm\"][\"ub\"]).apply(null,arguments)};var
__emscripten_call_on_thread=Module[\"__emscripten_call_on_thread\"]=function(){return(__emscripten_call_on_thread=Module[\"__emscripten_call_on_thread\"]=Module[\"asm\"][\"vb\"]).apply(null,arguments)};var
_emscripten_tls_init=Module[\"_emscripten_tls_init\"]=function(){return(_emscripten_tls_init=Module[\"_emscripten_tls_init\"]=Module[\"asm\"][\"wb\"]).apply(null,arguments)};var
__emscripten_thread_init=Module[\"__emscripten_thread_init\"]=function(){return(__emscripten_thread_init=Module[\"__emscripten_thread_init\"]=Module[\"asm\"][\"xb\"]).apply(null,arguments)};var
stackSave=Module[\"stackSave\"]=function(){return(stackSave=Module[\"stackSave\"]=Module[\"asm\"][\"yb\"]).apply(null,arguments)};var
stackRestore=Module[\"stackRestore\"]=function(){return(stackRestore=Module[\"stackRestore\"]=Module[\"asm\"][\"zb\"]).apply(null,arguments)};var
stackAlloc=Module[\"stackAlloc\"]=function(){return(stackAlloc=Module[\"stackAlloc\"]=Module[\"asm\"][\"Ab\"]).apply(null,arguments)};var
_emscripten_stack_set_limits=Module[\"_emscripten_stack_set_limits\"]=function(){return(_emscripten_stack_set_limits=Module[\"_emscripten_stack_set_limits\"]=Module[\"asm\"][\"Bb\"]).apply(null,arguments)};var
_memalign=Module[\"_memalign\"]=function(){return(_memalign=Module[\"_memalign\"]=Module[\"asm\"][\"Cb\"]).apply(null,arguments)};var
__emscripten_allow_main_runtime_queued_calls=Module[\"__emscripten_allow_main_runtime_queued_calls\"]=10512;var
__emscripten_main_thread_futex=Module[\"__emscripten_main_thread_futex\"]=12148;Module[\"cwrap\"]=cwrap;Module[\"PThread\"]=PThread;Module[\"PThread\"]=PThread;Module[\"wasmMemory\"]=wasmMemory;Module[\"ExitStatus\"]=ExitStatus;var
calledRun;function ExitStatus(status){this.name=\"ExitStatus\";this.message=\"Program terminated with exit(\"+status+\")\";this.status=status}dependenciesFulfilled=function
runCaller(){if(!calledRun)run();if(!calledRun)dependenciesFulfilled=runCaller};function
run(args){args=args||arguments_;if(runDependencies>0){return}if(ENVIRONMENT_IS_PTHREAD){readyPromiseResolve(Module);initRuntime();postMessage({\"cmd\":\"loaded\"});return}preRun();if(runDependencies>0){return}function
doRun(){if(calledRun)return;calledRun=true;Module[\"calledRun\"]=true;if(ABORT)return;initRuntime();preMain();readyPromiseResolve(Module);if(Module[\"onRuntimeInitialized\"])Module[\"onRuntimeInitialized\"]();postRun()}if(Module[\"setStatus\"]){Module[\"setStatus\"](\"Running...\");setTimeout(function(){setTimeout(function(){Module[\"setStatus\"](\"\")},1);doRun()},1)}else{doRun()}}Module[\"run\"]=run;function
exit(status,implicit){if(implicit&&noExitRuntime&&status===0){return}if(!implicit){if(ENVIRONMENT_IS_PTHREAD){postMessage({\"cmd\":\"exitProcess\",\"returnCode\":status});throw
new
ExitStatus(status)}else{}}if(noExitRuntime){}else{PThread.terminateAllThreads();EXITSTATUS=status;exitRuntime();if(Module[\"onExit\"])Module[\"onExit\"](status);ABORT=true}quit_(status,new
ExitStatus(status))}if(Module[\"preInit\"]){if(typeof
Module[\"preInit\"]==\"function\")Module[\"preInit\"]=[Module[\"preInit\"]];while(Module[\"preInit\"].length>0){Module[\"preInit\"].pop()()}}if(ENVIRONMENT_IS_PTHREAD){noExitRuntime=false;PThread.initWorker()}run();\n\n\n return WasmBackendModuleThreadedSimd.ready\n}\n);\n})();\nif (typeof exports === 'object' && typeof module === 'object')\n module.exports = WasmBackendModuleThreadedSimd;\nelse if (typeof define === 'function' && define['amd'])\n define([], function() { return WasmBackendModuleThreadedSimd; });\nelse if (typeof exports === 'object')\n exports[\"WasmBackendModuleThreadedSimd\"]
= WasmBackendModuleThreadedSimd;\n","export const wasmWorkerContents = 'var Module={};function
threadPrintErr(){var text=Array.prototype.slice.call(arguments).join(\" \");console.error(text)}function
threadAlert(){var text=Array.prototype.slice.call(arguments).join(\"
\");postMessage({cmd:\"alert\",text:text,threadId:Module[\"_pthread_self\"]()})}var

err=threadPrintErr;this.alert=threadAlert;Module[\"instantiateWasm\"]=function(info,receiveInstance){var instance=new WebAssembly.Instance(Module[\"wasmModule\"],info);Module[\"wasmModule\"]=null;receiveInstance(instance);return instance.exports};function moduleLoaded(){}this.onmessage=function(e){try{if(e.data.cmd===\"load\"){Module[\"wasmModule\"]=e.data.wasmModule;Module[\"wasmMemory\"]=e.data.wasmMemory;Module[\"buffer\"]=Module[\"wasmMemory\"].buffer;Module[\"ENVIRONMENT_IS_PTHREAD\"]=true;if(typeof e.data.urlOrBlob===\"string\"){importScripts(e.data.urlOrBlob)}else{var objectUrl=URL.createObjectURL(e.data.urlOrBlob);importScripts(objectUrl);URL.revokeObjectURL(objectUrl)}WasmBackendModuleThreadedSimd(Module).then(function(instance){Module=instance;moduleLoaded()})}else if(e.data.cmd===\"objectTransfer\"){Module[\"PThread\"].receiveObjectTransfer(e.data)}else if(e.data.cmd===\"run\"){Module[\"__performance_now_clock_drift\"]=performance.now()-e.data.time;Module[\"__emscripten_thread_init\"](e.data.threadInfoStruct,0,0);var max=e.data.stackBase;var top=e.data.stackBase+e.data.stackSize;Module[\"establishStackSpace\"](top,max);Module[\"_emscripten_tls_init\"]();Module[\"PThread\"].receiveObjectTransfer(e.data);Module[\"PThread\"].setThreadStatus(Module[\"_pthread_self\"](),1);try{var result=Module[\"invokeEntryPoint\"](e.data.start_routine,e.data.arg);if(!Module[\"getNoExitRuntime\"]())Module[\"PThread\"].threadExit(result)}catch(ex){if(ex===\"Canceled!\"){Module[\"PThread\"].threadCancel()}else if(ex!=\"unwind\"){if(ex instanceof Module[\"ExitStatus\"]){if(Module[\"getNoExitRuntime\"]()){}else{Module[\"PThread\"].threadExit(ex.status)}}else{Module[\"PThread\"].threadExit(-2);throw ex}}}}else if(e.data.cmd===\"cancel\"){if(Module[\"_pthread_self\"]()){Module[\"PThread\"].threadCancel()}}else if(e.data.target===\"setimmediate\"){}else if(e.data.cmd===\"processThreadQueue\"){if(Module[\"_pthread_self\"]()){Module[\"_emscripten_current_thread_process_queued_calls\"]()}}else{err(\"worker.js received unknown command \"+e.data.cmd);err(e.data)}}catch(ex){err(\"worker.js onmessage() captured an uncaught exception: \"+ex);if(ex&&ex.stack)err(ex.stack);throw ex}};if(typeof process===\"object\"&&typeof process.versions===\"object\"&&typeof process.versions.node===\"string\"){self={location:{href:__filename}};var onmessage=this.onmessage;var nodeWorkerThreads=require(\"worker_threads\");global.Worker=nodeWorkerThreads.Worker;var parentPort=nodeWorkerThreads.parentPort;parentPort.on(\"message\",function(data){onmessage({data:data})});var nodeFS=require(\"fs\");var nodeRead=function(filename){return nodeFS.readFileSync(filename,\"utf8\")};function globalEval(x){global.require=require;global.Module=Module;eval.call(null,x)}importScripts=function(f){globalEval(nodeRead(f))};postMessage=function(msg){parentPort.postMessage(msg)};if(typeof performance===\"undefined\"){performance={now:function(){return Date.now()}}}';","\nvar WasmBackendModule = (function() {\n var _scriptDir = typeof document !== 'undefined' && document.currentScript ? document.currentScript.src : undefined;\n if (typeof __filename !== 'undefined') _scriptDir = _scriptDir || __filename;\n return (\nfunction(WasmBackendModule) {\n WasmBackendModule = WasmBackendModule || {};\n\n\nvar Module=typeof WasmBackendModule!==\"undefined\"?WasmBackendModule:{};var readyPromiseResolve,readyPromiseReject;Module[\"ready\"]=new Promise(function(resolve,reject){readyPromiseResolve=resolve;readyPromiseReject=reject});var moduleOverrides={};var key;for(key in Module){if(Module.hasOwnProperty(key)){moduleOverrides[key]=Module[key]}}var arguments_=[];var thisProgram=\"./this.program\";var quit_=function(status,toThrow){throw toThrow};var ENVIRONMENT_IS_WEB=false;var ENVIRONMENT_IS_WORKER=false;var

ENVIRONMENT_IS_NODE=false;var ENVIRONMENT_IS_SHELL=false;ENVIRONMENT_IS_WEB=typeof window===\"object\";ENVIRONMENT_IS_WORKER=typeof importScripts===\"function\";ENVIRONMENT_IS_NODE=typeof process===\"object\"&&typeof process.versions===\"object\"&&typeof process.versions.node===\"string\";ENVIRONMENT_IS_SHELL=!ENVIRONMENT_IS_WEB&&!ENVIRONMENT_IS_NODE&&!ENVIRONMENT_IS_WORKER;var scriptDirectory=\"\";function locateFile(path){if(Module[\"locateFile\"]){return Module[\"locateFile\"](path,scriptDirectory)}return scriptDirectory+path}var read_,readAsync,readBinary,setWindowTitle;var nodeFS;var nodePath;if(ENVIRONMENT_IS_NODE){if(ENVIRONMENT_IS_WORKER){scriptDirectory=require(\"path\").dirname(scriptDirectory)+\"/\"}else{scriptDirectory=__dirname+\"/\"}read_=function shell_read(filename,binary){if(!nodeFS)nodeFS=require(\"fs\");if(!nodePath)nodePath=require(\"path\");filename=nodePath[\"normalize\"](filename);return nodeFS[\"readFileSync\"](filename,binary?null:\"utf8\")};readBinary=function readBinary(filename){var ret=read_(filename,true);if(!ret.buffer){ret=new Uint8Array(ret)}assert(ret.buffer);return ret};if(process[\"argv\"].length>1){thisProgram=process[\"argv\"][1].replace(/\\\\/g,\"/\")}arguments_=process[\"argv\"].slice(2);process[\"on\"](\"uncaughtException\",function(ex){if(!(ex instanceof ExitStatus)){throw ex}});process[\"on\"](\"unhandledRejection\",abort);quit_=function(status){process[\"exit\"](status)};Module[\"inspect\"]=function(){return\"[Emscripten Module object]\"}}else if(ENVIRONMENT_IS_SHELL){if(typeof read!=\"undefined\"){read_=function shell_read(f){return read(f)}}readBinary=function readBinary(f){var data;if(typeof readbuffer===\"function\"){return new Uint8Array(readbuffer(f))}data=read(f,\"binary\");assert(typeof data===\"object\");return data};if(typeof scriptArgs!=\"undefined\"){arguments_=scriptArgs}else if(typeof arguments!=\"undefined\"){arguments_=arguments}if(typeof quit===\"function\"){quit_=function(status){quit(status)}}if(typeof print!==\"undefined\"){if(typeof console===\"undefined\")console={};console.log=print;console.warn=console.error=typeof printErr!==\"undefined\"?printErr:print}}else if(ENVIRONMENT_IS_WEB||ENVIRONMENT_IS_WORKER){if(ENVIRONMENT_IS_WORKER){scriptDirectory=self.location.href}else if(typeof document!==\"undefined\"&&document.currentScript){scriptDirectory=document.currentScript.src}if(_scriptDir){scriptDirectory=_scriptDir}if(scriptDirectory.indexOf(\"blob:\")!==0){scriptDirectory=scriptDirectory.substr(0,scriptDirectory.lastIndexOf(\"/\")+1)}else{scriptDirectory=\"\"}{read_=function(url){var xhr=new XMLHttpRequest;xhr.open(\"GET\",url,false);xhr.send(null);return xhr.responseText};if(ENVIRONMENT_IS_WORKER){readBinary=function(url){var xhr=new XMLHttpRequest;xhr.open(\"GET\",url,false);xhr.responseType=\"arraybuffer\";xhr.send(null);return new Uint8Array(xhr.response)}}readAsync=function(url,onload,onerror){var xhr=new XMLHttpRequest;xhr.open(\"GET\",url,true);xhr.responseType=\"arraybuffer\";xhr.onload=function(){if(xhr.status==200||xhr.status==0&&xhr.response){onload(xhr.response);return}onerror()};xhr.onerror=onerror;xhr.send(null)}}setWindowTitle=function(title){document.title=title}}else{}var out=Module[\"print\"]||console.log.bind(console);var err=Module[\"printErr\"]||console.warn.bind(console);for(key in moduleOverrides){if(moduleOverrides.hasOwnProperty(key)){Module[key]=moduleOverrides[key]}}moduleOverrides=null;if(Module[\"arguments\"])arguments_=Module[\"arguments\"];if(Module[\"thisProgram\"])thisProgram=Module[\"thisProgram\"];if(Module[\"quit\"])quit_=Module[\"quit\"];var wasmBinary;if(Module[\"wasmBinary\"])wasmBinary=Module[\"wasmBinary\"];var noExitRuntime=Module[\"noExitRuntime\"]||true;if(typeof WebAssembly!==\"object\"){abort(\"no native wasm support detected\")}var wasmMemory;var ABORT=false;var EXITSTATUS;function assert(condition,text){if(!condition){abort(\"Assertion failed: \"+text)}}function getCFunc(ident){var func=Module[\"_\"+ident];assert(func,\"Cannot call unknown function

\"+ident+\", make sure it is exported\");return func}function ccall(ident,returnType,argTypes,args,opts){var toC={\"string\":function(str){var ret=0;if(str!==null&&str!==undefined&&str!==0){var len=(str.length<<2)+1;ret=stackAlloc(len);stringToUTF8(str,ret,len)}return ret},\"array\":function(arr){var ret=stackAlloc(arr.length);writeArrayToMemory(arr,ret);return ret}};function convertReturnValue(ret){if(returnType===\"string\")return UTF8ToString(ret);if(returnType===\"boolean\")return Boolean(ret);return ret}var func=getCFunc(ident);var cArgs=[];var stack=0;if(args){for(var i=0;i<args.length;i++){var converter=toC[argTypes[i]];if(converter){if(stack===0)stack=stackSave();cArgs[i]=converter(args[i])}else{cArgs[i]=args[i]}}}var ret=func.apply(null,cArgs);ret=convertReturnValue(ret);if(stack!==0)stackRestore(stack);return ret}function cwrap(ident,returnType,argTypes,opts){argTypes=argTypes||[];var numericArgs=argTypes.every(function(type){return type===\"number\"});var numericRet=returnType!==\"string\";if(numericRet&&numericArgs&&!opts){return getCFunc(ident)}return function(){return ccall(ident,returnType,argTypes,arguments,opts)}}var UTF8Decoder=typeof TextDecoder!==\"undefined\"?new TextDecoder(\"utf8\"):undefined;function UTF8ArrayToString(heap,idx,maxBytesToRead){var endIdx=idx+maxBytesToRead;var endPtr=idx;while(heap[endPtr]&&!(endPtr>=endIdx))++endPtr;if(endPtr-idx>16&&heap.subarray&&UTF8Decoder){return UTF8Decoder.decode(heap.subarray(idx,endPtr))}else{var str=\"\";while(idx<endPtr){var u0=heap[idx++];if(!(u0&128)){str+=String.fromCharCode(u0);continue}var u1=heap[idx++]&63;if((u0&224)==192){str+=String.fromCharCode((u0&31)<<6|u1);continue}var u2=heap[idx++]&63;if((u0&240)==224){u0=(u0&15)<<12|u1<<6|u2}else{u0=(u0&7)<<18|u1<<12|u2<<6|heap[idx++]&63}if(u0<65536){str+=String.fromCharCode(u0)}else{var ch=u0-65536;str+=String.fromCharCode(55296|ch>>10,56320|ch&1023)}}}return str}function UTF8ToString(ptr,maxBytesToRead){return ptr?UTF8ArrayToString(HEAPU8,ptr,maxBytesToRead):\"\"}function stringToUTF8Array(str,heap,outIdx,maxBytesToWrite){if(!(maxBytesToWrite>0))return 0;var startIdx=outIdx;var endIdx=outIdx+maxBytesToWrite-1;for(var i=0;i<str.length;++i){var u=str.charCodeAt(i);if(u>=55296&&u<=57343){var u1=str.charCodeAt(++i);u=65536+((u&1023)<<10)|u1&1023}if(u<=127){if(outIdx>=endIdx)break;heap[outIdx++]=u}else if(u<=2047){if(outIdx+1>=endIdx)break;heap[outIdx++]=192|u>>6;heap[outIdx++]=128|u&63}else if(u<=65535){if(outIdx+2>=endIdx)break;heap[outIdx++]=224|u>>12;heap[outIdx++]=128|u>>6&63;heap[outIdx++]=128|u&63}else{if(outIdx+3>=endIdx)break;heap[outIdx++]=240|u>>18;heap[outIdx++]=128|u>>12&63;heap[outIdx++]=128|u>>6&63;heap[outIdx++]=128|u&63}}heap[outIdx]=0;return outIdx-startIdx}function stringToUTF8(str,outPtr,maxBytesToWrite){return stringToUTF8Array(str,HEAPU8,outPtr,maxBytesToWrite)}function writeArrayToMemory(array,buffer){HEAP8.set(array,buffer)}function alignUp(x,multiple){if(x%multiple>0){x+=multiple-x%multiple}return x}var buffer,HEAP8,HEAPU8,HEAP16,HEAPU16,HEAP32,HEAPU32,HEAPF32,HEAPF64;function updateGlobalBufferAndViews(buf){buffer=buf;Module[\"HEAP8\"]=HEAP8=new Int8Array(buf);Module[\"HEAP16\"]=HEAP16=new Int16Array(buf);Module[\"HEAP32\"]=HEAP32=new Int32Array(buf);Module[\"HEAPU8\"]=HEAPU8=new Uint8Array(buf);Module[\"HEAPU16\"]=HEAPU16=new Uint16Array(buf);Module[\"HEAPU32\"]=HEAPU32=new Uint32Array(buf);Module[\"HEAPF32\"]=HEAPF32=new Float32Array(buf);Module[\"HEAPF64\"]=HEAPF64=new Float64Array(buf)}var INITIAL_MEMORY=Module[\"INITIAL_MEMORY\"]||16777216;var wasmTable;var __ATPRERUN__=[];var __ATINIT__=[];var __ATMAIN__=[];var __ATPOSTRUN__=[];var runtimeInitialized=false;__ATINIT__.push({func:function(){___wasm_call_ctors()}});function preRun(){if(Module[\"preRun\"]){if(typeof Module[\"preRun\"]==\"function\")Module[\"preRun\"]=[Module[\"preRun\"]];while(Module[\"preRun\"].length){a

ddOnPreRun(Module[\"preRun\"].shift())}}callRuntimeCallbacks(__ATPRERUN__)}function initRuntime(){runtimeInitialized=true;callRuntimeCallbacks(__ATINIT__)}function preMain(){callRuntimeCallbacks(__ATMAIN__)}function postRun(){if(Module[\"postRun\"]){if(typeof Module[\"postRun\"]==\"function\")Module[\"postRun\"]=[Module[\"postRun\"]];while(Module[\"postRun\"].length){addOnPostRun(Module[\"postRun\"].shift())}}callRuntimeCallbacks(__ATPOSTRUN__)}function addOnPreRun(cb){__ATPRERUN__.unshift(cb)}function addOnPostRun(cb){__ATPOSTRUN__.unshift(cb)}var runDependencies=0;var runDependencyWatcher=null;var dependenciesFulfilled=null;function addRunDependency(id){runDependencies++;if(Module[\"monitorRunDependencies\"]){Module[\"monitorRunDependencies\"](runDependencies)}}function removeRunDependency(id){runDependencies--;if(Module[\"monitorRunDependencies\"]){Module[\"monitorRunDependencies\"](runDependencies)}if(runDependencies==0){if(runDependencyWatcher!==null){clearInterval(runDependencyWatcher);runDependencyWatcher=null}if(dependenciesFulfilled){var callback=dependenciesFulfilled;dependenciesFulfilled=null;callback()}}}Module[\"preloadedImages\"]={};Module[\"preloadedAudios\"]={};function abort(what){if(Module[\"onAbort\"]){Module[\"onAbort\"](what)}what+=\"\";err(what);ABORT=true;EXITSTATUS=1;what=\"abort(\"+what+\"). Build with -s ASSERTIONS=1 for more info.\";var e=new WebAssembly.RuntimeError(what);readyPromiseReject(e);throw e}function hasPrefix(str,prefix){return String.prototype.startsWith?str.startsWith(prefix):str.indexOf(prefix)===0}var dataURIPrefix=\"data:application/octet-stream; base64,\";function isDataURI(filename){return hasPrefix(filename,dataURIPrefix)}var fileURIPrefix=\"file://\";function isFileURI(filename){return hasPrefix(filename,fileURIPrefix)}var wasmBinaryFile=\"tfjs-backend-wasm.wasm\";if(!isDataURI(wasmBinaryFile)){wasmBinaryFile=locateFile(wasmBinaryFile)}function getBinary(file){try{if(file==wasmBinaryFile&&wasmBinary){return new Uint8Array(wasmBinary)}if(readBinary){return readBinary(file)}else{throw\"both async and sync fetching of the wasm failed\"}}catch(err){abort(err)}}function getBinaryPromise(){if(!wasmBinary&&(ENVIRONMENT_IS_WEB||ENVIRONMENT_IS_WORKER)){if(typeof fetch===\"function\"&&!isFileURI(wasmBinaryFile)){return fetch(wasmBinaryFile,{credentials:\"same-origin\"}).then(function(response){if(!response[\"ok\"]){throw\"failed to load wasm binary file at '\"+wasmBinaryFile+\"'\"}return response[\"arrayBuffer\"]()}).catch(function(){return getBinary(wasmBinaryFile)})}else{if(readAsync){return new Promise(function(resolve,reject){readAsync(wasmBinaryFile,function(response){resolve(new Uint8Array(response))},reject)})}}}return Promise.resolve().then(function(){return getBinary(wasmBinaryFile)})}function createWasm(){var info={\"a\":asmLibraryArg};function receiveInstance(instance,module){var exports=instance.exports;Module[\"asm\"]=exports;wasmMemory=Module[\"asm\"][\"j\"];updateGlobalBufferAndViews(wasmMemory.buffer);wasmTable=Module[\"asm\"][\"r\"];removeRunDependency(\"wasm-instantiate\")}addRunDependency(\"wasm-instantiate\");function receiveInstantiatedSource(output){receiveInstance(output[\"instance\"])}function instantiateArrayBuffer(receiver){return getBinaryPromise().then(function(binary){return WebAssembly.instantiate(binary,info)}).then(receiver,function(reason){err(\"failed to asynchronously prepare wasm: \"+reason);abort(reason)})}function instantiateAsync(){if(!wasmBinary&&typeof WebAssembly.instantiateStreaming===\"function\"&&!isDataURI(wasmBinaryFile)&&!isFileURI(wasmBinaryFile)&&typeof fetch===\"function\"){return fetch(wasmBinaryFile,{credentials:\"same-origin\"}).then(function(response){var result=WebAssembly.instantiateStreaming(response,info);return result.then(receiveInstantiatedSource,function(reason){err(\"wasm streaming compile failed: \"+reason);err(\"falling back to ArrayBuffer instantiation\");return instantiateArrayBuffer(receiveInstantiatedSource)})})}else{return instantiateArrayBuffer(receiveInstantiatedSource)}}if(Module[\"instantiateWasm\"]){try{var

exports=Module[\"instantiateWasm\"](info,receiveInstance);return exports}catch(e){err(\"Module.instantiateWasm callback failed with error: \"+e);return false}}instantiateAsync().catch(readyPromiseReject);return{}}function callRuntimeCallbacks(callbacks){while(callbacks.length>0){var callback=callbacks.shift();if(typeof callback==\"function\"){callback(Module);continue}var func=callback.func;if(typeof func===\"number\"){if(callback.arg===undefined){wasmTable.get(func)()}else{wasmTable.get(func)(callback.arg)}}else{func(callback.arg===undefined?null:callback.arg)}}}function _abort(){abort()}function _emscripten_memcpy_big(dest,src,num){HEAPU8.copyWithin(dest,src,src+num)}function _emscripten_get_heap_size(){return HEAPU8.length}function emscripten_realloc_buffer(size){try{wasmMemory.grow(size-buffer.byteLength+65535>>>16);updateGlobalBufferAndViews(wasmMemory.buffer);return 1}catch(e){}}function _emscripten_resize_heap(requestedSize){var oldSize=_emscripten_get_heap_size();var maxHeapSize=2147483648;if(requestedSize>maxHeapSize){return false}for(var cutDown=1;cutDown<=4;cutDown*=2){var overGrownHeapSize=oldSize*(1+.2/cutDown);overGrownHeapSize=Math.min(overGrownHeapSize,requestedSize+100663296);var newSize=Math.min(maxHeapSize,alignUp(Math.max(requestedSize,overGrownHeapSize),65536));var replacement=emscripten_realloc_buffer(newSize);if(replacement){return true}}return false}var SYSCALLS={mappings:{},buffers:[null,[],[]],printChar:function(stream,curr){var buffer=SYSCALLS.buffers[stream];if(curr===0||curr===10){(stream===1?out:err)(UTF8ArrayToString(buffer,0));buffer.length=0}else{buffer.push(curr)}},varargs:undefined,get:function(){SYSCALLS.varargs+=4;var ret=HEAP32[SYSCALLS.varargs-4>>2];return ret},getStr:function(ptr){var ret=UTF8ToString(ptr);return ret},get64:function(low,high){return low}};function _fd_close(fd){return 0}function _fd_seek(fd,offset_low,offset_high,whence,newOffset){}function _fd_write(fd,iov,iovcnt,pnum){var num=0;for(var i=0;i<iovcnt;i++){var ptr=HEAP32[iov+i*8>>2];var len=HEAP32[iov+(i*8+4)>>2];for(var j=0;j<len;j++){SYSCALLS.printChar(fd,HEAPU8[ptr+j])}num+=len}HEAP32[pnum>>2]=num;return 0}function _pthread_create(){return 6}function _pthread_join(){return 28}function setErrNo(value){HEAP32[___errno_location()>>2]=value;return value}function _sysconf(name){switch(name){case 30:return 16384;case 85:var maxHeapSize=2147483648;return maxHeapSize/16384;case 132:case 133:case 12:case 137:case 138:case 15:case 235:case 16:case 17:case 18:case 19:case 20:case 149:case 13:case 10:case 236:case 153:case 9:case 21:case 22:case 159:case 154:case 14:case 77:case 78:case 139:case 82:case 68:case 67:case 164:case 11:case 29:case 47:case 48:case 95:case 52:case 51:case 46:return 200809;case 27:case 246:case 127:case 128:case 23:case 24:case 160:case 161:case 181:case 182:case 242:case 183:case 184:case 243:case 244:case 245:case 165:case 178:case 179:case 49:case 50:case 168:case 169:case 175:case 170:case 171:case 172:case 97:case 76:case 32:case 173:case 35:case 80:case 81:case 79:return-1;case 176:case 177:case 7:case 155:case 8:case 157:case 125:case 126:case 92:case 93:case 129:case 130:case 131:case 94:case 91:return 1;case 74:case 60:case 69:case 70:case 4:return 1024;case 31:case 42:case 72:return 32;case 87:case 26:case 33:return 2147483647;case 34:case 1:return 47839;case 38:case 36:return 99;case 43:case 37:return 2048;case 0:return 2097152;case 3:return 65536;case 28:return 32768;case 44:return 32767;case 75:return 16384;case 39:return 1e3;case 89:return 700;case 71:return 256;case 40:return 255;case 2:return 100;case 180:return 64;case 25:return 20;case 5:return 16;case 6:return 6;case 73:return 4;case 84:{if(typeof navigator===\"object\")return navigator[\"hardwareConcurrency\"]||1;return 1}}setErrNo(28);return-1}var asmLibraryArg={\"a\":_abort,\"d\":_emscripten_memcpy_big,\"e\":_emscripten_resize_heap,\"f\":_fd_close,\"c\":_fd_seek,\"b\":_fd_write,\"h\":_pthread_create,\"g\":_pthread_join,\"i\":_sysconf};var asm=createWasm();var ___wasm_call_ctors=Module[\"___wasm_call_ctors\"]=function(){return(___wasm_call_ctors=Module[\"___wasm_call_ctors\"]=Module[\"asm\"][\"k\"]).apply(null,arguments)};var _init=Module[\"_init\"]=function(){return(_init=Module[\"_init\"]=Module[\"asm\"][\"l\"]).apply(null,arguments)};

var
_init_with_threads_count=Module[\"_init_with_threads_count\"]=function(){return(_init_with_threads_count=Mod
ule[\"_init_with_threads_count\"]=Module[\"asm\"][\"m\"]).apply(null,arguments)};var
_get_threads_count=Module[\"_get_threads_count\"]=function(){return(_get_threads_count=Module[\"_get_threads
_count\"]=Module[\"asm\"][\"n\"]).apply(null,arguments)};var
_register_tensor=Module[\"_register_tensor\"]=function(){return(_register_tensor=Module[\"_register_tensor\"]=M
odule[\"asm\"][\"o\"]).apply(null,arguments)};var
_dispose_data=Module[\"_dispose_data\"]=function(){return(_dispose_data=Module[\"_dispose_data\"]=Module[\"
asm\"][\"p\"]).apply(null,arguments)};var
_dispose=Module[\"_dispose\"]=function(){return(_dispose=Module[\"_dispose\"]=Module[\"asm\"][\"q\"]).apply(n
ull,arguments)};var
_Abs=Module[\"_Abs\"]=function(){return(_Abs=Module[\"_Abs\"]=Module[\"asm\"][\"s\"]).apply(null,arguments
)};var
_Add=Module[\"_Add\"]=function(){return(_Add=Module[\"_Add\"]=Module[\"asm\"][\"t\"]).apply(null,argument
s)};var
_AddN=Module[\"_AddN\"]=function(){return(_AddN=Module[\"_AddN\"]=Module[\"asm\"][\"u\"]).apply(null,ar
guments)};var
_All=Module[\"_All\"]=function(){return(_All=Module[\"_All\"]=Module[\"asm\"][\"v\"]).apply(null,arguments)};
var
_Any=Module[\"_Any\"]=function(){return(_Any=Module[\"_Any\"]=Module[\"asm\"][\"w\"]).apply(null,argumen
ts)};var
_ArgMax=Module[\"_ArgMax\"]=function(){return(_ArgMax=Module[\"_ArgMax\"]=Module[\"asm\"][\"x\"]).app
ly(null,arguments)};var
_AvgPool=Module[\"_AvgPool\"]=function(){return(_AvgPool=Module[\"_AvgPool\"]=Module[\"asm\"][\"y\"]).a
pply(null,arguments)};var
_BatchMatMul=Module[\"_BatchMatMul\"]=function(){return(_BatchMatMul=Module[\"_BatchMatMul\"]=Modu
le[\"asm\"][\"z\"]).apply(null,arguments)};var
_Ceil=Module[\"_Ceil\"]=function(){return(_Ceil=Module[\"_Ceil\"]=Module[\"asm\"][\"A\"]).apply(null,argument
s)};var
_ClipByValue=Module[\"_ClipByValue\"]=function(){return(_ClipByValue=Module[\"_ClipByValue\"]=Module[\
"asm\"][\"B\"]).apply(null,arguments)};var
_Conv2D=Module[\"_Conv2D\"]=function(){return(_Conv2D=Module[\"_Conv2D\"]=Module[\"asm\"][\"C\"]).ap
ply(null,arguments)};var
_Conv2DBackpropInput=Module[\"_Conv2DBackpropInput\"]=function(){return(_Conv2DBackpropInput=Modul
e[\"_Conv2DBackpropInput\"]=Module[\"asm\"][\"D\"]).apply(null,arguments)};var
_Cos=Module[\"_Cos\"]=function(){return(_Cos=Module[\"_Cos\"]=Module[\"asm\"][\"E\"]).apply(null,arguments
)};var
_Cosh=Module[\"_Cosh\"]=function(){return(_Cosh=Module[\"_Cosh\"]=Module[\"asm\"][\"F\"]).apply(null,argu
ments)};var
_CropAndResize=Module[\"_CropAndResize\"]=function(){return(_CropAndResize=Module[\"_CropAndResize\"]
=Module[\"asm\"][\"G\"]).apply(null,arguments)};var
_Cumsum=Module[\"_Cumsum\"]=function(){return(_Cumsum=Module[\"_Cumsum\"]=Module[\"asm\"][\"H\"]).a
pply(null,arguments)};var
_DepthToSpace=Module[\"_DepthToSpace\"]=function(){return(_DepthToSpace=Module[\"_DepthToSpace\"]=M
odule[\"asm\"][\"I\"]).apply(null,arguments)};var
_DepthwiseConv2dNative=Module[\"_DepthwiseConv2dNative\"]=function(){return(_DepthwiseConv2dNative=M
odule[\"_DepthwiseConv2dNative\"]=Module[\"asm\"][\"J\"]).apply(null,arguments)};var
_Elu=Module[\"_Elu\"]=function(){return(_Elu=Module[\"_Elu\"]=Module[\"asm\"][\"K\"]).apply(null,arguments)}

;var
_Equal=Module[\"_Equal\"]=function(){return(_Equal=Module[\"_Equal\"]=Module[\"asm\"][\"L\"]).apply(null,arguments)};var
_Exp=Module[\"_Exp\"]=function(){return(_Exp=Module[\"_Exp\"]=Module[\"asm\"][\"M\"]).apply(null,arguments)};var
_FlipLeftRight=Module[\"_FlipLeftRight\"]=function(){return(_FlipLeftRight=Module[\"_FlipLeftRight\"]=Module[\"asm\"][\"N\"]).apply(null,arguments)};var
_Floor=Module[\"_Floor\"]=function(){return(_Floor=Module[\"_Floor\"]=Module[\"asm\"][\"O\"]).apply(null,arguments)};var
_FloorDiv=Module[\"_FloorDiv\"]=function(){return(_FloorDiv=Module[\"_FloorDiv\"]=Module[\"asm\"][\"P\"]).apply(null,arguments)};var
_FusedBatchNorm=Module[\"_FusedBatchNorm\"]=function(){return(_FusedBatchNorm=Module[\"_FusedBatchNorm\"]=Module[\"asm\"][\"Q\"]).apply(null,arguments)};var
_FusedConv2D=Module[\"_FusedConv2D\"]=function(){return(_FusedConv2D=Module[\"_FusedConv2D\"]=Module[\"asm\"][\"R\"]).apply(null,arguments)};var
_FusedDepthwiseConv2D=Module[\"_FusedDepthwiseConv2D\"]=function(){return(_FusedDepthwiseConv2D=Module[\"_FusedDepthwiseConv2D\"]=Module[\"asm\"][\"S\"]).apply(null,arguments)};var
_Gather=Module[\"_Gather\"]=function(){return(_Gather=Module[\"_Gather\"]=Module[\"asm\"][\"T\"]).apply(null,arguments)};var
_GatherNd=Module[\"_GatherNd\"]=function(){return(_GatherNd=Module[\"_GatherNd\"]=Module[\"asm\"][\"U\"]).apply(null,arguments)};var
_Greater=Module[\"_Greater\"]=function(){return(_Greater=Module[\"_Greater\"]=Module[\"asm\"][\"V\"]).apply(null,arguments)};var
_GreaterEqual=Module[\"_GreaterEqual\"]=function(){return(_GreaterEqual=Module[\"_GreaterEqual\"]=Module[\"asm\"][\"W\"]).apply(null,arguments)};var
_LeakyRelu=Module[\"_LeakyRelu\"]=function(){return(_LeakyRelu=Module[\"_LeakyRelu\"]=Module[\"asm\"][\"X\"]).apply(null,arguments)};var
_Less=Module[\"_Less\"]=function(){return(_Less=Module[\"_Less\"]=Module[\"asm\"][\"Y\"]).apply(null,arguments)};var
_LessEqual=Module[\"_LessEqual\"]=function(){return(_LessEqual=Module[\"_LessEqual\"]=Module[\"asm\"][\"Z\"]).apply(null,arguments)};var
_Log=Module[\"_Log\"]=function(){return(_Log=Module[\"_Log\"]=Module[\"asm\"][\"_\"]).apply(null,arguments)};var
_LogicalAnd=Module[\"_LogicalAnd\"]=function(){return(_LogicalAnd=Module[\"_LogicalAnd\"]=Module[\"asm\"][\"$\"]).apply(null,arguments)};var
_Max=Module[\"_Max\"]=function(){return(_Max=Module[\"_Max\"]=Module[\"asm\"][\"aa\"]).apply(null,arguments)};var
_MaxPool=Module[\"_MaxPool\"]=function(){return(_MaxPool=Module[\"_MaxPool\"]=Module[\"asm\"][\"ba\"]).apply(null,arguments)};var
_Maximum=Module[\"_Maximum\"]=function(){return(_Maximum=Module[\"_Maximum\"]=Module[\"asm\"][\"ca\"]).apply(null,arguments)};var
_Mean=Module[\"_Mean\"]=function(){return(_Mean=Module[\"_Mean\"]=Module[\"asm\"][\"da\"]).apply(null,arguments)};var
_Min=Module[\"_Min\"]=function(){return(_Min=Module[\"_Min\"]=Module[\"asm\"][\"ea\"]).apply(null,arguments)};var
_Minimum=Module[\"_Minimum\"]=function(){return(_Minimum=Module[\"_Minimum\"]=Module[\"asm\"][\"fa\"]).apply(null,arguments)};var
_MirrorPad=Module[\"_MirrorPad\"]=function(){return(_MirrorPad=Module[\"_MirrorPad\"]=Module[\"asm\"][\"g

a\"]).apply(null,arguments)};var
_Multiply=Module[\"_Multiply\"]=function(){return(_Multiply=Module[\"_Multiply\"]=Module[\"asm\"][\"ha\"]).apply(null,arguments)};var
_Neg=Module[\"_Neg\"]=function(){return(_Neg=Module[\"_Neg\"]=Module[\"asm\"][\"ia\"]).apply(null,arguments)};var
_NonMaxSuppressionV3=Module[\"_NonMaxSuppressionV3\"]=function(){return(_NonMaxSuppressionV3=Module[\"_NonMaxSuppressionV3\"]=Module[\"asm\"][\"ja\"]).apply(null,arguments)};var
_NonMaxSuppressionV4=Module[\"_NonMaxSuppressionV4\"]=function(){return(_NonMaxSuppressionV4=Module[\"_NonMaxSuppressionV4\"]=Module[\"asm\"][\"ka\"]).apply(null,arguments)};var
_NonMaxSuppressionV5=Module[\"_NonMaxSuppressionV5\"]=function(){return(_NonMaxSuppressionV5=Module[\"_NonMaxSuppressionV5\"]=Module[\"asm\"][\"la\"]).apply(null,arguments)};var
_NotEqual=Module[\"_NotEqual\"]=function(){return(_NotEqual=Module[\"_NotEqual\"]=Module[\"asm\"][\"ma\"]).apply(null,arguments)};var
_OneHot=Module[\"_OneHot\"]=function(){return(_OneHot=Module[\"_OneHot\"]=Module[\"asm\"][\"na\"]).apply(null,arguments)};var
_PadV2=Module[\"_PadV2\"]=function(){return(_PadV2=Module[\"_PadV2\"]=Module[\"asm\"][\"oa\"]).apply(null,arguments)};var
_Pow=Module[\"_Pow\"]=function(){return(_Pow=Module[\"_Pow\"]=Module[\"asm\"][\"pa\"]).apply(null,arguments)};var
_Prelu=Module[\"_Prelu\"]=function(){return(_Prelu=Module[\"_Prelu\"]=Module[\"asm\"][\"qa\"]).apply(null,arguments)};var
_Prod=Module[\"_Prod\"]=function(){return(_Prod=Module[\"_Prod\"]=Module[\"asm\"][\"ra\"]).apply(null,arguments)};var
_RealDiv=Module[\"_RealDiv\"]=function(){return(_RealDiv=Module[\"_RealDiv\"]=Module[\"asm\"][\"sa\"]).apply(null,arguments)};var
_Relu=Module[\"_Relu\"]=function(){return(_Relu=Module[\"_Relu\"]=Module[\"asm\"][\"ta\"]).apply(null,arguments)};var
_Relu6=Module[\"_Relu6\"]=function(){return(_Relu6=Module[\"_Relu6\"]=Module[\"asm\"][\"ua\"]).apply(null,arguments)};var
_ResizeBilinear=Module[\"_ResizeBilinear\"]=function(){return(_ResizeBilinear=Module[\"_ResizeBilinear\"]=Module[\"asm\"][\"va\"]).apply(null,arguments)};var
_Reverse=Module[\"_Reverse\"]=function(){return(_Reverse=Module[\"_Reverse\"]=Module[\"asm\"][\"wa\"]).apply(null,arguments)};var
_RotateWithOffset=Module[\"_RotateWithOffset\"]=function(){return(_RotateWithOffset=Module[\"_RotateWithOffset\"]=Module[\"asm\"][\"xa\"]).apply(null,arguments)};var
_Round=Module[\"_Round\"]=function(){return(_Round=Module[\"_Round\"]=Module[\"asm\"][\"ya\"]).apply(null,arguments)};var
_Rsqrt=Module[\"_Rsqrt\"]=function(){return(_Rsqrt=Module[\"_Rsqrt\"]=Module[\"asm\"][\"za\"]).apply(null,arguments)};var
_ScatterNd=Module[\"_ScatterNd\"]=function(){return(_ScatterNd=Module[\"_ScatterNd\"]=Module[\"asm\"][\"Aa\"]).apply(null,arguments)};var
_SelectV2=Module[\"_SelectV2\"]=function(){return(_SelectV2=Module[\"_SelectV2\"]=Module[\"asm\"][\"Ba\"]).apply(null,arguments)};var
_Sigmoid=Module[\"_Sigmoid\"]=function(){return(_Sigmoid=Module[\"_Sigmoid\"]=Module[\"asm\"][\"Ca\"]).apply(null,arguments)};var
_Sin=Module[\"_Sin\"]=function(){return(_Sin=Module[\"_Sin\"]=Module[\"asm\"][\"Da\"]).apply(null,arguments)};var

_Softmax=Module[\"_Softmax\"]=function(){return(_Softmax=Module[\"_Softmax\"]=Module[\"asm\"][\"Ea\"]).apply(null,arguments)};var
_Sqrt=Module[\"_Sqrt\"]=function(){return(_Sqrt=Module[\"_Sqrt\"]=Module[\"asm\"][\"Fa\"]).apply(null,arguments)};var
_Square=Module[\"_Square\"]=function(){return(_Square=Module[\"_Square\"]=Module[\"asm\"][\"Ga\"]).apply(null,arguments)};var
_SquaredDifference=Module[\"_SquaredDifference\"]=function(){return(_SquaredDifference=Module[\"_SquaredDifference\"]=Module[\"asm\"][\"Ha\"]).apply(null,arguments)};var
_Step=Module[\"_Step\"]=function(){return(_Step=Module[\"_Step\"]=Module[\"asm\"][\"Ia\"]).apply(null,arguments)};var
_StridedSlice=Module[\"_StridedSlice\"]=function(){return(_StridedSlice=Module[\"_StridedSlice\"]=Module[\"asm\"][\"Ja\"]).apply(null,arguments)};var
_Sub=Module[\"_Sub\"]=function(){return(_Sub=Module[\"_Sub\"]=Module[\"asm\"][\"Ka\"]).apply(null,arguments)};var
_Sum=Module[\"_Sum\"]=function(){return(_Sum=Module[\"_Sum\"]=Module[\"asm\"][\"La\"]).apply(null,arguments)};var
_Tan=Module[\"_Tan\"]=function(){return(_Tan=Module[\"_Tan\"]=Module[\"asm\"][\"Ma\"]).apply(null,arguments)};var
_Tanh=Module[\"_Tanh\"]=function(){return(_Tanh=Module[\"_Tanh\"]=Module[\"asm\"][\"Na\"]).apply(null,arguments)};var
_Tile=Module[\"_Tile\"]=function(){return(_Tile=Module[\"_Tile\"]=Module[\"asm\"][\"Oa\"]).apply(null,arguments)};var
_TopK=Module[\"_TopK\"]=function(){return(_TopK=Module[\"_TopK\"]=Module[\"asm\"][\"Pa\"]).apply(null,arguments)};var
_Transform=Module[\"_Transform\"]=function(){return(_Transform=Module[\"_Transform\"]=Module[\"asm\"][\"Qa\"]).apply(null,arguments)};var
_Transpose=Module[\"_Transpose\"]=function(){return(_Transpose=Module[\"_Transpose\"]=Module[\"asm\"][\"Ra\"]).apply(null,arguments)};var
__FusedMatMul=Module[\"__FusedMatMul\"]=function(){return(__FusedMatMul=Module[\"__FusedMatMul\"]=Module[\"asm\"][\"Sa\"]).apply(null,arguments)};var
_malloc=Module[\"_malloc\"]=function(){return(_malloc=Module[\"_malloc\"]=Module[\"asm\"][\"Ta\"]).apply(null,arguments)};var
_free=Module[\"_free\"]=function(){return(_free=Module[\"_free\"]=Module[\"asm\"][\"Ua\"]).apply(null,arguments)};var
___errno_location=Module[\"___errno_location\"]=function(){return(___errno_location=Module[\"___errno_location\"]=Module[\"asm\"][\"Va\"]).apply(null,arguments)};var
stackSave=Module[\"stackSave\"]=function(){return(stackSave=Module[\"stackSave\"]=Module[\"asm\"][\"Wa\"]).apply(null,arguments)};var
stackRestore=Module[\"stackRestore\"]=function(){return(stackRestore=Module[\"stackRestore\"]=Module[\"asm\"][\"Xa\"]).apply(null,arguments)};var
stackAlloc=Module[\"stackAlloc\"]=function(){return(stackAlloc=Module[\"stackAlloc\"]=Module[\"asm\"][\"Ya\"]).apply(null,arguments)};Module[\"cwrap\"]=cwrap;var calledRun;function
ExitStatus(status){this.name=\"ExitStatus\";this.message=\"Program terminated with
exit(\"+status+\")\";this.status=status}dependenciesFulfilled=function
runCaller(){if(!calledRun)run();if(!calledRun)dependenciesFulfilled=runCaller};function
run(args){args=args||arguments_;if(runDependencies>0){return}preRun();if(runDependencies>0){return}function
doRun(){if(calledRun)return;calledRun=true;Module[\"calledRun\"]=true;if(ABORT)return;initRuntime();preMain();readyPromiseResolve(Module);if(Module[\"onRuntimeInitialized\"])Module[\"onRuntimeInitialized\"]();postRun(

)}if(Module[\"setStatus\"]){Module[\"setStatus\"](\"Running...\");setTimeout(function(){setTimeout(function(){Module[\"setStatus\"](\"\")},1);doRun()},1)}else{doRun()}}Module[\"run\"]=run;if(Module[\"preInit\"]){if(typeof Module[\"preInit\"]==\"function\")Module[\"preInit\"]=[Module[\"preInit\"]];while(Module[\"preInit\"].length>0){Module[\"preInit\"].pop()()}}run();\n\n\n return WasmBackendModule.ready\n}\n);\n})();\nif (typeof exports === 'object' && typeof module === 'object')\n module.exports = WasmBackendModule;\nelse if (typeof define === 'function' && define['amd'])\n define([], function() { return WasmBackendModule; });\nelse if (typeof exports === 'object')\n exports[\"WasmBackendModule\"] = WasmBackendModule;\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\nimport './flags_wasm';\n\nimport {backend_util, BackendTimingInfo, DataStorage, DataType, deprecationWarn, engine, env, KernelBackend, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasmModule, WasmFactoryConfig} from '../wasm-out/tfjs-backend-wasm';\nimport {BackendWasmThreadedSimdModule} from '../wasm-out/tfjs-backend-wasm-threaded-simd';\nimport wasmFactoryThreadedSimd from '../wasm-out/tfjs-backend-wasm-threaded-simd.js';\n// @ts-ignore\nimport {wasmWorkerContents} from '../wasm-out/tfjs-backend-wasm-threaded-simd.worker.js';\nimport wasmFactory from '../wasm-out/tfjs-backend-wasm.js';\n\ninterface TensorData {\n id: number;\n memoryOffset: number;\n shape: number[];\n dtype: DataType;\n refCount: number;\n /** Only used for string tensors, storing encoded bytes. */\n stringBytes?: Uint8Array[];\n}\n\nexport type DataId = object; // object instead of {} to force non-primitive.\n\nexport class BackendWasm extends KernelBackend {\n // 0 is reserved for null data ids.\n private dataIdNextNumber = 1;\n dataIdMap: DataStorage<TensorData>;\n\n constructor(public wasm: BackendWasmModule|BackendWasmThreadedSimdModule) {\n super();\n this.wasm.tfjs.initWithThreadsCount(threadsCount);\n actualThreadsCount = this.wasm.tfjs.getThreadsCount();\n this.dataIdMap = new DataStorage(this, engine());\n }\n\n write(values: backend_util.BackendValues, shape: number[], dtype: DataType):\n DataId {\n const dataId = {id: this.dataIdNextNumber++};\n this.move(dataId, values, shape, dtype, 1);\n return dataId;\n }\n\n numDataIds(): number {\n return this.dataIdMap.numDataIds();\n }\n\n async time(f: () => void): Promise<BackendTimingInfo> {\n const start = util.now();\n f();\n const kernelMs = util.now() - start;\n return {kernelMs};\n }\n\n move(\n dataId: DataId, values: backend_util.BackendValues, shape: number[],\n dtype: DataType, refCount: number): void {\n const id = this.dataIdNextNumber++;\n if (dtype === 'string') {\n const stringBytes = values as Uint8Array[];\n this.dataIdMap.set(\n dataId,\n {id, stringBytes, shape, dtype, memoryOffset: null, refCount});\n return;\n }\n\n const size = util.sizeFromShape(shape);\n const numBytes = size * util.bytesPerElement(dtype);\n const memoryOffset = this.wasm._malloc(numBytes);\n\n this.dataIdMap.set(dataId, {id, memoryOffset, shape, dtype, refCount});\n\n this.wasm.tfjs.registerTensor(id, size, memoryOffset);\n\n if (values != null) {\n this.wasm.HEAPU8.set(\n new Uint8Array(\n (values as backend_util.TypedArray).buffer,\n (values as backend_util.TypedArray).byteOffset, numBytes),\n memoryOffset);\n }\n }\n\n async read(dataId: DataId): Promise<backend_util.BackendValues> {\n return this.readSync(dataId);\n }\n\n readSync(dataId: DataId): backend_util.BackendValues {\n const {memoryOffset, dtype, shape, stringBytes} =\n this.dataIdMap.get(dataId);\n if (dtype === 'string') {\n return stringBytes;\n }\n const bytes = this.wasm.HEAPU8.slice(\n memoryOffset,\n memoryOffset + util.sizeFromShape(shape) * util.bytesPerElement(dtype));\n return typedArrayFromBuffer(bytes.buffer, dtype);\n }\n\n /**\n * Dispose the memory if the dataId has 0 refCount. Return true if the memory\n * is released, false otherwise.\n * @param dataId\n * @oaram force Optional, remove the data regardless of refCount\n */\n

disposeData(dataId: DataId, force = false): boolean {\n if (this.dataIdMap.has(dataId)) {\n const data = this.dataIdMap.get(dataId);\n data.refCount--;\n if (!force && data.refCount > 0) {\n return false;\n }\n\n this.wasm._free(data.memoryOffset);\n this.wasm.tfjs.disposeData(data.id);\n this.dataIdMap.delete(dataId);\n }\n return true;\n }\n\n /** Return refCount of a `TensorData`. */\n refCount(dataId: DataId): number {\n if (this.dataIdMap.has(dataId)) {\n const tensorData = this.dataIdMap.get(dataId);\n
  return tensorData.refCount;\n }\n return 0;\n }\n\n incRef(dataId: DataId) {\n const data = this.dataIdMap.get(dataId);\n if (data != null) {\n data.refCount++;\n }\n }\n\n floatPrecision(): 32 {\n return 32;\n }\n\n // Returns the memory offset of a tensor. Useful for debugging and unit\n // testing.\n getMemoryOffset(dataId: DataId): number {\n return this.dataIdMap.get(dataId).memoryOffset;\n }\n\n dispose() {\n this.wasm.tfjs.dispose();\n if ('PThread' in this.wasm) {\n this.wasm.PThread.terminateAllThreads();\n }\n this.wasm = null;\n }\n\n memory() {\n return {unreliable: false};\n }\n\n /**\n * Make a tensor info for the output of an op. If `memoryOffset` is not\n * present, this method allocates memory on the WASM heap. If `memoryOffset`\n * is present, the memory was allocated elsewhere (in c++) and we just record\n * the pointer where that memory lives.\n */\n makeOutput(shape: number[], dtype: DataType, memoryOffset?: number):\n TensorInfo {\n let dataId: {};\n if (memoryOffset == null) {\n dataId = this.write(null /* values */, shape, dtype);\n } else {\n const id = this.dataIdNextNumber++;\n dataId = {id};\n this.dataIdMap.set(dataId, {id, memoryOffset, shape, dtype, refCount: 1});\n const size = util.sizeFromShape(shape);\n this.wasm.tfjs.registerTensor(id, size, memoryOffset);\n }\n return {dataId, shape, dtype};\n }\n\n typedArrayFromHeap({shape, dtype, dataId}: TensorInfo):\n backend_util.TypedArray {\n const buffer = this.wasm.HEAPU8.buffer;\n const {memoryOffset} = this.dataIdMap.get(dataId);\n const size = util.sizeFromShape(shape);\n switch (dtype) {\n case 'float32':\n return new Float32Array(buffer, memoryOffset, size);\n case 'int32':\n return new Int32Array(buffer, memoryOffset, size);\n case 'bool':\n return new Uint8Array(buffer, memoryOffset, size);\n default:\n throw new Error(`Unknown dtype ${dtype}`);\n }\n }\n}\n\nfunction createInstantiateWasmFunc(path: string) {\n // this will be replace by rollup plugin patchWechatWebAssembly in\n // minprogram's output.\n // tslint:disable-next-line:no-any\n return (imports: any, callback: any) => {\n util.fetch(path, {credentials: 'same-origin'}).then((response) => {\n if (!response['ok']) {\n imports.env.a(`failed to load wasm binary file at '${path}'`);\n }\n response.arrayBuffer().then(binary => {\n WebAssembly.instantiate(binary, imports).then(output => {\n callback(output.instance, output.module);\n });\n });\n });\n return {};\n };\n}\n\n/**\n * Returns the path of the WASM binary.\n * @param simdSupported whether SIMD is supported\n * @param threadsSupported whether multithreading is supported\n * @param wasmModuleFolder the directory containing the WASM binaries.\n */\nfunction getPathToWasmBinary(\n simdSupported: boolean, threadsSupported: boolean,\n wasmModuleFolder: string) {\n if (wasmPath != null) {\n // If wasmPath is defined, the user has supplied a full path to\n // the vanilla .wasm binary.\n return wasmPath;\n }\n\n let path: WasmBinaryName = 'tfjs-backend-wasm.wasm';\n if (simdSupported && threadsSupported) {\n path = 'tfjs-backend-wasm-threaded-simd.wasm';\n } else if (simdSupported) {\n path = 'tfjs-backend-wasm-simd.wasm';\n }\n\n if (wasmFileMap != null) {\n if (wasmFileMap[path] != null) {\n return wasmFileMap[path];\n }\n }\n\n return wasmModuleFolder + path;\n}\n\n/**\n * Initializes the wasm module and creates the js <--> wasm bridge.\n *\n * NOTE: We wrap the wasm module in a object with property 'wasm' instead of\n * returning Promise<BackendWasmModule> to avoid freezing Chrome (last tested\n * in Chrome 76).\n */\nexport async function init(): Promise<{wasm: BackendWasmModule}> {\n const [simdSupported,
 threadsSupported] = await Promise.all([\n env().getAsync('WASM_HAS_SIMD_SUPPORT'),\n env().getAsync('WASM_HAS_MULTITHREAD_SUPPORT')\n]);\n\n return new Promise((resolve, reject) => {\n const factoryConfig: WasmFactoryConfig = {};\n\n /**\n * This function overrides the Emscripten module locateFile utility.\n * @param path The relative path to the file that needs to be loaded.\n * @param prefix The path to the main JavaScript file's directory.\n */\n factoryConfig.locateFile = (path, prefix) => {\n

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if (path.endsWith('.worker.js')) {\n  const response = wasmWorkerContents;\n  const blob = new Blob([response], {type: 'application/javascript'});\n  return URL.createObjectURL(blob);\n  }\n\n  if (path.endsWith('.wasm')) {\n  return getPathToWasmBinary(\n  simdSupported as boolean, threadsSupported as boolean,\n  wasmPathPrefix != null ? wasmPathPrefix : prefix);\n  }\n  return prefix + path;\n
  };\n\n  // Use the instantiateWasm override when system fetch is not available.\n  // Reference:\n  // https://github.com/emscripten-core/emscripten/blob/2bca083cbbd5a4133db61fbd74d04f7feecfa907/tests/manual_wasm_instantiate.html#L170\n  if (customFetch) {\n  factoryConfig.instantiateWasm =\n  createInstantiateWasmFunc(getPathToWasmBinary(\n  simdSupported as boolean, threadsSupported as boolean,\n  wasmPathPrefix != null ? wasmPathPrefix : ''));\n  }\n\n  let initialized = false;\n  factoryConfig.onAbort = () => {\n  if (initialized) {\n  // Emscripten already called console.warn so no need to double log.\n  return;\n  }\n  if (initAborted) {\n  // Emscripten calls `onAbort` twice, resulting in double error\n  // messages.\n  return;\n  }\n  initAborted = true;\n  const rejectMsg =\n  'Make sure the server can serve the `.wasm` file relative to the ' +\n  'bundled
 js file. For more details see https://github.com/tensorflow/tfjs/blob/master/tfjs-backend-wasm/README.md#using-bundlers';\n  reject({message: rejectMsg});\n  };\n\n  let wasm: Promise<BackendWasmModule>;\n  // If `wasmPath` has been defined we must initialize the vanilla module.\n  if (threadsSupported && simdSupported && wasmPath == null) {\n  factoryConfig.mainScriptUrlOrBlob = new Blob(\n  [`var WasmBackendModuleThreadedSimd = ` +\n  wasmFactoryThreadedSimd.toString()],\n  {type: 'text/javascript'});\n  wasm = wasmFactoryThreadedSimd(factoryConfig);\n  } else {\n  // The wasmFactory works for both vanilla and SIMD binaries.\n  wasm = wasmFactory(factoryConfig);\n  }\n\n  // The WASM module has been successfully created by the factory.\n  // Any error will be caught by the onAbort callback defined above.\n  wasm.then((module) => {\n  initialized = true;\n  initAborted = false;\n\n  const voidReturnType: string
 = null;\n  // Using the tfjs namespace to avoid conflict with emscripten's API.\n  module.tfjs = {\n  init: module.cwrap('init', null, []),\n  initWithThreadsCount:\n  module.cwrap('init_with_threads_count', null, ['number']),\n  getThreadsCount: module.cwrap('get_threads_count', 'number', []),\n  registerTensor: module.cwrap(\n  'register_tensor', null,\n  [\n  'number',  // id\n  'number',  // size\n
  'number',  // memoryOffset\n  ]),\n  disposeData: module.cwrap('dispose_data', voidReturnType, ['number']),\n  dispose: module.cwrap('dispose', voidReturnType, []),\n  };\n\n  resolve({wasm: module});\n
  });\n  });\n}\n\nfunction typedArrayFromBuffer(\n  buffer: ArrayBuffer, dtype: DataType): backend_util.TypedArray {\n  switch (dtype) {\n  case 'float32':\n  return new Float32Array(buffer);\n  case 'int32':\n  return new Int32Array(buffer);\n
  case 'bool':\n  return new Uint8Array(buffer);\n  default:\n  throw new Error(`Unknown dtype ${dtype}`);\n}\n}\n\nconst wasmBinaryNames = [\n  'tfjs-backend-wasm.wasm', 'tfjs-backend-wasm-simd.wasm',\n  'tfjs-backend-wasm-threaded-simd.wasm'\n] as const ;\ntype WasmBinaryName = typeof wasmBinaryNames[number];\n\nlet wasmPath: string = null;\nlet wasmPathPrefix: string = null;\nlet wasmFileMap: {[key in WasmBinaryName]?: string} = {};\nlet initAborted = false;\nlet customFetch = false;\n\n/**\n * @deprecated Use `setWasmPaths` instead.\n * Sets the path to the `.wasm` file which will be fetched when the wasm\n * backend is initialized. See\n * https://github.com/tensorflow/tfjs/blob/master/tfjs-backend-wasm/README.md#using-bundlers\n * for more details.\n * @param path wasm file path or url\n * @param usePlatformFetch optional boolean to use platform fetch to download\n *  the wasm file, default to false.\n *\n * @doc {heading: 'Environment', namespace: 'wasm'}\n */\nexport
 function setWasmPath(path: string, usePlatformFetch = false): void {\n  deprecationWarn(\n  'setWasmPath has been deprecated in favor of setWasmPaths and' +\n  ' will be removed in a future release.');\n  if (initAborted) {\n  throw new Error(\n  'The WASM backend was already initialized. Make sure you call ' +\n  '`setWasmPath()` before you call `tf.setBackend()` or `tf.ready()`');\n  }\n  wasmPath = path;\n  customFetch =
```

usePlatformFetch;\n}\n\n/**\n * Configures the locations of the WASM binaries.\n *\n * ```js\n * setWasmPaths({\n * 'tfjs-backend-wasm.wasm': 'renamed.wasm',\n * 'tfjs-backend-wasm-simd.wasm': 'renamed-simd.wasm',\n * 'tfjs-backend-wasm-threaded-simd.wasm': 'renamed-threaded-simd.wasm'\n * });\n * tf.setBackend('wasm');\n * ```\n *\n * @param prefixOrFileMap This can be either a string or object:\n * - (string) The path to the directory where the WASM binaries are located.\n * Note that this prefix will be used to load each binary (vanilla,\n * SIMD-enabled, threading-enabled, etc.).\n * - (object) Mapping from names of WASM binaries to custom\n * full paths specifying the locations of those binaries. This is useful if\n * your WASM binaries are not all located in the same directory, or if your\n * WASM binaries have been renamed.\n * @param usePlatformFetch optional boolean to use platform fetch to download\n * the wasm file, default to false.\n *\n * @doc {heading: 'Environment', namespace: 'wasm'}\n */\nexport function setWasmPaths(\n prefixOrFileMap: string|{[key in WasmBinaryName]?: string},\n usePlatformFetch = false): void {\n if (initAborted) {\n throw new Error(\n 'The WASM backend was already initialized. Make sure you call ' +\n '`setWasmPaths()` before you call `tf.setBackend()` or ' +\n '`tf.ready()`');\n }\n\n if (typeof prefixOrFileMap === 'string') {\n wasmPathPrefix = prefixOrFileMap;\n } else {\n wasmFileMap = prefixOrFileMap;\n const missingPaths =\n wasmBinaryNames.filter(name => wasmFileMap[name] == null);\n if (missingPaths.length > 0) {\n throw new Error(\n `There were no entries found for the following binaries: ` +\n `${missingPaths.join(',')}. Please either call setWasmPaths with a ` +\n `map providing a path for each binary, or with a string indicating ` +\n `the directory where all the binaries can be found.`);\n }\n }\n\ncustomFetch = usePlatformFetch;\n}\n\n/** Used in unit tests. */\nexport function resetWasmPath(): void {\n wasmPath = null;\n wasmPathPrefix = null;\n wasmFileMap = {};\n customFetch = false;\n initAborted = false;\n}\n\nlet threadsCount = -1;\nlet actualThreadsCount = -1;\n\n/**\n * Sets the number of threads that will be used by XNNPACK to create\n * threadpool (default to the number of logical CPU cores).\n *\n * This must be called before calling `tf.setBackend('wasm')`.\n */\nexport function setThreadsCount(numThreads: number) {\n threadsCount = numThreads;\n}\n\n/**\n * Gets the actual threads count that is used by XNNPACK.\n *\n * It is set after the backend is intialized.\n */\nexport function getThreadsCount(): number {\n if (actualThreadsCount === -1) {\n throw new Error(`WASM backend not initialized.`);\n }\n return actualThreadsCount;\n}\n","/** @license See the LICENSE file. */\n\n// This code is auto-generated, do not modify this file!\nconst version = '3.11.0';\nexport {version};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==\n */\n\nimport './flags_wasm';\n\nimport {registerBackend} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm, init} from './backend_wasm';\n\nexport {BackendWasm, getThreadsCount, setThreadsCount, setWasmPath, setWasmPaths} from './backend_wasm';\nexport {version as version_wasm} from './version';\n\nconst WASM_PRIORITY = 2;\nregisterBackend('wasm', async () => {\n const {wasm} = await init();\n return new BackendWasm(wasm);\n},\nWASM_PRIORITY);\n"],"names":["setup","wasmFunc","sliceImplCPU","concatImplCPU","supportsFullBroadcast","setupFunc","kernelFunc","rangeImplCPU","require$$0","require$$1","require$$2","global","require$$3","require$$4","wasmFactoryThreadedSimd","wasmFactory"],"mappings":";;;;;;;;;;;;;;;;;;;;;;AAAA;;;;;;;;;;;;;;;;AAiBA;AACA,IAAAY,QAAMX;AAAN,WAAAY,WAAAC,WAAAC,WAAAC

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 OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n * ==\n */\n\n// This enum must align with the enum defined in cc/backend.h.\nexport enum CppDType {\n float32 = 0,\n int32 = 1,\n bool = 2,\n string = 3,\n complex64 = 4\n}\n\n// Must match enum in cc/fusable_activations.h.\nexport enum FusableActivation {\n linear = 0,\n relu = 1,\n relu6 = 2,\n prelu = 3,\n leakyrelu = 4,\n sigmoid = 5,\n elu = 6\n}\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n *
 distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n * ==\n */\n\nimport {_FusedMatMul, _FusedMatMulAttrs, _FusedMatMulInputs, KernelConfig, KernelFunc} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {FusableActivation} from './types';\n\nlet wasmFusedMatMul:\n   (aId: number, aShape: Uint8Array, aShapeSize: number, bId: number,\n bShape: Uint8Array, bShapeSize: number, transposeA: boolean,\n   transposeB: boolean, activation: number, biasId: number,\n   preluActivationWeightsId: number, leakyreluAlpha: number, outId: number) =>\n

void;\n\nfunction setup(backend: BackendWasm) {\n wasmFusedMatMul = backend.wasm.cwrap(_FusedMatMul, null /* void */, [\n   'number',
  // a_id\n   'array',   // a_shape\n   'number', // a_shape.length\n   'number', // b_id\n   'array',   // b_shape\n   'number', // b_shape.length\n   'number', // transpose_a\n   'number', // transpose_b\n   'number', // activation\n   'number', // biasId\n   'number', // preluActivationWeightsId\n   'number', // leakyreluAlpha\n   'number'   // out_id\n]);\n}\n\nfunction fusedBatchMatMul(args: {\n inputs: _FusedMatMulInputs,\n backend: BackendWasm,\n attrs: _FusedMatMulAttrs\n}) {\n const {inputs, backend, attrs} = args;\n const {a, b, bias, preluActivationWeights} = inputs;\n\n if (a.dtype !== 'float32' || b.dtype !== 'float32') {\n   throw new Error(\n`_FusedMatMul for non non-float32 tensors not yet supported.`);\n }\n\n const {transposeA, transposeB, activation, leakyreluAlpha} = attrs;\n const aId = backend.dataIdMap.get(a.dataId).id;\n const bId = backend.dataIdMap.get(b.dataId).id;\n\n let biasId = 0;\n if (bias != null) {\n   const biasData = backend.dataIdMap.get(bias.dataId);\n   if (biasData.shape.length !== 1) {\n   throw new Error(\n   `_FusedMatMul only supports rank-1 bias but got ` +\n   `rank ${biasData.shape.length}.`);\n   }\n   biasId = biasData.id;\n }\n const preluActivationWeightsId = preluActivationWeights == null ?\n   0 :\n   backend.dataIdMap.get(preluActivationWeights.dataId).id;\n const fusedActivation =\n   FusableActivation[activation as {} as keyof typeof FusableActivation];\n if (fusedActivation == null) {\n   throw new Error(\n   `${activation} activation not yet supported for FusedConv2D ` +\n   `in the wasm backend.`);\n }\n\n const leftDim = transposeA ? a.shape[2] : a.shape[1];\n const rightDim = transposeB ? b.shape[1] :\n   b.shape[2];\n const batchDim = a.shape[0];\n\n const out = backend.makeOutput([batchDim, leftDim, rightDim], a.dtype);\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n const aShapeBytes = new Uint8Array(new Int32Array(a.shape).buffer);\n const bShapeBytes = new Uint8Array(new Int32Array(b.shape).buffer);\n\n wasmFusedMatMul(\n   aId, aShapeBytes, a.shape.length, bId, bShapeBytes, b.shape.length,\n   transposeA, transposeB, fusedActivation, biasId, preluActivationWeightsId,\n   leakyreluAlpha || 0, outId);\n\n return out;\n}\n\nexport const fusedMatMulConfig: KernelConfig = {\n kernelName: _FusedMatMul,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: fusedBatchMatMul as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES
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==\n */\n\nimport {DataType, KernelConfig, TensorInfo, UnaryInputs, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {CppDType} from './types';\n\nexport function createUnaryKernelConfig(\n   kernelName: string, outType?: DataType): KernelConfig {\n let wasmFunc: (xId: number, dtype: number, outId: number) => void;\n\n function setupFunc(backend: BackendWasm): void {\n   wasmFunc = backend.wasm.cwrap(kernelName, null /* void */, [\n   'number', // x_id\n   'number', // dtype\n   'number', // out_id\n   ]);\n }\n\n function kernelFunc(args: {backend: BackendWasm, inputs: UnaryInputs}):\n   TensorInfo {\n   const {backend, inputs: {x}} = args;\n   const xId = backend.dataIdMap.get(x.dataId).id;\n   const out = backend.makeOutput(x.shape, outType || x.dtype);\n   const outId = backend.dataIdMap.get(out.dataId).id;\n\n   // Short-circuit zero-sized tensors.\n   if (util.sizeFromShape(out.shape) === 0) {\n   return out;\n   }\n\n   wasmFunc(xId, CppDType[x.dtype], outId);\n   return out;\n }\n\n return {kernelName, backendName: 'wasm', setupFunc, kernelFunc};\n}\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES

OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n
 * limitations under the License.\n *
==========\n
*/\nimport {Abs, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\n\nexport const absConfig: KernelConfig = createUnaryKernelConfig(Abs);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n
 /\n\nimport {backend_util, BinaryInputs, DataType, KernelConfig, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {CppDType} from './types';\n\nexport function createBinaryKernelConfig(\n kernelName: string, supportsFullBroadcast: boolean,\n dtype?: DataType): KernelConfig {\n let wasmFunc:\n   (aId: number, aShape: Uint8Array, aShapeLen: number, bId: number,\n   bShape: Uint8Array, bShapeLen: number, dtype: number, outId: number) =>\n   void;\n\n function setupFunc(backend: BackendWasm): void {\n   wasmFunc = backend.wasm.cwrap(kernelName, null / void */, [\n   'number', // a_id,\n   'array',   // a_shape\n   'number', // a_shape.length\n   'number', // b_id\n   'array',   // b_shape\n   'number', // b_shape.length\n   'number', // dtype\n   'number'   // out_id\n   ]);\n }\n\n function kernelFunc(args: {backend: BackendWasm, inputs: BinaryInputs}):\n   TensorInfo {\n   const {backend, inputs} = args;\n   const {a, b} = inputs;\n   const aId = backend.dataIdMap.get(a.dataId).id;\n   const bId = backend.dataIdMap.get(b.dataId).id;\n\n   const outputType = dtype != null ? dtype : a.dtype;\n   const newShape = backend_util.assertAndGetBroadcastShape(a.shape, b.shape);\n   const out = backend.makeOutput(newShape, outputType);\n\n   // Short-circuit zero-sized tensors.\n   if (util.sizeFromShape(newShape) === 0) {\n   return out;\n   }\n\n   const aShapeBytes = new Uint8Array(new Int32Array(a.shape).buffer);\n   const bShapeBytes = new Uint8Array(new Int32Array(b.shape).buffer);\n   const outId = backend.dataIdMap.get(out.dataId).id;\n   const kernelFunc = () => wasmFunc(\n   aId, aShapeBytes, a.shape.length, bId, bShapeBytes, b.shape.length,\n   CppDType[a.dtype], outId);\n\n   // Currently only some float operations support full broadcast.\n   if (supportsFullBroadcast && a.dtype === 'float32') {\n   kernelFunc();\n   return out;\n   }\n\n   const aBroadcastDims = backend_util.getBroadcastDims(a.shape, newShape);\n   const bBroadcastDims = backend_util.getBroadcastDims(b.shape, newShape);\n   const loopsOverAllOfA = aBroadcastDims.every((v, i) => v === i);\n   const loopsOverAllOfB = bBroadcastDims.every((v, i) => v === i);\n   if (loopsOverAllOfA && loopsOverAllOfB) {\n   kernelFunc();\n   return out;\n   } else {\n   throw new Error(\n   `Broadcasting along outer dims is not yet ` +\n   `supported for ${a.dtype} ${kernelName}.`);\n   }\n }\n\n return {kernelName, backendName: 'wasm', setupFunc, kernelFunc};\n}\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required
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==========\n
*/\n\nimport {Add, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from './binary_kernel';\n\nconst supportsFullBroadcast = true;\n\nexport const addConfig: KernelConfig =\n createBinaryKernelConfig(Add, supportsFullBroadcast);\n","/**\n * @license\n * Copyright 2019 Google LLC. All

Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {AddN, KernelConfig, KernelFunc, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {CppDType} from './types';\n\nlet wasmFunc:\n (inputIds: Uint8Array, inputIdsLen: number, dtype: number, outId: number) =>\n void;\n\nfunction setupFunc(backend: BackendWasm): void {\n wasmFunc = backend.wasm.cwrap(AddN, null /* void */, [\n 'array', // input_ids\n 'number', // input_ids.length\n 'number', // dtype\n 'number', // out_id\n]);\n}\n\nfunction addn(args: {inputs: TensorInfo[], backend: BackendWasm}) {\n const {inputs, backend} = args;\n const out = backend.makeOutput(inputs[0].shape, inputs[0].dtype);\n\n // Short-circuit zero-sized tensors.\n if (util.sizeFromShape(out.shape) === 0) {\n return out;\n }\n\n const inputIds = inputs.map(x => backend.dataIdMap.get(x.dataId).id);\n const inputIdsBytes = new Uint8Array(new Int32Array(inputIds).buffer);\n const outId = backend.dataIdMap.get(out.dataId).id;\n wasmFunc(inputIdsBytes, inputIds.length, CppDType[out.dtype], outId);\n\n return out;\n}\n\nexport const addNConfig: KernelConfig = {\n kernelName: AddN,\n backendName: 'wasm',\n setupFunc,\n kernelFunc: addn as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {Identity, IdentityInputs, KernelConfig, KernelFunc} from '@tensorflow/tfjs-core';\nimport {TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nexport function identity(args: {inputs: IdentityInputs, backend: BackendWasm}):\n TensorInfo {\n const {inputs: {x}, backend} = args;\n const out = backend.makeOutput(x.shape, x.dtype);\n const inVals = backend.typedArrayFromHeap(x);\n const outVals = backend.typedArrayFromHeap(out);\n outVals.set(inVals);\n return out;\n}\n\nexport const identityConfig: KernelConfig = {\n kernelName: Identity,\n backendName: 'wasm',\n kernelFunc: identity as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {KernelConfig, KernelFunc, TensorInfo, Transpose, TransposeAttrs, TransposeInputs} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {identity} from './Identity';\nimport {CppDType} from './types';\n\nlet wasmTranspose: (\n xId: number, xShape: Uint8Array, xShapeLength: number, dtype: CppDType,\n outId: number, perm: Uint8Array, permLength: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmTranspose = backend.wasm.cwrap(Transpose, null /* void */, [\n 'number', // xId\n 'array', // x.shape\n 'number', // x.shape.length\n 'number', // dtype\n 'number', // outId\n 'array', // perm\n

'number', // perm.length\n]);\n}\n\nexport function transpose(\n   args:\n   {inputs: TransposeInputs, backend: BackendWasm, attrs: TransposeAttrs}):\n   TensorInfo {\n const {inputs, backend, attrs} = args;\n // Reduce any dimensions with size one. Lower-rank transpose kernel performs\n // better due to simpler memory access pattern.\n const [reducedShape, perm] = removeOneSizeDims(inputs.x.shape, attrs.perm);\n\n let permIsNoOp = true;\n for (let i = 0; i < perm.length; i++) {\n   if (perm[i] !== i) {\n   permIsNoOp = false;\n   }\n }\n const outShape = computeOutShape(inputs.x.shape, attrs.perm);\n const x = {\n   dataId: inputs.x.dataId,\n   shape: reducedShape,\n   dtype: inputs.x.dtype\n };\n\n if (permIsNoOp) {\n   const cloned = identity({inputs, backend});\n   cloned.shape = outShape;\n   return cloned;\n }\n\n const out = backend.makeOutput(outShape, x.dtype);\n const xId = backend.dataIdMap.get(x.dataId).id;\n const outId = backend.dataIdMap.get(out.dataId).id;\n const permBytes = new Uint8Array(new Int32Array(perm).buffer);\n const xShapeBytes = new Uint8Array(new Int32Array(x.shape).buffer);\n\n wasmTranspose(\n   xId, xShapeBytes, x.shape.length, CppDType[x.dtype], outId, permBytes,\n   perm.length);\n return out;\n}\n\nfunction computeOutShape(inShape: number[], perm: number[]): number[] {\n const outShape = new Array(inShape.length);\n for (let i = 0; i < outShape.length; i++) {\n   outShape[i] = inShape[perm[i]];\n }\n return outShape;\n}\n\nfunction removeOneSizeDims(\n   shape: number[], perm: number[]): [number[], number[]] {\n const newShape: number[] = [];\n const newPerm: number[] = [];\n for (let i = 0; i < shape.length; ++i) {\n   if (shape[i] !== 1) {\n   newShape.push(shape[i]);\n   }\n   if (shape[perm[i]] !== 1) {\n   newPerm.push(perm[i]);\n   }\n }\n for (let i = 0; i < newPerm.length; ++i) {\n   let minValIdx = -1;\n   for (let j = 0; j < newPerm.length; ++j) {\n   if (newPerm[j] >= i &&\n   (minValIdx === -1 || newPerm[minValIdx] > newPerm[j])) {\n   minValIdx = j;\n   }\n   }\n   newPerm[minValIdx] = i;\n }\n return [newShape, newPerm];\n}\n\nexport const transposeConfig: KernelConfig = {\n kernelName: Transpose,\n backendName: 'wasm',\n kernelFunc: transpose as {} as KernelFunc,\n setupFunc: setup,\n};\n","/**\n * @license\n * Copyright 2021 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ===\n */\n\nimport {All, AllAttrs, AllInputs, backend_util, KernelConfig, KernelFunc, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {permuteAxesAndTranspose} from './kernel_utils';\n\nlet wasmAll: (xId: number, reduceSize: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n wasmAll = backend.wasm.cwrap(All, null /*void*/, ['number, number, number']);\n}\n\nfunction all(args: {backend: BackendWasm, inputs: AllInputs, attrs: AllAttrs}):\n   TensorInfo {\n const {backend, inputs, attrs} = args;\n const {axis, keepDims} = attrs;\n const {x} = inputs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n let inputId = xId;\n let input = x;\n\n const {transposed, axes, originalAxes, inputWasTransposed} =\n   permuteAxesAndTranspose(x, axis, backend);\n\n if (inputWasTransposed) {\n   const transposedId = backend.dataIdMap.get(transposed.dataId).id;\n   input = transposed;\n   inputId = transposedId;\n }\n\n const inputRank = input.shape.length;\n backend_util.assertAxesAreInnerMostDims('all', axes, inputRank);\n const [outShape, reduceShape] =\n   backend_util.computeOutAndReduceShapes(input.shape, axes);\n const reduceSize = util.sizeFromShape(reduceShape);\n\n const out = backend.makeOutput(outShape, x.dtype);\n if (util.sizeFromShape(input.shape) !== 0) {\n   const outId = backend.dataIdMap.get(out.dataId).id;\n   wasmAll(inputId,\n reduceSize, outId);\n }\n\n if (inputWasTransposed) {\n   // dispose of the transposed tensor.\n   backend.disposeData(transposed.dataId);\n }\n\n if (keepDims) {\n   // reshape\n   const newShape =

backend_util.expandShapeToKeepDim(out.shape, originalAxes);\n out.shape = newShape;\n }\n\n return out;\n}\n\nexport const allConfig: KernelConfig = {\n kernelName: All,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: all as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google Inc. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express
 or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {backend_util, TensorInfo, util} from '@tensorflow/tfjs-core';\nimport {BackendWasm} from '../backend_wasm';\nimport {transpose} from './Transpose';\n\n/**\n * Compute permutation axes and do a transpose if necessary.\n *\n * Used by reduction ops.\n * @param x input TensorInfo\n * @param axis reduction axes\n * @param backend wasm backend instance\n */\nexport function permuteAxesAndTranspose(\n   x: TensorInfo, axis: number|number[], backend: BackendWasm): {\n transposed: TensorInfo|null,\n axes: number[],\n originalAxes: number[],\n inputWasTransposed: boolean\n} {\n const xShape = x.shape;\n const xRank = x.shape.length;\n\n const originalAxes = util.parseAxisParam(axis, xShape);\n let axes = originalAxes;\n const permutedAxes = backend_util.getAxesPermutation(axes,
 xRank);\n let xTransposed = null;\n let inputWasTransposed = false;\n if (permutedAxes != null) {\n   const newShape: number[] = new Array(xRank);\n   for (let i = 0; i < newShape.length; i++) {\n   newShape[i] = xShape[permutedAxes[i]];\n   }\n\n   axes = backend_util.getInnerMostAxes(axes.length, xRank);\n   xTransposed =\n   transpose({inputs: {x}, attrs: {perm: permutedAxes}, backend});\n\n   const xId = backend.dataIdMap.get(x.dataId).id;\n   const transposedId = backend.dataIdMap.get(xTransposed.dataId).id;\n   if (transposedId !== xId) {\n   inputWasTransposed = true;\n   }\n }\n\n return {transposed: xTransposed, originalAxes, axes, inputWasTransposed};\n}\n","/**\n * @license\n * Copyright 2021 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n
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==========\n */\n\nimport {Any, AnyAttrs, AnyInputs, backend_util, KernelConfig, KernelFunc, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {permuteAxesAndTranspose} from './kernel_utils';\n\nlet wasmAny: (xId: number, reduceSize: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n wasmAny = backend.wasm.cwrap(Any, null /*void*/, ['number, number, number']);\n}\n\nfunction any(args: {backend: BackendWasm, inputs: AnyInputs, attrs: AnyAttrs}):\n   TensorInfo {\n const {backend, inputs,
 attrs} = args;\n const {axis, keepDims} = attrs;\n const {x} = inputs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n let inputId = xId;\n let input = x;\n\n const {transposed, axes, originalAxes, inputWasTransposed} =\n   permuteAxesAndTranspose(x, axis, backend);\n\n if (inputWasTransposed) {\n   const transposedId = backend.dataIdMap.get(transposed.dataId).id;\n   input = transposed;\n   inputId = transposedId;\n }\n\n const inputRank = input.shape.length;\n backend_util.assertAxesAreInnerMostDims('any', axes, inputRank);\n const [outShape, reduceShape] =\n   backend_util.computeOutAndReduceShapes(input.shape, axes);\n const reduceSize = util.sizeFromShape(reduceShape);\n\n const out = backend.makeOutput(outShape, x.dtype);\n if

(util.sizeFromShape(input.shape) !== 0) {\n const outId = backend.dataIdMap.get(out.dataId).id;\n wasmAny(inputId, reduceSize, outId);\n }\n\n if (inputWasTransposed) {\n // dispose of the transposed tensor.\n backend.disposeData(transposed.dataId);\n

}\n\n if (keepDims) {\n // reshape\n const newShape = backend_util.expandShapeToKeepDim(out.shape, originalAxes);\n out.shape = newShape;\n }\n\n return out;\n}\n\nexport const anyConfig: KernelConfig = {\n kernelName: Any,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: any as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n

* ===\n */\n\nimport {ArgMax, ArgMaxAttrs, ArgMaxInputs, KernelConfig, KernelFunc, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {permuteAxesAndTranspose} from './kernel_utils';\nimport {CppDType} from './types';\n\nlet wasmFunc: (\n xId: number, dtype: number, outerSize: number, innerSize: number,\n outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmFunc = backend.wasm.cwrap(ArgMax, null /* void */, [\n 'number', // x_id\n 'number', // dtype\n 'number', // outer_size\n 'number', // inner_size\n 'number' // out_id\n]);\n}\n\nfunction argmax(\n args: {inputs: ArgMaxInputs, backend: BackendWasm, attrs: ArgMaxAttrs}) {\n const {backend, inputs, attrs} = args;\n const {axis} = attrs as {} as ArgMaxAttrs;\n const {x} = inputs as {} as ArgMaxInputs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n let inputId

= xId;\n let input = x;\n\n const {transposed, axes, inputWasTransposed} =\n permuteAxesAndTranspose(x, axis, backend);\n\n if (inputWasTransposed) {\n const transposedId = backend.dataIdMap.get(transposed.dataId).id;\n if (transposedId !== xId) {\n // transpose was not a no-op. We will need to dispose of this\n // once we are done.\n input = transposed;\n inputId = transposedId;\n }\n }\n\n const outShape = input.shape.slice(0, -1);\n const out = backend.makeOutput(outShape, 'int32');\n const outId = backend.dataIdMap.get(out.dataId).id;\n const outerSize = util.sizeFromShape(out.shape);\n const innerSize = input.shape[axes[0]];\n wasmFunc(inputId, CppDType[input.dtype], outerSize, innerSize, outId);\n\n if (inputWasTransposed) {\n // dispose of the transposed tensor.\n backend.disposeData(transposed.dataId);\n }\n\n return out;\n}\n\nexport const argMaxConfig: KernelConfig = {\n kernelName: ArgMax,\n backendName: 'wasm',\n

kernelFunc: argmax as {} as KernelFunc,\n setupFunc: setup\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *

* ===\n */\n\nimport {AvgPool, AvgPoolAttrs, AvgPoolInputs, backend_util, KernelConfig, KernelFunc, Tensor4D} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmAvgPool: (\n xId: number, batchSize: number, inputHeight: number, inputWidth: number,\n filterHeight: number, filterWidth: number, padTop: number, padRight: number,\n padBottom: number, padLeft: number, strideHeight: number,\n strideWidth: number, channels: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmAvgPool = backend.wasm.cwrap(AvgPool, null /* void */, [\n 'number', // xId\n 'number', // batchSize\n 'number', // inputHeight\n 'number', // inputWidth\n 'number', // filterHeight\n 'number', // filterWidth\n

'number', // padTop\n 'number', // padRight\n 'number', // padBottom\n 'number', // padLeft\n 'number', // strideHeight\n 'number', // strideWidth\n 'number', // channels\n 'number', // outId\n]);\n}\n\nfunction avgPool(\n args: {inputs: AvgPoolInputs, backend: BackendWasm, attrs: AvgPoolAttrs}) {\n const {inputs, attrs, backend} = args;\n\n const x = inputs.x as Tensor4D;\n const xId = backend.dataIdMap.get(x.dataId).id;\n\n const {filterSize, strides, pad, dimRoundingMode} = attrs;\n const convInfo = backend_util.computePool2DInfo(\n x.shape, filterSize, strides, 1 /* dilations */, pad, dimRoundingMode);\n\n const filterHeight = convInfo.filterHeight;\n const filterWidth = convInfo.filterWidth;\n const padTop = convInfo.padInfo.top;\n const padRight = convInfo.padInfo.right;\n const padBottom = convInfo.padInfo.bottom;\n const padLeft = convInfo.padInfo.left;\n const strideHeight = convInfo.strideHeight;\n const strideWidth = convInfo.strideWidth;\n const channels = convInfo.inChannels;\n\n if (convInfo.dataFormat !== 'channelsLast') {\n throw new Error(\n `wasm backend does not support dataFormat:'` +\n `${convInfo.dataFormat}'. Please use 'channelsLast'.`);\n }\n\n if (convInfo.dilationWidth !== 1 || convInfo.dilationHeight !== 1) {\n throw new Error(\n `was backend only supports average pooling with dilation = [1, 1], ` +\n `got [${convInfo.dilationHeight}, ${convInfo.dilationWidth}].`);\n }\n\n const out = backend.makeOutput(convInfo.outShape, 'float32');\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n wasmAvgPool(\n xId, x.shape[0], x.shape[1], x.shape[2], filterHeight, filterWidth,\n padTop, padRight, padBottom, padLeft, strideHeight, strideWidth, channels,\n outId);\n return out;\n}\n\nexport const avgPoolConfig: KernelConfig = {\n kernelName: AvgPool,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: avgPool as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==*/\n\nimport {KernelConfig, KernelFunc, Reshape, ReshapeAttrs, ReshapeInputs, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nexport function reshape(\n args: {inputs: ReshapeInputs, attrs: ReshapeAttrs, backend: BackendWasm}) {\n const {inputs, attrs} = args;\n const {x} = inputs;\n const {shape} = attrs;\n\n const xSize = util.sizeFromShape(x.shape);\n const $shape = util.inferFromImplicitShape(shape, xSize);\n\n util.assert(\n xSize === util.sizeFromShape($shape),\n () => `new shape: ${$shape}, old shape: ${x.shape}. New shape and old ` +\n `shape must have the same number of elements.`);\n\n // Backend needs to track refCount for the dataId for reshape op\n args.backend.incRef(x.dataId);\n return {dataId: x.dataId, shape: $shape, dtype: x.dtype};\n}\n\nexport const reshapeConfig: KernelConfig = {\n kernelName: Reshape,\n backendName: 'wasm',\n kernelFunc: reshape as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==*/\n\nimport {BatchMatMul, BatchMatMulAttrs, BatchMatMulInputs, KernelConfig, KernelFunc, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {reshape} from './Reshape';\n\nlet wasmBatchMatMul: (\n aId: number, aShape: Uint8Array, aShapeSize: number, bId: number,\n bShape:

```
Uint8Array, bShapeSize: number, transposeA: boolean,\n    transposeB: boolean, outId: number) =>
void;\n\nfunction setup(backend: BackendWasm) {\n  wasmBatchMatMul = backend.wasm.cwrap(BatchMatMul,
null /* void */, [\n    'number',  // a_id\n    'array',   // a_shape\n    'number',  // a_shape.length\n    'number',  // b_id\n
'array',   // b_shape\n    'number',  // b_shape.length\n    'number',  // transpose_a\n    'number',  // transpose_b\n
'number'   // out_id\n  ]);\n}\n\nfunction batchMatMul(args: {\n  inputs: BatchMatMulInputs,\n  backend:
BackendWasm,\n  attrs: BatchMatMulAttrs\n}) {\n  const {inputs, backend, attrs} = args;\n  const {a, b} = inputs;\n
const
 {transposeA, transposeB} = attrs;\n\n  if (a.dtype !== 'float32' || b.dtype !== 'float32') {\n    throw new Error(\n
`BatchMatMul for non non-float32 tensors not yet supported.`);\n  }\n\n  const aRank = a.shape.length;\n  const
bRank = b.shape.length;\n\n  const innerShapeA = transposeA ? a.shape[aRank - 2] : a.shape[aRank - 1];\n  const
innerShapeB = transposeB ? b.shape[bRank - 1] : b.shape[bRank - 2];\n\n  const outerShapeA = transposeA ?
a.shape[aRank - 1] : a.shape[aRank - 2];\n  const outerShapeB = transposeB ? b.shape[bRank - 2] : b.shape[bRank -
1];\n\n  const outerDimsA = a.shape.slice(0, -2);\n  const outerDimsB = b.shape.slice(0, -2);\n\n  const batchDimA =
util.sizeFromShape(outerDimsA);\n  const batchDimB = util.sizeFromShape(outerDimsB);\n\n  const
batchDimsCompatible =\n      batchDimA === batchDimB || batchDimA === 1 || batchDimB === 1;\n\n
util.assert(\n      aRank >= 2 && bRank >= 2 && batchDimsCompatible,\n      () => `Error in matMul: the input
batch dimensions
 must either be the ` +\n          `same or at least one input batch dimension must be 1. Got input ` +\n          `batch
dimensions of (${outerDimsA}) and (${outerDimsB}).`);\n\n  const outShapeOuterDims =\n      batchDimA >
batchDimB ? a.shape.slice(0, -2) : b.shape.slice(0, -2);\n  const outShape =
outShapeOuterDims.concat([outerShapeA, outerShapeB]);\n\n  util.assert(\n      innerShapeA === innerShapeB,\n
() => `Error in matMul: inner shapes (${innerShapeA}) and (` +\n          `${innerShapeB}) of Tensors with shapes
${a.shape} and ` +\n          `${b.shape} and transposeA=${transposeA}` +\n          ` and transposeB=${transposeB}
must match.`);\n\n  const a3dShape = transposeA ? [batchDimA, innerShapeA, outerShapeA] :\n
[batchDimA, outerShapeA, innerShapeA];\n  const b3dShape = transposeB ? [batchDimB, outerShapeB,
innerShapeB] :\n                                  [batchDimB, innerShapeB, outerShapeB];\n\n  // The rest of the
implementation is
 designed to operate on rank-3 tensors\n  const a3d = reshape({inputs: {x: a}, backend, attrs: {shape: a3dShape}});\n
const b3d = reshape({inputs: {x: b}, backend, attrs: {shape: b3dShape}});\n\n  const a3dId =
backend.dataIdMap.get(a3d.dataId).id;\n  const b3dId = backend.dataIdMap.get(b3d.dataId).id;\n\n  const leftDim =
transposeA ? a3d.shape[2] : a3d.shape[1];\n  const rightDim = transposeB ? b3d.shape[1] : b3d.shape[2];\n  const
batchDim = Math.max(batchDimA, batchDimB);\n\n  const out = backend.makeOutput([batchDim, leftDim,
rightDim], a3d.dtype);\n  const outId = backend.dataIdMap.get(out.dataId).id;\n\n  const aShapeBytes = new
Uint8Array(new Int32Array(a3d.shape).buffer);\n  const bShapeBytes = new Uint8Array(new
Int32Array(b3d.shape).buffer);\n\n  wasmBatchMatMul(\n      a3dId, aShapeBytes, a3d.shape.length, b3dId,
bShapeBytes,\n      b3d.shape.length, transposeA, transposeB, outId);\n\n  backend.disposeData(a3d.dataId);\n
backend.disposeData(b3d.dataId);\n\n  out.shape = outShape;\n
 return out;\n}\n\nexport const batchMatMulConfig: KernelConfig = {\n  kernelName: BatchMatMul,\n
backendName: 'wasm',\n  setupFunc: setup,\n  kernelFunc: batchMatMul as {} as KernelFunc\n};\n","/**\n *
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the specific language governing permissions and\n * limitations under the License.\n *
==========================================================================\n
*/\nimport { backend_util, buffer, Slice, slice_util, util } from '@tensorflow/tfjs-core';\nimport
```

{ assertNotComplex } from '../cpu_util';\nexport function sliceImpl(vals, begin, size, shape, dtype) {\n const isContinous = slice_util.isSliceContinous(shape, begin, size);\n const length = util.sizeFromShape(size);\n const xStrides = util.computeStrides(shape);\n if (isContinous) {\n const flatOffset = slice_util.computeFlatOffset(begin, xStrides);\n if (dtype === 'string') {\n return vals.slice(flatOffset, flatOffset + length);\n }\n return vals.subarray(flatOffset, flatOffset + length);\n }\n const decodedData = dtype === 'string' ?\n backend_util.fromUint8ToStringArray(vals) :\n vals;\n const inBuf = buffer(shape, dtype, decodedData);\n const outBuf = buffer(size, dtype);\n for (let i = 0; i < outBuf.size; ++i) {\n const outLoc = outBuf.indexToLoc(i);\n const inLoc = outLoc.map((idx, j) => idx + begin[j]);\n outBuf.set(inBuf.get(...inLoc), ...outLoc);\n }\n if (dtype === 'string') {\n return backend_util.fromStringArrayToUint8(outBuf.values);\n }\n return outBuf.values;\n}\nexport function slice(args) {\n const { inputs, backend, attrs } = args;\n const { x } = inputs;\n const { begin, size } = attrs;\n assertNotComplex(x, 'slice');\n const [$begin, $size] = slice_util.parseSliceParams(x, begin, size);\n slice_util.assertParamsValid(x, $begin, $size);\n const vals = backend.data.get(x.dataId).values;\n const outVals = sliceImpl(vals, $begin, $size, x.shape, x.dtype);\n return backend.makeTensorInfo($size, x.dtype, outVals);\n}\nexport const sliceConfig = {\n kernelName: Slice,\n backendName: 'cpu',\n kernelFunc: slice\n};\n//# sourceMappingURL=data:application/json; base64,eyJ2ZXJzaW9uIjozLCJmaWxlIjoiU2xpY2UuanMiLCJzb3VyY2VSb290IjoiIiwic291cmNlcyI6WyIuLi8uLi8uLi8uLi8uLi8uLi90ZmpzLWJhY2tlbmQtY3B1L3NyYy9rZXJuZWxzL1NsaWNlLnRzIl0sIm5hbWVzIjpbXSwibWFwcGluZ3MiOiJBQUFBOzs7Ozs7Ozs7Ozs7R0FlRztBQU8sRUFBQyxZQUFZLENBQUM7QUFDZCxPQUFPLEVBQUUsa0JBQWtCLEVBQUUsTUFBTSxlQUFlLENBQUM7QUFDbkQsT0FBTyxLQUFLLFVBQVUsTUFBTSxlQUFlLENBQUM7QUFDNUMsT0FBTyxLQUFLLGNBQWMsTUFBTSxtQkFBbUIsQ0FBQztBQUNwRCxPQUFPLEtBQUssSUFBSSxNQUFNLFNBQVMsQ0FBQztBQUNoQyxPQUFPLEVBQUUsTUFBTSxFQUFFLE1BQU0sV0FBVyxDQUFDO0FBQ25DLE1BQU0sVUFBVSxTQUFTSW1wbChWYWxzLCBiZWdpbiwgc2l6ZSwgc2hhcGUsIGR0eXBlKSB7CiAgICBjb25zdCBpc0NvbnRpbm91cyA9IHNsaWNlX3V0aWwuaXNTbGljZUNvbnRpbm91cyhzaGFwZSwgYmVnaW4sIHNpemUpOwogICAgY29uc3QgbGVuZ3RoID0gdXRpbC5zaXplRnJvbVNoYXBlKHNpemUpOwogICAgY29uc3QgeFN0cmlkZXMgPSB1dGlsLmNvbXB1dGVTdHJpZGVzKHNoYXBlKTsKICAgIGlmIChpc0NvbnRpbm91cykgewogICAgICAgIGNvbnN0IGZsYXRPZmZzZXQgPSBzbGljZV91dGlsLmNvbXB1dGVGbGF0T2Zmc2V0KGJlZ2luLCB4U3RyaWRlcyk7CiAgICAgICAgaWYgKGR0eXBlID09PSAnc3RyaW5nJykgewogICAgICAgICAgICByZXR1cm4gdmFscy5zbGljZShmbGF0T2Zmc2V0LCBmbGF0T2Zmc2V0ICsgbGVuZ3RoKTsKICAgICAgICB9CiAgICAgICAgcmV0dXJuIHZhbHMuc3ViYXJyYXkoZmxhdE9mZnNldCwgZmxhdE9mZnNldCArIGxlbmd0aCk7CiAgICB9CiAgICBjb25zdCBkZWNvZGVkRGF0YSA9IGR0eXBlID09PSAnc3RyaW5nJyA/CiAgICAgICAgYmFja2VuZF91dGlsLmZyb21VaW50OFRvU3RyaW5nQXJyYXkodmFscykgOgogICAgICAgIHZhbHM7CiAgICBjb25zdCBpbkJ1ZiA9IGJ1ZmZlcihzaGFwZSwgZHR5cGUsIGRlY29kZWREYXRhKTsKICAgIGNvbnN0IG91dEJ1ZiA9IGJ1ZmZlcihzaXplLCBkdHlwZSk7CiAgICBmb3IgKGxldCBpID0gMDsgaSA8IG91dEJ1Zi5zaXplOyArK2kpIHsKICAgICAgICBjb25zdCBvdXRMb2MgPSBvdXRCdWYuaW5kZXhUb0xvYyhpKTsKICAgICAgICBjb25zdCBpbkxvYyA9IG91dExvYy5tYXAoKGlkeCwgaikgPT4gaWR4ICsgYmVnaW5bal0pOwogICAgICAgIG91dEJ1Zi5zZXQoaW5CdWYuZ2V0KC4uLmluTG9jKSwgLi4ub3V0TG9jKTsKICAgIH0KICAgIGlmIChkdHlwZSA9PT0gJ3N0cmluZycpIHsKICAgICAgICByZXR1cm4gYmFja2VuZF91dGlsLmZyb21TdHJpbmdBcnJheVRvVWludDgob3V0QnVmLnZhbHVlcyk7CiAgICB9CiAgICByZXR1cm4gb3V0QnVmLnZhbHVlczsKfQpleHBvcnQgZnVuY3Rpb24gc2xpY2UoYXJncykgewogICAgY29uc3QgeyBpbnB1dHMsIGJhY2tlbmQsIGF0dHJzIH0gPSBhcmdzOwogICAgY29uc3QgeyB4IH0gPSBpbnB1dHM7CiAgICBjb25zdCB7IGJlZ2luLCBzaXplIH0gPSBhdHRyczsKICAgIGFzc2VydE5vdENvbXBsZXgoeCwgJ3NsaWNlJyk7CiAgICBjb25zdCBbJGJlZ2luLCAkc2l6ZV0gPSBzbGljZV91dGlsLnBhcnNlU2xpY2VQYXJhbXMoeCwgYmVnaW4sIHNpemUpOwogICAgc2xpY2VfdXRpbC5hc3NlcnRQYXJhbXNWYWxpZCh4LCAkYmVnaW4sICRzaXplKTsKICAgIGNvbnN0IHZhbHMgPSBiYWNrZW5kLmRhdGEuZ2V0KHguZGF0YUlkKS52YWx1ZXM7CiAgICBjb25zdCBvdXRWYWxzID0gc2xpY2VJbXBsKHZhbHMsICRiZWdpbiwgJHNpemUsIHguc2hhcGUsIHguZHR5cGUpOwogICAgcmV0dXJuIGJhY2tlbmQubWFrZVRlbnNvckluZm8oJHNpemUsIHguZHR5cGUsIG91dFZhbHMpOwp9CmV4cG9ydCBjb25zdCBzbGljZUNvbmZpZyA9IHsKICAgIGtlcm5lbE5hbWU6IFNsaWNlLAogICAgYmFja2VuZE5hbWU6ICdjcHUnLAogICAga2VybmVsRnVuYzogc2xpY2UKfTsKLy8jIHNvdXJjZU1hcHBpbmdVUkw9ZGF0YTphcHBsaWNhdGlvbi9qc29uO2Jhc2U2NCxleUoyWlhKemFXOXVJam96TENKbWFXeGxJam9pVTJ4cFkyVnVhVzVwTWlJc0luTnZkWEpqWlhNaU9sc2lMaTR2TGk0dkxpNHZMaTR2TGk0dkxpNHZMaTR2TGk5MGNtWnpMV0poWTJ0bGJtUXRZM0IxTDNOeVl5OXpiR2xqWldRdlpHVnNaWFJsY3k5VGJHbGpaUzV5YzBKQlFVRkJPenM3T3pzN096czdPenM3T3pzN1IwRlJRVHRCUVVOQk96czdPenM3T3pzN096czdPenM3UjBGSFFUdEJRVU5CT3pzN096czdPenM3T3pzN096czdPMEZCUlVVc1JVRkJRVHRCUVVOQk96czdPenM3T3pzN096czdPenM3UjBGSFFUdEJRVU5CT3pzN096

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UFBTSxDQUFDLE1BQU0sV0FBVyxHQUFHLENBQUMsQ2yxVQUFVLFVLEVBQUUsS0FBSSxzTJUNqQixxXQUFXLE
VBQUUsS0FBSztJQUNsQixxVQUFVLEVBQUUsS0FBeUI7Q0FDdEMsMsQ0FBQyxDQUNBeMsQ0FBQyxDQUNBeMsQ0FBQyxDQ
bIi8qKlxuICogQGxpY2Vuc2VcbiAqIENvcHlyaWdodCAyMDIwIEdvb2dsZSBMTEMuIEFsbCBSaWdodHMgUm
VzZXJ2ZWQuXG4gKiBMaWNlbnNlZCB1bmRlciB0aGUgQXBhY2hlIExpY2Vuc2UsIFZlcnNpb24gMi4wICh0a
GUgXCJMaWNlbnNlXCIpO1xuICogeW91IG1heSBub3QgdXNlIHRoaXMgZmlsZSBleGNlcHQgaW4gY29tcGxp
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ogVW5sZXNzIHJlcXVpcmVkIGJ5IGFwcGxpY2FibGUgbGF3IG9yIGFncmVlZCB0byByBpbiB3cml0aW5nLCBzb2
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XCJBUyBJU1wiIEJBU0lTLFxuICogV0lUSE9VVCBXQVJSQU5USUVTIE9SIENPTkRJVElPTlMgT0YgQU5ZI
EtJTkQsIGVpdGhlciBleHByZXNzIG9yIGltcGxpZWQuXG4gKiBiBTZWUgdGhlIExpY2Vuc2UgZm9yIHRoZSBzc
GVjaWZpYyBsYW5ndWFnZSBnb3Zlcm5pbmcgcGVybWlzc2lvbnMgYW5kXG4gKiBiBsaW1pdGF0aW9ucyBpbiB3cml0aW
JhY2tlbmRWYWx1ZXMsIGJ1ZmZlciwgRGF0YVR5cGUsIEtlcm5lbENvbmZpZywgS2VybmVuYywgU2xp
Y2UsIHNsaWNlX3V0aWwsIFNsaWNlQXR0cnMsIFNsaWNlSW5wdXRzLCBUZW5zb3JJbmZvLCBUeXBlZEF
ycmF5LCB1dGlsSBmcm9tICdAdGVuc29yZmxvdy90ZmpzLWNvcmUnO1xuXG5pbXBvcnQge01hdGhCYWNr
ZW5kQ1BVfSBmcm9tICcuLi9iYWNrZW5kX2NwdSc7XG5pbXBvcnQge2Fzc2VydE5vdENvbXBsZXh9IGZyb2
0gJy4uL2NwdV91dGlsJztcblxuZXhwb3J0IGZ1bmN0aW9uIHNsaWNlSW1wbChcbiAgICB2YWxzOiBCYWNrZ
W5kVmFsdWVzLCBiZWdpbjogbnVtYmVyW10sIHNpemU6IG51bWJlcltdLCBzaGFwZTogbnVtYmVyW10sXG
4gICAgZHR5cGU6IERhdGFUeXBlKTogQmFja2VuZFZhbHVlcyB7XG4gICAgcmV0dXJuIGNvbnN0IG1lzQ29udGlub3VzID0gc2
xpY2VfdXRpbC5pc1NsaWNlQ29udGlub3VzKHNoYXBlLCBiZWdpbiwgc2l6ZSk7XG4gICAgcmV0dXJuIG
4gICAgZHR5cGU6IERhdGFUeXBlKTogQmFja2VuZFZhbHVlcyB7XG4gICAgY29uc3QgeFN0cmlkZXMgPSB1dGlsLmNvbXB1dGVT
HJpZGVzKHNoYXBlKTtcblxuICBpZiAoaXNDb250aW5vdXMpIHtcbiAgICBjb25zdCBmbGF0T2Zmc2V0ID0gc
2xpY2VfdXRpbC5jb21wdXRlRmxhdE9mZnNldChiZWdpbiwgeFN0cmlkZXMpO1xuXG4gICAgcmV0dXJuIG
BlID09PSAnc3RyaW5nJykge1xuICAgICAgcmV0dXJuICh2YWxzIGFzIVpbnQ4QXJyYXlbXSkuc2xpY2UoZmx
hdE9mZnNldCwgZmxhdE9mZnNldCArIHNpemUpO1xuICB9XG5cbiAgY29uc3QgYnVmZmVyID0gYnVmZmVyKHNoYXBlLCBkYX
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A9IHV0aWwuc2l6ZUZyb21TaGFwZShzaXplKTtcblxuICBjb25zdCBzdWJhcnJheSA9IHZhbHVlcy5zdWJhcnJheShi
HJpZGVzKHNoYXBlKTtcblxuICBpZiAoaXNDb250aW5vdXMpIHtcbiAgICBjb25zdCBmbGF0T2Zmc2V0ID0gc
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hdE9mZnNldCwgZmxhdE9mZnNldCArIHNpemUpO1xuICB9XG4gICAgcmV0dXJuIGNvbnN0IG1lzQ29udGlub3VzID0gc2
xpY2VfdXRpbC5pc1NsaWNlQ29udGlub3VzKHNoYXBlLCBiZWdpbiwgeFN0cmlkZXMpO1xuXG4gICAgcmV0dXJuIG
4gICAgZHR5cGU6IERhdGFUeXBlKTogQmFja2VuZFZhbHVlcyB7XG4gICAgY29uc3QgeFN0cmlkZXMgPSB1dGlsLmNvbXB1dGVT

0gYXR0cnM7XG5cbiAgYXNzZXJ0Tm90Q29tcGxleCh4LCAnc2xpY2UnKTtcblxuICBjb25zdCBbJGJlZ2luLCAkc2l6ZV0gPSBzbGljZV91dGlsLnBhcnNlU2xpY2VQYXJhbXMoeCwgYmVnaW4sIHNpemUpO1xuICBzbGljZV91dGlsLmFzc2VydFBhcmFtc1ZhbGlkKHgsICRiZWdpbiwgJHNpemUpO1xuXG4gIGNvbnN0IGlzQ29udGlub3VzID0gc2xpY2VfdXRpbC5pc1NsaWNlQ29udGlub3VzKHguc2hhcGUsIGJlZ2luLCBzaXplKTtcbiAgY29uc3QgeFZhbHMgPSBiYWNrZW5kLnJlYWRTeW5jKHguZGF0YUlkKTtcbiAgY29uc3Qgb3V0ID0gYmFja2VuZC5tYWtlT3V0cHV0KHNpemUsIHguZHR5cGUpO1xuICBjb25zdCB4U3RyaWRlcyA9IHV0aWwuY29tcHV0ZVN0cmlkZXMoeC5zaGFwZSk7XG4gIGNvbnN0IG91dERhdGEgPSBiYWNrZW5kLmRhdGFJZE1hcC5nZXQob3V0LmRhdGFJZCk7XG5cbiAgaWYgKGlzQ29udGlub3VzKSB7XG4gICAgY29uc3QgZmxhdE9mZnNldCA9IHNsaWNlX3V0aWwuY29tcHV0ZUZsYXRPZmZzZXQoJGJlZ2luLCB4U3RyaWRlcyk7XG5cbiAgICBpZiAoeC5kdHlwZSA9PT0gJ3N0cmluZycpIHtcbiAgICAgIG91dERhdGEuc3RyaW5nQnl0ZXMgPVxuICAgICAgICAgICh4VmFscyBhcyBVaW50OEFycmF5W10pXG4gICAgICAgICAgICAgIC5zbGljZShmbGF0T2Zmc2V0LCBmbGF0T2Zmc2V0ICsgdXRpbC5zaXplRnJvbVNoYXBlKHNpemUpKTtcbiAgICB9IGVsc2Uge1xuICAgICAgY29uc3Qgb3V0VmFscyA9IGJhY2tlbmQudHlwZWRBcnJheUZyb21IZWFwKG91dCk7XG4gICAgICBvdXRWYWxzLnNldChcbiAgICAgICAgICAoeFZhbHMgYXMgVHlwZWRBcnJheSlcbiAgICAgICAgICAgICAgLnN1YmFycmF5KGZsYXRPZmZzZXQsIGZsYXRPZmZzZXQgKyB1dGlsLnNpemVGcm9tU2hhcGUoc2l6ZSkpKTtcbiAgICB9XG5cbiAgICByZXR1cm4gb3V0O1xuICB9XG5cbiAgaWYgKHguZHR5cGUgPT09ICdzdHJpbmcnKSB7XG4gICAgY29uc3QgcmVzID0gc2xpY2VJbXBsQ1BVKHhWYWxzLCAkYmVnaW4sIHNpemUsIHguc2hhcGUsIHguZHR5cGUpO1xuICAgIG91dERhdGEuc3RyaW5nQnl0ZXMgPSByZXMgYXMgVWludDhBcnJheVtdO1xuICAgIHJldHVybiBvdXQ7XG4gIH1cblxuICBjb25zdCBvdXRWYWxzID0gYmFja2VuZC50eXBlZEFycmF5RnJvbUhlYXAob3V0KTtcbiAgY29uc3QgcmFuayA9IHguc2hhcGUubGVuZ3RoO1xuICBpZiAocmFuayA9PT0gMikge1xuICAgIHNsaWNlMmQoXG4gICAgICAgIHhWYWxzIGFzIFR5cGVkQXJyYXksIHhTdHJpZGVzWzBdLCBvdXRWYWxzLCAkYmVnaW4gYXNcbiAgICAgICAgW251bWJlciwgbnVtYmVyXSxcbiAgICAgICAgc2l6ZSBhcyBbbnVtYmVyLCBudW1iZXJdKTtcbiAgfSBlbHNlIGlmIChyYW5rID09PSAzKSB7XG4gICAgc2xpY2UzZChcbiAgICAgICAgeFZhbHMgYXMgVHlwZWRBcnJheSwgeFN0cmlkZXNbMF0sIHhTdHJpZGVzWzFdLCBvdXRWYWxzLFxuICAgICAgICAkYmVnaW4gYXMgW251bWJlciwgbnVtYmVyLCBudW1iZXJdLCBzaXplIGFzIFtudW1iZXIsXG4gICAgICAgIG51bWJlciwgbnVtYmVyXSk7XG4gIH0gZWxzZSBpZiAocmFuayA9PT0gNCkge1xuICAgIHNsaWNlNGQoXG4gICAgICAgIHhWYWxzIGFzIFR5cGVkQXJyYXksIHhTdHJpZGVzWzBdLCB4U3RyaWRlc1sxXSxcbiAgICAgICAgeFN0cmlkZXNbMl0sIG91dFZhbHMsXG4gICAgICAgICRiZWdpbiBhcyBbbnVtYmVyLCBudW1iZXIsIG51bWJlciwgbnVtYmVyXSxcbiAgICAgICAgc2l6ZSBhcyBbbnVtYmVyLCBudW1iZXIsIG51bWJlcixcbiAgICAgICAgbnVtYmVyXSk7XG4gIH0gZWxzZSB7XG4gICAgY29uc3QgcmVzID1cbiAgICAgICAgc2xpY2VJbXBsQ1BVKHhWYWxzLCAkYmVnaW4sIHNpemUsIHguc2hhcGUsIHguZHR5cGUpIGFzIFR5cGVkQXJyYXk7XG4gICAgb3V0VmFscy5zZXQocmVzKTtcbiAgfVxuXG4gIHJldHVybiBvdXQ7XG59XG5cbmZ1bmN0aW9uIHNsaWNlMmQoXG4gICAgeFZhbHM6IGJhY2tlbmRfdXRpbC5UeXBlZEFycmF5LCB4U3RyaWRlOiBudW1iZXIsXG4gICAgb3V0VmFsczogYmFja2VuZF91dGlsLlR5cGVkQXJyYXksICRiZWdpbjogW251bWJlciwgbnVtYmVyXSxcbiAgICBzaXplOiBbbnVtYmVyLCBudW1iZXJdKTogdm9pZCB7XG4gIGxldCBvdXRPZmZzZXQgPSAwO1xuICBjb25zdCBiZWdpbkkgPSAkYmVnaW5bMF07XG4gIGNvbnN0IGJlZ2luSiA9ICRiZWdpblsxXTtcbiAgY29uc3QgZW5kSSA9IGJlZ2luSSArIHNpemVbMF07XG4gIGZvciAobGV0IGkgPSBiZWdpbkk7IGkgPCBlbmRJOyBpKyspIHtcbiAgICBjb25zdCB4T2Zmc2V0ID0gaSAqIHhTdHJpZGUgKyBiZWdpbko7XG4gICAgb3V0VmFscy5zZXQoeFZhbHMuc3ViYXJyYXkoeE9mZnNldCwgeE9mZnNldCArIHNpemVbMV0pLCBvdXRPZmZzZXQpO1xuICAgIG91dE9mZnNldCArPSBzaXplWzFdO1xuICB9XG59XG5cbmZ1bmN0aW9uIHNsaWNlM2QoXG4gICAgeFZhbHM6IGJhY2tlbmRfdXRpbC5UeXBlZEFycmF5LCB4U3RyaWRlMTogbnVtYmVyLCB4U3RyaWRlMjogbnVtYmVyLFxuICAgIG91dFZhbHM6IGJhY2tlbmRfdXRpbC5UeXBlZEFycmF5LCAkYmVnaW46IFtudW1iZXIsIG51bWJlciwgbnVtYmVyXSxcbiAgICBzaXplOiBbbnVtYmVyLCBudW1iZXIsIG51bWJlcl0pOiB2b2lkIHtcbiAgbGV0IG91dE9mZnNldCA9IDA7XG4gIGNvbnN0IGJlZ2luSSA9ICRiZWdpblswXTtcbiAgY29uc3QgYmVnaW5KID0gJGJlZ2luWzFdO1xuICBjb25zdCBiZWdpbksgPSAkYmVnaW5bMl07XG4gIGNvbnN0IGVuZEkgPSBiZWdpbkkgKyBzaXplWzBdO1xuICBjb25zdCBlbmRKID0gYmVnaW5KICsgc2l6ZVsxXTtcbiAgZm9yIChsZXQgaSA9IGJlZ2luSTsgaSA8IGVuZEk7IGkrKykge1xuICAgIGZvciAobGV0IGogPSBiZWdpbko7IGogPCBlbmRKOyBqKyspIHtcbiAgICAgIGNvbnN0IHhPZmZzZXQgPSBpICogeFN0cmlkZTEgKyBqICogeFN0cmlkZTIgKyBiZWdpbks7XG4gICAgICBvdXRWYWxzLnNldCh4VmFscy5zdWJhcnJheSh4T2Zmc2V0LCB4T2Zmc2V0ICsgc2l6ZVsyXSksIG91dE9mZnNldCk7XG4gICAgICBvdXRPZmZzZXQgKz0gc2l6ZVsyXTtcbiAgICB9XG4gIH1cbn1cblxuZnVuY3Rpb24gc2xpY2U0ZChcbiAgICB4VmFsczogYmFja2VuZF91dGlsLlR5cGVkQXJyYXksIHhTdHJpZGUxOiBudW1iZXIsIHhTdHJpZGUyOiBudW1iZXIsXG4gICAgeFN0cmlkZTM6IG51bWJlciwgb3V0VmFsczogYmFja2VuZF91dGlsLlR5cGVkQXJyYXksXG4=","/**\n * @license\n * Copyright 2019 Google LLC. 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begin: [number, number, number, number],\n size: [number, number, number, number]): void {\n let outOffset = 0;\n const beginI = begin[0];\n const beginJ = begin[1];\n const beginK = begin[2];\n const endI = beginI + size[0];\n const endJ = beginJ + size[1];\n const endK = beginK + size[2];\n const beginL = begin[3];\n\n for (let i = beginI; i < endI; i++) {\n for (let j = beginJ; j < endJ; j++) {\n for (let k = beginK; k < endK; k++) {\n const xOffset = i * xStride1 + j * xStride2 + k * xStride3 + beginL;\n outVals.set(xVals.subarray(xOffset, xOffset + size[3]), outOffset);\n outOffset += size[3];\n }\n }\n }\n}\n\nexport const sliceConfig: KernelConfig = {\n kernelName: Slice,\n backendName: 'wasm',\n kernelFunc: slice as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2021 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {backend_util, BatchToSpaceND, BatchToSpaceNDAttrs, BatchToSpaceNDInputs, KernelConfig, KernelFunc} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {reshape} from './Reshape';\nimport {slice} from './Slice';\nimport {transpose} from './Transpose';\n\nfunction batchToSpaceND(args: {\n inputs: BatchToSpaceNDInputs,\n backend: BackendWasm,\n attrs: BatchToSpaceNDAttrs\n}) {\n const {inputs, backend, attrs} = args;\n const {x} = inputs;\n const {blockShape, crops} = attrs;\n\n const prod = blockShape.reduce((a, b) => a * b);\n\n const reshaped = backend_util.getReshaped(x.shape, blockShape, prod);\n const permuted = backend_util.getPermuted(reshaped.length, blockShape.length);\n const reshapedPermuted =\n backend_util.getReshapedPermuted(x.shape, blockShape, prod);\n const sliceBeginCoords =\n backend_util.getSliceBeginCoords(crops, blockShape.length);\n const sliceSize =\n backend_util.getSliceSize(reshapedPermuted, crops, blockShape.length);\n\n const xReshaped = reshape({inputs: {x}, backend, attrs: {shape: reshaped}});\n const xTransposed =\n transpose({inputs: {x: xReshaped}, backend, attrs: {perm: permuted}});\n const xTransposedReshaped = reshape({\n inputs: {x: xTransposed}, backend, attrs: {shape: reshapedPermuted}});\n const result = slice({\n inputs: {x: xTransposedReshaped},\n backend,\n attrs: {begin: sliceBeginCoords, size: sliceSize}\n });\n\n backend.disposeData(xReshaped.dataId);\n backend.disposeData(xTransposed.dataId);\n backend.disposeData(xReshaped.dataId);\n\n return result;\n}\n\nexport const batchToSpaceNDConfig: KernelConfig = {\n kernelName: BatchToSpaceND,\n backendName: 'wasm',\n kernelFunc: batchToSpaceND as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {Cast, CastAttrs, CastInputs, KernelConfig, KernelFunc} from '@tensorflow/tfjs-core';\nimport {TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nexport function cast(\n args: {inputs: CastInputs, attrs: CastAttrs, backend: BackendWasm}):\n TensorInfo {\n const {inputs: {x}, attrs: {dtype}, backend} = args;\n const out = backend.makeOutput(x.shape, dtype);\n const inVals = backend.typedArrayFromHeap(x);\n const outVals = backend.typedArrayFromHeap(out);\n outVals.set(inVals);\n return out;\n}\n\nexport const castConfig: KernelConfig = {\n kernelName: Cast,\n backendName: 'wasm',\n kernelFunc: cast as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights

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==========\n */\n\nimport {ClipByValue, ClipByValueAttrs, ClipByValueInputs, KernelConfig, KernelFunc} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmClip: (xId: number, min: number, max: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmClip = backend.wasm.cwrap(ClipByValue, null /* void */, [\n 'number', // x_id\n 'number', // min\n 'number', // max\n 'number' // out_id\n]);\n}\n\nfunction clip(args: {\n inputs: ClipByValueInputs,\n backend: BackendWasm,\n attrs: ClipByValueAttrs\n}) {\n const {inputs, backend, attrs} = args;\n const {x} = inputs;\n const {clipValueMin, clipValueMax} = attrs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n const out = backend.makeOutput(x.shape, x.dtype);\n const outId = backend.dataIdMap.get(out.dataId).id;\n wasmClip(xId, clipValueMin, clipValueMax, outId);\n return out;\n}\n\nexport const clipByValueConfig: KernelConfig = {\n kernelName: ClipByValue,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: clip as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2021 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is
distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\nimport {KernelConfig, Ceil} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\n\nexport const ceilConfig: KernelConfig = createUnaryKernelConfig(Ceil);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND,
either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {backend_util, Concat, ConcatAttrs, ConcatInputs, KernelConfig, KernelFunc, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\nimport {concatImplCPU} from '../kernel_utils/shared';\nimport {identity} from './Identity';\nimport {reshape} from './Reshape';\n\nexport function concat(\n args: {inputs: ConcatInputs, backend: BackendWasm, attrs: ConcatAttrs}) {\n const {inputs, backend} = args;\n\n const axis = util.parseAxisParam(args.attrs.axis, inputs[0].shape)[0];\n\n let outShape = backend_util.computeOutShape(inputs.map(t => t.shape), axis);\n\n // Keep only non-empty tensors (ignore tensors with 0 in their shape).\n const $inputs = inputs.filter(t => util.sizeFromShape(t.shape) > 0);\n if ($inputs.length === 1)
{\n return identity({inputs: {x: $inputs[0]}, backend});\n }\n\n const out = backend.makeOutput(outShape, inputs[0].dtype);\n\n if (util.sizeFromShape(outShape) === 0) {\n return out;\n }\n\n const shapes = $inputs.map(t => t.shape);\n backend_util.assertParamsConsistent(shapes, axis);\n\n if ($inputs[0].dtype === 'string') {\n // Any concat of n-dimensional tensors across any axis can be reduced to\n // a concatenation of two-dimensional tensors across the axis 1 by first\n // partitioning the axes of the original tensors into those less than

the\n   // axis to be concatenated and the rest. Then reshape the tensors\n   // into a two-dimensional tensor by collapsing these two sets of axes and\n   // concatenate the resulting matrices across the axis 1, finally reshaping\n   // the result to have the proper shape.\n   const inputs2D = $inputs.map(t => {\n   const innerSize = util.sizeFromShape(t.shape.slice(axis));\n   const shape = [-1, innerSize];\n   return reshape({inputs: {x: t}, backend, attrs: {shape}});\n   });\n\n   const inputsValShapes = inputs2D.map(t => {\n   return {vals: backend.readSync(t.dataId), shape: t.shape};\n   });\n\n   // Concats 2d tensors along axis=1.\n   outShape =\n   backend_util.computeOutShape(inputs2D.map(t => t.shape), 1 /* axis */);\n   const simplyConcat = inputs2D[0].shape[0] === 1;\n   const outVals = concatImplCPU(\n   inputsValShapes, outShape, inputs[0].dtype,\n   simplyConcat) as string[];\n\n   const finalOutShape =\n   backend_util.computeOutShape($inputs.map(t => t.shape), axis);\n\n   out.shape = finalOutShape;\n   const outData = backend.dataIdMap.get(out.dataId);\n   outData.stringBytes = backend_util.fromStringArrayToUint8(outVals);\n\n   inputs2D.forEach(t => backend.disposeData(t.dataId));\n\n   return out;\n }\n\n const batchDim = util.sizeFromShape($inputs[0].shape.slice(0, axis));\n let sumInnerDims = 0;\n const innerDims = $inputs.map(input => {\n   const innerDim = util.sizeFromShape(input.shape.slice(axis));\n   sumInnerDims += innerDim;\n   return innerDim;\n });\n const inVals = $inputs.map(input => backend.typedArrayFromHeap(input));\n const outVals = backend.typedArrayFromHeap(out);\n for (let b = 0; b < batchDim; b++) {\n   let outOffset = b * sumInnerDims;\n   for (let i = 0; i < inVals.length; i++) {\n   const innerDim = innerDims[i];\n   const inOffset = b * innerDim;\n   const vals = inVals[i].subarray(inOffset, inOffset + innerDim);\n   outVals.set(vals, outOffset);\n   outOffset += innerDim;\n   }\n }\n return out;\n}\n\nexport const concatConfig: KernelConfig = {\n kernelName: Concat,\n backendName: 'wasm',\n kernelFunc: concat as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ===\n */\nimport { backend_util, util } from '@tensorflow/tfjs-core';\nexport function concatImpl(inputs, outShape, dtype, simplyConcat) {\n   const outVals = util.getArrayFromDType(dtype, util.sizeFromShape(outShape));\n   if (simplyConcat && dtype !== 'string') {\n   // Use built-in TypedArray.set() method for speed.\n   let offset = 0;\n   inputs.forEach(input => {\n   const size = util.sizeFromShape(input.shape);\n   outVals.set(input.vals, offset);\n   offset += size;\n   });\n   }\n   else {\n   let colOffset = 0;\n   inputs.forEach(input => {\n   const decodedData = dtype === 'string' ?\n   backend_util.fromUint8ToStringArray(input.vals) :\n   input.vals;\n   let tIdx = 0;\n   for (let row = 0; row < input.shape[0]; ++row) {\n   const resIdx = row * outShape[1] + colOffset;\n   for (let col = 0; col < input.shape[1]; ++col) {\n   outVals[resIdx + col] = decodedData[tIdx++];\n   }\n   }\n   colOffset += input.shape[1];\n   });\n   }\n   return outVals;\n}\n//# sourceMappingURL=data:application/json; base64,eyJ2ZXJzaW9uIjozLCJmaWxlIjoiQ29uY2F0X2ltcGwuanMiLCJzb3VyY2VSb290IjoiIiwic291cmNlcyI6WyIuLi8uLi8uLi8uLi8uLi8uLi90ZmpzLWJhY2tlbmQtY3B1L3NyYy9rZXJuZWxzL0NvbmNhdF9pbXBsLnRzIl0sIm5hbWVzIjpbXSwibWFwcGluZ3MiOiJBQUFBOzs7OztBQUFBOzs7Ozs7Ozs7Oz

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U7WUFDckIsTUFBTSxJQUFJLEdBQUcsSUFBSSxDQUFDLGFBQWEsQ0FBQyxyLQUFLLENBQUMsS0FBSy
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QUFFLEdBQUcsR0FBRyxxLQUFLLENBQUMsS0FBSyxDQUFDLENBQUMsQ0FBQyxxFQUFFLEVBQUUsR0F
BRyxFQUFFO2dCQUM3QyxyNQUFNLE1BQU0sR0FBRyxHQUFHLHdCQUcsUUFBUSxDQUFDLENBQ
0FBQyxHQUFHLFNLE1BQU0sR0FBRyxHQUFHLEdBQUcsR0FBRyxxLQUFLLENBQUMsQ0FBQyxR0
FBRyxHQUFHLEtBQUssQ0FBQyxLQUFLLENBQUMsQ0FBQyxDQUFDLEVBQUUsRUFBRSxRSxHQUFHLEVB
QUU7b0JBQzdDLE9BQU8sQ0FBQyxNQUFNLEdBQUcsR0FBRyxDQUFDLEdBQUcsV0FBVyxDQUFDLEVBQ
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QUssQ0FBQyxDQUFDLENBQUMsQ0FBQztRQUM5QyxNQUQsQ0FBQyxDQUFDLENBQUMsQ0FBQztRQUNmLE1BQU0sQ0FBQyxPQUFPLENBQUMsS0FBSyxDQUFDLElBQUlBRTd
qIENvcHlyaWdodCAyMDIwIEdvb2dsZSBMTEMuIEFsbCBSaWdodHMgUmVzZXJ2ZWQuXG4gKiBMaWNlbn
NlZCB1bmRlciB0aGUgQXBhY2hlIExpY2Vuc2UsIFZlcnNpb24gMi4wICh0aGUgXCJMaWNlbnNlXCIpO1xuICo
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GFwcGxpY2FibGUgbGF3IG9yIGFncmVlZCB0byBpbiB3cml0aW5nLCBzb2Z0d2FyZVxuICogZGlzdHJpYnV0Z
WQgdW5kZXIgdGhlIExpY2Vuc2UgaXMgZGlzdHJpYnV0ZWQgb24gYW4gXCJBUyBJU1wiIEJBU0lTLFxuICo
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G9yIGltcGxpZWQuXG4gKiBiZWUgdGhlIExpY2Vuc2UgZm9yIHRoZSBzcGVjaWZpYYBsYW5ndWFnZSBnb3
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09PT09PT09PT09PT09PT09PT09PT09PT09PT09PT09PT09PT09PT09PT09PT09PT09PT09PT09PT09
PT09PT09PT09XG4gKi9cblxuaW1wb3J0IHtiYWNrZW5kX3V0aWwsIEJhY2tlbmRWYWx1ZXMsIERhdG
FUeXBlLCBUeXBlZEFycmF5LCB1dGlsfSBmcm9tICdAdGVuc29yZmxvdy90ZmpzLWNvcmUnO1xuXG5leHBv
cnQgZnVuY3Rpb24gY29uY2F0SW1wbChchcbiAgICBpbnB1dHM6IEFycmF5PHt2YWxzOiBCYWNrZW5kVmFsd
WVzLCBzaGFwZTogbnVtYmVyW119Piwgb3V0U2hhcGU6IG51bWJlcltdLFxuICAgIGR0eXBlOiBEYXRhVHl
wZSwgc2ltcGx5Q29uY2F0OiBib29sZWFuKTogVHlwZWRBcnJheXxzdHJpbmdbXSB7XG4gIGNvbnN0IG91dF
ZhbHMgPSB1dGlsLmdldEFycmF5RnJvbURUeXBlKGR0eXBlLCB1dGlsLnNpemVGcm9tU2hhcGUob3V0U2hh
cGUpKTtcblxuICBpZiAoc2ltcGx5Q29uY2F0ICYmIGR0eXBlICE9PSAnc3RyaW5nJykge1xuICAgIC8vIFRlc
nNvcnMgY2FuIGJlIGNvbnN0IGRlY29kZWREYXRhID0gZHR5cGUgPT09ICdzdHJpbmcnID9cbiAgICAgICAgIC

gICAgIH1cblxuICAgICAgY29sT2Zmc2V0ICs9IGlucHV0LnNoYXBlWzFdO1xuICAgIH0pO1xuICB9XG5cbiAgcmV0dXJuIG91dFZhbHM7XG59\n","/**\n
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==========\n
*/\n\nimport {backend_util,
 Conv2D, Conv2DAttrs, Conv2DInputs, KernelConfig, KernelFunc, Tensor4D} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmConv2d: (\n xId: number, batchSize: number, inputHeight: number, inputWidth: number,\n filterId: number, filterHeight: number, filterWidth: number, padTop: number,\n padRight: number, padBottom: number, padLeft: number, isSamePad: number,\n dilationHeight: number, dilationWidth: number, strideHeight: number,\n strideWidth: number, inputChannels: number, outputChannels: number,\n outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmConv2d = backend.wasm.cwrap(Conv2D, null /* void */, [\n 'number', // xId\n 'number', // batchSize\n 'number', // inputHeight\n 'number', // inputWidth\n 'number', // filterId\n 'number', // filterHeight\n 'number', // filterWidth\n 'number', // padTop\n 'number', // padRight\n 'number', // padBottom\n 'number', // padLeft\n
  'number', // isSamePad\n 'number', // dilationHeight\n 'number', // dilationWidth\n 'number', // strideHeight\n 'number', // strideWidth\n 'number', // inputChannels\n 'number', // outputChannels\n 'number', // outId\n]);\n}\n\nfunction conv2d(\n args: {inputs: Conv2DInputs, backend: BackendWasm, attrs: Conv2DAttrs}) {\n const {inputs, attrs, backend} = args;\n\n const {x, filter} = inputs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n const filterId = backend.dataIdMap.get(filter.dataId).id;\n\n const {strides, dilations, pad, dimRoundingMode, dataFormat} = attrs;\n const $dataFormat = backend_util.convertConv2DDataFormat(dataFormat);\n const convInfo = backend_util.computeConv2DInfo(\n (x as Tensor4D).shape, (filter as Tensor4D).shape, strides, dilations,\n   pad, dimRoundingMode, false, $dataFormat);\n\n const filterHeight = convInfo.filterHeight;\n const filterWidth = convInfo.filterWidth;\n const padTop = convInfo.padInfo.top;\n
  const padRight = convInfo.padInfo.right;\n const padBottom = convInfo.padInfo.bottom;\n const padLeft = convInfo.padInfo.left;\n const dilationHeight = convInfo.dilationHeight;\n const dilationWidth = convInfo.dilationWidth;\n const strideHeight = convInfo.strideHeight;\n const strideWidth = convInfo.strideWidth;\n const inputChannels = convInfo.inChannels;\n const outputChannels = convInfo.outChannels;\n const isSamePad = convInfo.padInfo.type === 'SAME' ? 1 : 0;\n\n if (convInfo.dataFormat !== 'channelsLast') {\n throw new Error(\n   `wasm backend Conv2D does not support dataFormat:` +\n   `${convInfo.dataFormat}'. Please use 'channelsLast'.`);\n }\n\n const out = backend.makeOutput(convInfo.outShape, 'float32');\n const outId = backend.dataIdMap.get(out.dataId).id;\n wasmConv2d(\n   xId, x.shape[0], x.shape[1], x.shape[2], filterId, filterHeight,\n   filterWidth, padTop, padRight, padBottom, padLeft, isSamePad,\n   dilationHeight, dilationWidth,
 strideHeight, strideWidth, inputChannels,\n   outputChannels, outId);\n return out;\n}\n\nexport const conv2DConfig: KernelConfig = {\n kernelName: Conv2D,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: conv2d as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language

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*/\n\nimport
{backend_util, Conv2DBackpropInput, Conv2DBackpropInputAttrs, Conv2DBackpropInputInputs, KernelConfig, KernelFunc, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmConv2DBackpropInput: (\n dyId: number, filterId: number, batchSize: number, filterHeight: number,\n filterWidth: number, inHeight: number, inWidth: number, inChannels: number,\n outHeight: number, outWidth: number, outChannels: number,\n strideHeight: number, strideWidth: number, topPad: number, leftPad: number,\n fltS0: number, fltS1: number, fltS2: number, xBatchStride: number,\n xRowStride: number, xColStride: number, xChannelStride: number,\n yBatchStride: number, yRowStride: number, yColStride: number,\n yChannelStride: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n wasmConv2DBackpropInput = backend.wasm.cwrap(Conv2DBackpropInput, null, [\n 'number', // dyId\n 'number', // filterId\n 'number',
// batchSize\n 'number', // filterHeight\n 'number', // filterWidth\n 'number', // inHeight\n 'number', // inWidth\n 'number', // inChannels\n 'number', // outHeight\n 'number', // outWidth\n 'number', // outChannels\n 'number', // strideHeight\n 'number', // strideWidth\n 'number', // topPad\n 'number', // leftPad\n 'number', // fltS0\n 'number', // fltS1\n 'number', // fltS2\n 'number', // xBatchStride\n 'number', // xRowStride\n 'number', // xColStride\n 'number', // xChannelStride\n 'number', // yBatchStride\n 'number', // yRowStride\n 'number', // yColStride\n 'number', // yChannelStride\n 'number', // outId\n]);\n}\n\nfunction conv2DBackpropInput(args: {\n backend: BackendWasm,\n inputs: Conv2DBackpropInputInputs,\n attrs: Conv2DBackpropInputAttrs\n}): TensorInfo {\n const {backend, inputs, attrs} = args;\n const {dy, filter} = inputs;\n const {strides, pad, dataFormat, dimRoundingMode,
inputShape} = attrs;\n\n const dilations = 1;\n\n const $dataFormat = backend_util.convertConv2DDataFormat(dataFormat);\n const convInfo = backend_util.computeConv2DInfo(\n inputShape, filter.shape as [number, number, number, number], strides,\n dilations, pad, dimRoundingMode, false /* depthwise */, $dataFormat);\n const {\n batchSize,\n filterHeight,\n filterWidth,\n inChannels,\n inHeight,\n inWidth,\n outChannels,\n outHeight,\n outWidth,\n strideHeight,\n strideWidth\n } = convInfo;\n\n const topPad = filterHeight - 1 - convInfo.padInfo.top;\n const leftPad = filterWidth - 1 - convInfo.padInfo.left;\n\n const isChannelsLast = convInfo.dataFormat === 'channelsLast';\n const dxStrides = util.computeStrides(convInfo.inShape);\n const dyStrides = util.computeStrides(dy.shape);\n const [fltS0, fltS1, fltS2] = util.computeStrides(filter.shape);\n const xBatchStride = dxStrides[0];\n const xRowStride = isChannelsLast ?
dxStrides[1] : dxStrides[2];\n const xColStride = isChannelsLast ? dxStrides[2] : 1;\n const xChannelStride = isChannelsLast ? 1 : dxStrides[1];\n const yBatchStride = dyStrides[0];\n const yRowStride = isChannelsLast ? dyStrides[1] : dyStrides[2];\n const yColStride = isChannelsLast ? dyStrides[2] : 1;\n const yChannelStride = isChannelsLast ? 1 : dyStrides[1];\n\n const out = backend.makeOutput(convInfo.inShape, 'float32');\n const outId = backend.dataIdMap.get(out.dataId).id;\n const dyId = backend.dataIdMap.get(dy.dataId).id;\n const filterId = backend.dataIdMap.get(filter.dataId).id;\n\n wasmConv2DBackpropInput(\n dyId, filterId, batchSize, filterHeight, filterWidth, inHeight, inWidth,\n inChannels, outHeight, outWidth, outChannels, strideHeight, strideWidth,\n topPad, leftPad, fltS0, fltS1, fltS2, xBatchStride, xRowStride,\n xColStride, xChannelStride, yBatchStride, yRowStride, yColStride,\n yChannelStride, outId);\n return out;\n}\n\nexport
const conv2DBackpropInputConfig: KernelConfig = {\n kernelName: Conv2DBackpropInput,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: conv2DBackpropInput as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for

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==========\n
*/\n\nimport {CropAndResize, CropAndResizeAttrs, CropAndResizeInputs, KernelConfig, KernelFunc,
TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {cast}
from './Cast';\n\n// Must match enum in CropAndResize.cc\nenum InterpolationMethod {\n bilinear = 0,\n nearest
= 1\n}\n\nlet wasmCropAndResize: (\n imagesId: number, boxesId: number, boxIndId: number, numBoxes:
number,\n imagesShape: Uint8Array, cropHeight: number, cropWidth: number,\n method: number,
extrapolationValue: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n
wasmCropAndResize = backend.wasm.cwrap(CropAndResize, null /*void*/, [\n 'number', // imagesId\n
'number', // boxesId\n 'number', // boxIndId\n 'number', // numBoxes\n 'array', // images shape\n 'number',
// cropHeight\n 'number', // cropWidth\n 'number', // method\n 'number', // extrapolation value\n 'number'
// out id\n]);\n}\n\nfunction cropAndResize(args: {\n backend: BackendWasm,\n inputs: CropAndResizeInputs,\n
attrs: CropAndResizeAttrs\n}): TensorInfo {\n const {backend, inputs, attrs} = args;\n const {method,
extrapolationValue, cropSize} = attrs;\n const {image, boxes, boxInd} = inputs;\n\n const numBoxes =
boxes.shape[0];\n\n const [cropHeight, cropWidth] = cropSize as [number, number];\n const outShape =
[numBoxes, cropHeight, cropWidth, image.shape[3]];\n\n let imagesData =
backend.dataIdMap.get(image.dataId);\n let castedData;\n if (image.dtype !== 'float32') {\n castedData =
cast({backend, inputs: {x: image}, attrs: {dtype: 'float32'}});\n imagesData =
backend.dataIdMap.get(castedData.dataId);\n }\n\n const imagesId = imagesData.id;\n const boxesId =
backend.dataIdMap.get(boxes.dataId).id;\n const boxIndId = backend.dataIdMap.get(boxInd.dataId).id;\n\n const
out = backend.makeOutput(outShape, 'float32');\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n const
imagesShapeBytes = new Uint8Array(new Int32Array(image.shape).buffer);\n\n wasmCropAndResize(\n
imagesId, boxesId, boxIndId, numBoxes, imagesShapeBytes, cropHeight,\n cropWidth,\n
InterpolationMethod[method as {} as keyof typeof InterpolationMethod],\n extrapolationValue, outId);\n\n if
(castedData != null) {\n backend.disposeData(castedData.dataId);\n }\n\n return out;\n}\n\nexport const
cropAndResizeConfig: KernelConfig = {\n kernelName: CropAndResize,\n backendName: 'wasm',\n setupFunc:
setup,\n kernelFunc: cropAndResize as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google
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software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES
OR CONDITIONS OF ANY KIND, either
express or implied.\n * See the License for the specific language governing permissions and\n * limitations under
the License.\n *
==========\n
*/\n\nimport {Cos, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from
'./unary_kernel';\n\nexport const cosConfig: KernelConfig = createUnaryKernelConfig(Cos);\n","/**\n * @license\n
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WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for
the specific language governing permissions
and\n * limitations under the License.\n *
==========\n
*/\nimport {Cosh, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from
'./unary_kernel';\n\nexport const coshConfig: KernelConfig = createUnaryKernelConfig(Cosh);\n","/**\n *
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2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {backend_util, KernelConfig, KernelFunc, Cumsum, CumsumAttrs, CumsumInputs, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {CppDType} from './types';\n\nimport {transpose} from './Transpose';\n\nlet wasmCumsum: (xId: number, exclusive: number, reverse: number,\n finalDim: number, outId: number, dtype: CppDType) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmCumsum = backend.wasm.cwrap(Cumsum, null /* void */, [\n 'number', // x_id\n 'number', // exclusive\n 'number', // reverse\n 'number', // final_dim\n 'number', // out_id\n 'number' // dtype\n]);\n}\n\nexport function cumsum(\n args: {inputs: CumsumInputs, backend: BackendWasm, attrs: CumsumAttrs}):\nTensorInfo {\n const {inputs, backend, attrs} = args;\n const {x} = inputs;\n const {axis, exclusive, reverse} = attrs;\n const xRank = x.shape.length;\n\n util.assert(x.dtype === 'float32' || x.dtype === 'int32',\n () => `cumsum does not support ${x.dtype} tensors in the WASM backend`);\n // permute required axis to inner most axis\n const permutation = backend_util.getAxesPermutation([axis], xRank);\n let permutedX = x;\n if (permutation !== null) {\n permutedX = transpose({inputs: {x}, attrs: {perm: permutation}, backend});\n }\n const permutedAxis = backend_util.getInnerMostAxes(1, xRank)[0];\n backend_util.assertAxesAreInnerMostDims('cumsum', [permutedAxis], xRank);\n\n const permutedOut = backend.makeOutput(permutedX.shape, permutedX.dtype);\n const finalDim = permutedX.shape[permutedAxis];\n const permutedXId = backend.dataIdMap.get(permutedX.dataId).id;\n const permutedOutId = backend.dataIdMap.get(permutedOut.dataId).id;\n wasmCumsum(permutedXId, exclusive ? 1 : 0, reverse ? 1 : 0, finalDim,\n permutedOutId, CppDType[x.dtype]);\n\n // transpose data back if permuted\n let out = permutedOut;\n if (permutation !== null) {\n const undoPermutation = backend_util.getUndoAxesPermutation(permutation);\n out = transpose(\n {inputs: {x: permutedOut}, attrs: {perm: undoPermutation}, backend});\n backend.disposeData(permutedX.dataId);\n backend.disposeData(permutedOut.dataId);\n }\n return out;\n}\n\nexport const cumsumConfig: KernelConfig = {\n kernelName: Cumsum,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: cumsum as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {DepthToSpace, DepthToSpaceAttrs, DepthToSpaceInputs, KernelConfig, KernelFunc, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmDepthToSpace: (\n xId: number, blockSize: number, channelsLast: number, xStrides: Uint8Array,\n xStridesLength: number, outputShape: Uint8Array, outputStrides: Uint8Array,\n outSize: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n wasmDepthToSpace = backend.wasm.cwrap(DepthToSpace, null /*void*/, [\n 'number', // xId\n 'number', // blockSize\n 'number', // channelsLast\n 'array', // xStrides\n 'number', // xStridesLength\n 'array', // outputShape\n 'array', // outputStrides\n 'number', // outSize\n 'number', // outId\n]);\n}\n\nexport\n function depthToSpace(args: {\n backend: BackendWasm,\n inputs: DepthToSpaceInputs,\n attrs: DepthToSpaceAttrs\n}): TensorInfo {\n const {backend, inputs, attrs} = args;\n const {x} = inputs;\n const

{blockSize, dataFormat} = attrs;\n\n const batchSize = x.shape[0];\n const inputHeight = (dataFormat === 'NHWC') ? x.shape[1] : x.shape[2];\n const inputWidth = (dataFormat === 'NHWC') ? x.shape[2] : x.shape[3];\n const inputDepth = (dataFormat === 'NHWC') ? x.shape[3] : x.shape[1];\n\n const outputHeight = inputHeight * blockSize;\n const outputWidth = inputWidth * blockSize;\n const outputDepth = inputDepth / (blockSize * blockSize);\n\n const outputShape = (dataFormat === 'NHWC') ?\n   [batchSize, outputHeight, outputWidth, outputDepth] :\n   [batchSize, outputDepth, outputHeight, outputWidth];\n\n const out = backend.makeOutput(outputShape, 'float32');\n\n const xData = backend.dataIdMap.get(x.dataId);\n const xId = xData.id;\n const xStridesBytes
 =\n   new Uint8Array(new Int32Array(util.computeStrides(x.shape)).buffer);\n\n const outputShapeBytes = new Uint8Array(new Int32Array(outputShape).buffer);\n const outStridesBytes =\n   new Uint8Array(new Int32Array(util.computeStrides(outputShape)).buffer);\n\n const outId = backend.dataIdMap.get(out.dataId).id;\n const channelsLast = dataFormat === 'NHWC' ? 1 : 0;\n wasmDepthToSpace(\n   xId, blockSize, channelsLast, xStridesBytes, x.shape.length - 1,\n   outputShapeBytes, outStridesBytes, outputShape.length, outId);\n\n return out;\n}\n\nexport const depthToSpaceConfig: KernelConfig = {\n kernelName: DepthToSpace,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: depthToSpace as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n
 *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==\n */\n\nimport {backend_util, DepthwiseConv2dNative, DepthwiseConv2dNativeAttrs, DepthwiseConv2dNativeInputs, KernelConfig, KernelFunc, Tensor4D} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmDepthwiseConv2d: (\n   xId: number, batchSize: number, inputHeight: number, inputWidth: number,\n   filterId: number, filterHeight: number, filterWidth: number, padTop: number,\n   padRight: number, padBottom: number, padLeft: number, isSamePad: number,\n   dilationHeight: number, dilationWidth: number,
 strideHeight: number,\n   strideWidth: number, inputChannels: number, outputChannels: number,\n   outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmDepthwiseConv2d =\n backend.wasm.cwrap(DepthwiseConv2dNative, null /* void */, [\n   'number', // xId\n   'number', // batchSize\n   'number', // inputHeight\n   'number', // inputWidth\n   'number', // filterId\n   'number', // filterHeight\n   'number', // filterWidth\n   'number', // padTop\n   'number', // padRight\n   'number', // padBottom\n   'number', // padLeft\n   'number', // isSamePad\n   'number', // dilationHeight\n   'number', // dilationWidth\n   'number', // strideHeight\n   'number', // strideWidth\n   'number', // inputChannels\n   'number', // outputChannels\n   'number', // outId\n   ]);\n}\n\nfunction depthwiseConv2d(args: {\n inputs: DepthwiseConv2dNativeInputs,\n
 backend: BackendWasm,\n attrs: DepthwiseConv2dNativeAttrs\n}) {\n const {inputs, attrs, backend} = args;\n\n const {x, filter} = inputs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n const filterId = backend.dataIdMap.get(filter.dataId).id;\n\n const {strides, dilations, pad, dimRoundingMode} = attrs;\n\n const $dilations = dilations == null ? [1, 1] : dilations;\n\n const convInfo = backend_util.computeConv2DInfo(\n   (x as Tensor4D).shape, (filter as Tensor4D).shape, strides,\n   ($dilations as number | [number, number]), pad, dimRoundingMode,\n   true /* depthwise */);\n\n const filterHeight = convInfo.filterHeight;\n const filterWidth = convInfo.filterWidth;\n const padTop = convInfo.padInfo.top;\n const padRight = convInfo.padInfo.right;\n const padBottom = convInfo.padInfo.bottom;\n const padLeft = convInfo.padInfo.left;\n const dilationHeight = convInfo.dilationHeight;\n const dilationWidth = convInfo.dilationWidth;\n const strideHeight = convInfo.strideHeight;\n

const strideWidth = convInfo.strideWidth;\n const inputChannels = convInfo.inChannels;\n const outputChannels = convInfo.outChannels;\n const isSamePad = convInfo.padInfo.type === 'SAME' ? 1 : 0;\n\n if (convInfo.dataFormat !== 'channelsLast') {\n   throw new Error(\n   `wasm backend DepthwiseConv2dNative does not support dataFormat:'` +\n   `${convInfo.dataFormat}'. Please use 'channelsLast'.`);\n }\n\n const out = backend.makeOutput(convInfo.outShape, 'float32');\n const outId = backend.dataIdMap.get(out.dataId).id;\n wasmDepthwiseConv2d(\n   xId, x.shape[0], x.shape[1], x.shape[2], filterId, filterHeight,\n   filterWidth, padTop, padRight, padBottom, padLeft, isSamePad,\n   dilationHeight, dilationWidth, strideHeight, strideWidth, inputChannels,\n   outputChannels, outId);\n return out;\n}\n\nexport const depthwiseConv2dNativeConfig: KernelConfig = {\n kernelName: DepthwiseConv2dNative,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: depthwiseConv2d as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2021 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\nimport {Elu, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\n\nexport const eluConfig: KernelConfig = createUnaryKernelConfig(Elu);\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\nimport {Equal, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from './binary_kernel';\n\nconst supportsFullBroadcast = false;\nexport const equalConfig: KernelConfig =\n createBinaryKernelConfig(Equal, supportsFullBroadcast, 'bool');\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\nimport {Exp, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\n\nexport const expConfig: KernelConfig = createUnaryKernelConfig(Exp, 'float32');\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {ExpandDims, ExpandDimsAttrs, ExpandDimsInputs, KernelConfig, KernelFunc, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\nimport {reshape} from

'./Reshape';\n\nexport function expandDims(args: {\n inputs: ExpandDimsInputs,\n attrs: ExpandDimsAttrs,\n backend: BackendWasm\n}) {\n const {inputs, attrs, backend} = args;\n const {input}
 = inputs;\n const {dim} = attrs;\n\n const inputRank = input.shape.length;\n const newShape =
input.shape.slice();\n let $dim = dim;\n if (dim < 0) {\n   // Negative value is counted from the tail of rank.\n
util.assert(\n   -(inputRank + 1) <= dim,\n   () => `Axis must be in the interval [${- (inputRank + 1)}, ${\n
  inputRank}]`);\n $dim = inputRank + dim + 1;\n }\n newShape.splice($dim, 0, 1);\n\n return reshape({inputs:
{x: input}, backend, attrs: {shape: newShape}});\n}\n\nexport const expandDimsConfig: KernelConfig = {\n
kernelName: ExpandDims,\n backendName: 'wasm',\n kernelFunc: expandDims as {} as KernelFunc,\n};\n","/**\n
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BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the
License for the specific language governing permissions and\n * limitations under the License.\n *
==\n
*/\n\nimport {KernelConfig, KernelFunc} from '@tensorflow/tfjs-core';\nimport {Fill, FillAttrs} from
'@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nexport function fill(args: {attrs:
FillAttrs, backend: BackendWasm}) {\n const {attrs: {shape, value, dtype}, backend} = args;\n const out =
backend.makeOutput(shape, dtype);\n const outVals = backend.typedArrayFromHeap(out);\n outVals.fill(value as
number);\n return out;\n}\n\nexport const fillConfig: KernelConfig = {\n kernelName: Fill,\n backendName:
'wasm',\n kernelFunc: fill as {} as KernelFunc,\n};\n","/**\n *
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the specific language governing permissions and\n * limitations under the License.\n *
==\n
*/\n\nimport {FlipLeftRight, FlipLeftRightInputs, KernelConfig, KernelFunc, TensorInfo} from '@tensorflow/tfjs-
core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmFlipLeftRight: (\n   xId: number, batch:
number, imageHeight: number, imageWidth: number,\n   numChannels: number,
 outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmFlipLeftRight =
backend.wasm.cwrap(FlipLeftRight, null /* void */, [\n   'number', // xId\n   'number', // batch\n   'number', //
imageHeight\n   'number', // imageWidth\n   'number', // numChannels\n   'number', // outId\n]);\n}\n\nexport
function flipLeftRight(\n   args: {inputs: FlipLeftRightInputs, backend: BackendWasm}): TensorInfo {\n const
{inputs, backend} = args;\n const {image} = inputs;\n\n const out = backend.makeOutput(image.shape,
image.dtype);\n const imageId = backend.dataIdMap.get(image.dataId).id;\n const outId =
backend.dataIdMap.get(out.dataId).id;\n\n const [batch, imageHeight, imageWidth, numChannels] =
image.shape;\n\n wasmFlipLeftRight(\n   imageId, batch, imageHeight, imageWidth, numChannels, outId);\n
return out;\n}\n\nexport const flipLeftRightConfig: KernelConfig = {\n kernelName: FlipLeftRight,\n
backendName: 'wasm',\n kernelFunc: flipLeftRight as {}
 as KernelFunc,\n setupFunc: setup\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights
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OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language
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==========================================================================\n
*/\n\nimport {FusedBatchNorm, FusedBatchNormAttrs, FusedBatchNormInputs, KernelConfig, KernelFunc,
TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet
wasmBatchNorm: (\n    xId: number, meanId:
 number, varianceId: number, offsetId: number,\n    scaleId: number, varianceEpsilon: number, outId: number) =>
void;\n\nfunction setup(backend: BackendWasm): void {\n  wasmBatchNorm = backend.wasm.cwrap(\n
FusedBatchNorm, null /* void */,\n      ['number', 'number', 'number', 'number', 'number', 'number',
'number']);\n}\n\nfunction fusedBatchNorm(args: {\n  backend: BackendWasm,\n  inputs:
FusedBatchNormInputs,\n  attrs: FusedBatchNormAttrs\n}): TensorInfo {\n  const {backend, inputs, attrs} = args;\n
const {varianceEpsilon} = attrs;\n  const {x, mean, variance, offset, scale} = inputs;\n  const xId =
backend.dataIdMap.get(x.dataId).id;\n  const meanId = backend.dataIdMap.get(mean.dataId).id;\n  const varianceId
= backend.dataIdMap.get(variance.dataId).id;\n  const offsetId = offset != null ?
backend.dataIdMap.get(offset.dataId).id : 0;\n  const scaleId = scale != null ?
backend.dataIdMap.get(scale.dataId).id : 0;\n\n  const out = backend.makeOutput(x.shape, x.dtype);\n  //
 Short-circuit zero-sized tensors.\n  if (util.sizeFromShape(x.shape) === 0) {\n    return out;\n  }\n\n  const outId =
backend.dataIdMap.get(out.dataId).id;\n\n  wasmBatchNorm(\n      xId, meanId, varianceId, offsetId, scaleId,
varianceEpsilon, outId);\n  return out;\n}\n\nexport const fusedBatchNormConfig: KernelConfig = {\n  kernelName:
FusedBatchNorm,\n  backendName: 'wasm',\n  setupFunc: setup,\n  kernelFunc: fusedBatchNorm as {} as
KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the
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implied.\n * See the
 License for the specific language governing permissions and\n * limitations under the License.\n *
==========================================================================\n
*/\nimport {Floor, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from
'./unary_kernel';\nexport const floorConfig: KernelConfig = createUnaryKernelConfig(Floor);\n","/**\n *
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WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for
the specific language governing permissions and\n * limitations under
 the License.\n *
==========================================================================\n
*/\n\nimport {FloorDiv, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from
'./binary_kernel';\n\nconst supportsFullBroadcast = false;\nexport const floorDivConfig: KernelConfig =\n
createBinaryKernelConfig(FloorDiv, supportsFullBroadcast);\n","/**\n * @license\n * Copyright 2019 Google
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OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language
governing permissions and\n * limitations under
 the License.\n *
==========================================================================\n
*/\n\nimport {backend_util, FusedConv2D, FusedConv2DAttrs, FusedConv2DInputs, KernelConfig, KernelFunc,
```

```
Tensor4D} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport
{FusableActivation} from './types';\n\nlet wasmFusedConv2d:\n    (xId: number, batchSize: number, inputHeight:
number, inputWidth: number,\n     filterId: number, filterHeight: number, filterWidth: number,\n     biasId: number,
padTop: number, padRight: number, padBottom: number,\n     padLeft: number, isSamePad: number,
dilationHeight: number,\n     dilationWidth: number, strideHeight: number, strideWidth: number,\n
inputChannels: number, outputChannels: number, activation: number,\n     preluActivationWeightsId: number,
leakyreluAlpha: number, outId: number) =>\n         void;\n\nfunction setup(backend: BackendWasm) {\n
wasmFusedConv2d = backend.wasm.cwrap(FusedConv2D, null /* void
 */, [\n    'number',  // xId\n    'number',  // batchSize\n    'number',  // inputHeight\n    'number',  // inputWidth\n
'number',  // filterId\n    'number',  // filterHeight\n    'number',  // filterWidth\n    'number',  // biasId\n    'number',  //
padTop\n    'number',  // padRight\n    'number',  // padBottom\n    'number',  // padLeft\n    'number',  // isSamePad\n
 'number',  // dilationHeight\n    'number',  // dilationWidth\n    'number',  // strideHeight\n    'number',  //
strideWidth\n    'number',  // inputChannels\n    'number',  // outputChannels\n    'number',  // activation\n    'number',
// preluActivationWeightsId\n    'number',  // leakyreluAlpha\n    'number',  // outId\n  ]);\n}\n\nfunction
fusedConv2d(args: {\n  inputs: FusedConv2DInputs,\n  backend: BackendWasm,\n  attrs: FusedConv2DAttrs\n})
{\n  const {inputs, attrs, backend} = args;\n  const {x, filter, bias, preluActivationWeights} = inputs;\n  const {\n
strides,\n    pad,\n    dilations,\n    dataFormat,\n
    dimRoundingMode,\n    activation,\n    leakyreluAlpha\n  } = attrs;\n\n  const convInfo =
backend_util.computeConv2DInfo(\n      (x as Tensor4D).shape, (filter as Tensor4D).shape, strides, dilations,\n
pad, dimRoundingMode);\n\n  const fusedActivation =\n      FusableActivation[activation as {} as keyof typeof
FusableActivation];\n  if (fusedActivation == null) {\n    throw new Error(\n        `${activation} activation not yet
supported for FusedConv2D ` +\n        `in the wasm backend.`);\n  }\n\n  const xId =
backend.dataIdMap.get(x.dataId).id;\n  const filterId = backend.dataIdMap.get(filter.dataId).id;\n\n  const
outputChannels = convInfo.outChannels;\n\n  let biasId = 0;\n  if (bias != null) {\n    const biasData =
backend.dataIdMap.get(bias.dataId);\n    if (biasData.shape.length !== 1) {\n      throw new Error(\n
`FusedConv2D only supports rank-1 bias but got ` +\n          `rank ${biasData.shape.length}.`);\n    }\n    if
(biasData.shape[0] !== outputChannels)
 {\n      throw new Error(\n          `FusedConv2D bias shape (${biasData.shape}) does not ` +\n          `match the
number of output channels (${outputChannels})`);\n    }\n    biasId = biasData.id;\n  }\n\n  const filterHeight =
convInfo.filterHeight;\n  const filterWidth = convInfo.filterWidth;\n  const padTop = convInfo.padInfo.top;\n  const
padRight = convInfo.padInfo.right;\n  const padBottom = convInfo.padInfo.bottom;\n  const padLeft =
convInfo.padInfo.left;\n  const dilationHeight = convInfo.dilationHeight;\n  const dilationWidth =
convInfo.dilationWidth;\n  const strideHeight = convInfo.strideHeight;\n  const strideWidth =
convInfo.strideWidth;\n  const inputChannels = convInfo.inChannels;\n  const isSamePad = convInfo.padInfo.type
=== 'SAME' ? 1 : 0;\n  const batchSize = convInfo.batchSize;\n  const inHeight = convInfo.inHeight;\n  const
inWidth = convInfo.inWidth;\n\n  if (dataFormat !== 'NHWC') {\n    throw new Error(\n        `wasm backend
FusedConv2D does not support
 dataFormat:'` +\n        `${dataFormat}'. Please use 'NHWC'.`);\n  }\n\n  const out =
backend.makeOutput(convInfo.outShape, 'float32');\n  const outId = backend.dataIdMap.get(out.dataId).id;\n  const
preluActivationWeightsId = preluActivationWeights == null ?\n      0 :\n
backend.dataIdMap.get(preluActivationWeights.dataId).id;\n\n  wasmFusedConv2d(\n      xId, batchSize, inHeight,
inWidth, filterId, filterHeight, filterWidth,\n      biasId, padTop, padRight, padBottom, padLeft, isSamePad,
dilationHeight,\n      dilationWidth, strideHeight, strideWidth, inputChannels, outputChannels,\n      fusedActivation,
preluActivationWeightsId, leakyreluAlpha || 0, outId);\n\n  return out;\n}\n\nexport const fusedConv2DConfig:
KernelConfig = {\n  kernelName: FusedConv2D,\n  backendName: 'wasm',\n  setupFunc: setup,\n  kernelFunc:
fusedConv2d as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights
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 number, filterWidth: number,\n     biasId: number, padTop: number, padRight: number, padBottom: number,\n padLeft: number, isSamePad: number, dilationHeight: number,\n     dilationWidth: number, strideHeight: number, strideWidth: number,\n     inputChannels: number, outputChannels: number, activation: number,\n preluActivationWeightsId: number, leakyreluAlpha: number, outId: number) =>\n        void;\n\nfunction setup(backend: BackendWasm) {\n  wasmFusedDepthwiseConv2d =\n backend.wasm.cwrap(FusedDepthwiseConv2D, null /* void */, [\n        'number',  // xId\n        'number',  // batchSize\n        'number',  // inputHeight\n        'number',  // inputWidth\n        'number',  // filterId\n        'number',  // filterHeight\n        'number',  // filterWidth\n        'number',  // biasId\n        'number',  // padTop\n        'number',  // padRight\n        'number',  // padBottom\n        'number',  // padLeft\n        'number',  // isSamePad\n        'number',  // dilationHeight\n        'number',  // dilationWidth\n        'number',  // strideHeight\n        'number',  // strideWidth\n        'number',  // inputChannels\n        'number',  // outputChannels\n        'number',  // activation\n        'number',  // preluActivationWeightsId\n        'number',  // leakyreluAlpha\n        'number',  // outId\n      ]);\n}\n\nfunction fusedDepthwiseConv2d(args: {\n  inputs: FusedDepthwiseConv2DInputs,\n  backend: BackendWasm,\n  attrs: FusedDepthwiseConv2DAttrs\n}) {\n  const {inputs, attrs, backend} = args;\n  const {x, filter, bias, preluActivationWeights} = inputs;\n  const {\n    strides,\n    pad,\n    dilations,\n    dataFormat,\n dimRoundingMode,\n    activation,\n    leakyreluAlpha\n  } = attrs;\n\n  const convInfo = backend_util.computeConv2DInfo(\n      (x as Tensor4D).shape, (filter as Tensor4D).shape, strides, dilations,\n pad, dimRoundingMode, true /* depthwise */);\n\n  const fusedActivation =\n      FusableActivation[activation
 as {} as keyof typeof FusableActivation];\n  if (fusedActivation == null) {\n    throw new Error(\n `${activation} activation not yet supported for FusedDepthwiseConv2D ` +\n        `in the wasm backend.`);\n  }\n\n const xId = backend.dataIdMap.get(x.dataId).id;\n  const filterId = backend.dataIdMap.get(filter.dataId).id;\n\n const outputChannels = convInfo.outChannels;\n\n  let biasId = 0;\n  if (bias != null) {\n    const biasData = backend.dataIdMap.get(bias.dataId);\n    if (biasData.shape.length !== 1) {\n      throw new Error(\n `FusedDepthwiseConv2D only supports rank-1 bias but got ` +\n          `rank ${biasData.shape.length}.`);\n    }\n if (biasData.shape[0] !== outputChannels) {\n      throw new Error(\n          `FusedDepthwiseConv2D bias shape (${biasData.shape}) does not ` +\n          `match the number of output channels (${outputChannels})`);\n    }\n biasId = biasData.id;\n  }\n\n  const filterHeight = convInfo.filterHeight;\n  const
 filterWidth = convInfo.filterWidth;\n  const padTop = convInfo.padInfo.top;\n  const padRight =
 convInfo.padInfo.right;\n  const padBottom = convInfo.padInfo.bottom;\n  const padLeft = convInfo.padInfo.left;\n const dilationHeight = convInfo.dilationHeight;\n  const dilationWidth = convInfo.dilationWidth;\n  const strideHeight = convInfo.strideHeight;\n  const strideWidth = convInfo.strideWidth;\n  const inputChannels = convInfo.inChannels;\n  const isSamePad = convInfo.padInfo.type === 'SAME' ? 1 : 0;\n  const batchSize = convInfo.batchSize;\n  const inHeight = convInfo.inHeight;\n  const inWidth = convInfo.inWidth;\n\n  if (dataFormat !== 'NHWC') {\n    throw new Error(\n        `wasm backend FusedDepthwiseConv2D does not support dataFormat:` +\n        `${dataFormat}'. Please use 'NHWC'.`);\n  }\n\n  const out = backend.makeOutput(convInfo.outShape, 'float32');\n  const outId = backend.dataIdMap.get(out.dataId).id;\n  const preluActivationWeightsId = preluActivationWeights == null
```

?\n 0 :\n backend.dataIdMap.get(preluActivationWeights.dataId).id;\n\n wasmFusedDepthwiseConv2d(\n xId, batchSize, inHeight, inWidth, filterId, filterHeight, filterWidth,\n biasId, padTop, padRight, padBottom, padLeft, isSamePad, dilationHeight,\n dilationWidth, strideHeight, strideWidth, inputChannels, outputChannels,\n fusedActivation, preluActivationWeightsId, leakyreluAlpha || 0, outId);\n\n return out;\n}\n\nexport const fusedDepthwiseConv2DConfig: KernelConfig = {\n kernelName: FusedDepthwiseConv2D,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: fusedDepthwiseConv2d as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or
agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {gather_util, GatherNd, GatherNdInputs, KernelConfig, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {CppDType} from './types';\n\nlet wasmGatherNd: (\n xId: number, dtype: CppDType, indicesId: number, numSlices: number,\n sliceRank: number, sliceSize: number, strides: Uint8Array, outId: number) =>\n void;\n\nfunction setup(backend: BackendWasm): void {\n wasmGatherNd = backend.wasm.cwrap(GatherNd, null /*void*/, [\n 'number', // xId\n 'number', // dtype\n 'number', // indicesId\n 'number', // numSlices\n 'number', // sliceRank\n 'number', // sliceSize\n 'array', // strides\n 'number' // outId\n]);\n}\n\nfunction gatherNd(args: {backend: BackendWasm, inputs: GatherNdInputs}):\n TensorInfo {\n const {backend, inputs} = args;\n const {params, indices} = inputs;\n\n const [resultShape, numSlices, sliceSize, strides] =\n gather_util.prepareAndValidate(params, indices);\n\n const out = backend.makeOutput(resultShape, params.dtype);\n if (numSlices === 0) {\n return out;\n }\n\n const indicesShape = indices.shape;\n const sliceRank = indicesShape[indicesShape.length - 1];\n\n const xData = backend.dataIdMap.get(params.dataId);\n const xId = xData.id;\n const indicesData = backend.dataIdMap.get(indices.dataId);\n const indicesId = indicesData.id;\n\n const stridesBytes = new Uint8Array(new Int32Array(strides).buffer);\n\n const outId = backend.dataIdMap.get(out.dataId).id;\n wasmGatherNd(\n xId, CppDType[params.dtype], indicesId, numSlices, sliceRank, sliceSize,\n stridesBytes, outId);\n\n return out;\n}\n\nexport const gatherNdConfig: KernelConfig = {\n kernelName: GatherNd,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: gatherNd\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {backend_util, GatherV2, GatherV2Attrs, GatherV2Inputs, KernelConfig, KernelFunc, Tensor, TensorInfo, TypedArray, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {reshape} from './Reshape';\nimport {CppDType} from './types';\n\nlet wasmGather: (\n xId: number, dtype: CppDType, xStrides: Uint8Array, stridesSize: number,\n indicesId: number, batchSize: number, outStrides: Uint8Array,\n outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n wasmGather = backend.wasm.cwrap('Gather', null /*void*/, [\n 'number', // xId\n 'number', // dtype\n 'array', // xStrides\n 'number', // stridesSize\n 'number', // indicesId\n 'number', // batchSize\n 'array', // outStrides\n 'number' // outId\n]);\n}\n\nfunction gatherV2(\n args: {backend: BackendWasm, inputs: GatherV2Inputs, attrs: GatherV2Attrs}):\n TensorInfo {\n const {backend, inputs, attrs} = args;\n const {x,

indices} = inputs;\n const {axis, batchDims} = attrs;\n\n // Throw error when any index is out of bound.\n const parsedAxis = util.parseAxisParam(axis, x.shape)[0];\n const indicesVals = backend.readSync(indices.dataId) as TypedArray;\n const axisDim = x.shape[parsedAxis];\n for (let i = 0; i < indicesVals.length; ++i) {\n   const index = indicesVals[i];\n   util.assert(\n   index <= axisDim - 1 && index >= 0,\n   () =>\n   `GatherV2: the index value ${index} is not in [0, ${axisDim - 1}]`);\n }\n\n const shapeInfo = backend_util.segment_util.collectGatherOpShapeInfo(\n   x as Tensor, indices as Tensor, parsedAxis, batchDims);\n\n const flattenX = reshape({\n   inputs: {x},\n   attrs: {\n   shape: [\n   shapeInfo.batchSize, shapeInfo.outerSize, shapeInfo.dimSize,\n   shapeInfo.sliceSize\n   ]\n   },\n   backend\n });\n const indicesSize = util.sizeFromShape(indices.shape);\n const flattenIndex = reshape({\n   inputs: {x: indices},\n   attrs: {shape: [shapeInfo.batchSize, indicesSize / shapeInfo.batchSize]},\n   backend\n });\n const flattenOutputShape = [\n   shapeInfo.batchSize, shapeInfo.outerSize, indicesSize / shapeInfo.batchSize,\n   shapeInfo.sliceSize\n];\n\n const out = backend.makeOutput(flattenOutputShape, x.dtype);\n if (util.sizeFromShape(x.shape) === 0) {\n   return out;\n }\n const stridesSize = flattenX.shape.length - 1;\n\n const xData = backend.dataIdMap.get(flattenX.dataId);\n const xId = xData.id;\n\n const indicesData = backend.dataIdMap.get(flattenIndex.dataId);\n const indicesId = indicesData.id;\n\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n const xStridesBytes = new Uint8Array(\n   new Int32Array(util.computeStrides(flattenX.shape)).buffer);\n const outStridesBytes = new Uint8Array(\n   new Int32Array(util.computeStrides(flattenOutputShape)).buffer);\n\n wasmGather(\n   xId, CppDType[x.dtype], xStridesBytes, stridesSize, indicesId,\n   shapeInfo.batchSize, outStridesBytes, outId);\n\n backend.disposeData(flattenX.dataId);\n backend.disposeData(flattenIndex.dataId);\n\n // reshape\n out.shape = shapeInfo.outputShape;\n return out;\n}\n\nexport const gatherV2Config: KernelConfig = {\n kernelName: GatherV2,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: gatherV2 as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==*/\n\nimport {KernelConfig, KernelFunc, LeakyRelu, LeakyReluAttrs, LeakyReluInputs, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {CppDType} from './types';\n\nlet wasmFunc: (\n   xId: number, dtype: number, leakyreluAlpha: number, outId: number) => void;\n\nfunction setupFunc(backend: BackendWasm): void {\n wasmFunc = backend.wasm.cwrap(LeakyRelu, null /* void */, [\n   'number', // x_id\n   'number', // dtype\n   'number', // leakyrelu_alpha\n   'number', // out_id\n]);\n}\n\nexport function leakyRelu(\n   args:\n   {inputs: LeakyReluInputs, attrs: LeakyReluAttrs, backend: BackendWasm}):\n   TensorInfo {\n const {inputs: {x}, attrs: {alpha}, backend} = args;\n\n const xId = backend.dataIdMap.get(x.dataId).id;\n // According to TF API, LeakyRelu returns float32 when input is either float32\n // or int32.\n const out = backend.makeOutput(x.shape, 'float32');\n\n if (util.sizeFromShape(x.shape) !== 0)\n {\n   const outId = backend.dataIdMap.get(out.dataId).id;\n   wasmFunc(xId, CppDType[x.dtype], alpha, outId);\n }\n\n return out;\n}\n\nexport const leakyReluConfig: KernelConfig = {\n kernelName: LeakyRelu,\n backendName: 'wasm',\n setupFunc,\n kernelFunc: leakyRelu as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for

the specific language governing permissions and\n * limitations under the License.\n *
==========\n
*/\nimport {Greater, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from
'./binary_kernel';\n\nconst supportsFullBroadcast = false;\nexport const greaterConfig: KernelConfig =\n
createBinaryKernelConfig(Greater, supportsFullBroadcast, 'bool');\n","/**\n * @license\n * Copyright 2019 Google
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OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language
governing permissions and\n * limitations under the License.\n *
==========\n
*/\nimport {GreaterEqual, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig}
from './binary_kernel';\n\nconst supportsFullBroadcast = false;\nexport const greaterEqualConfig: KernelConfig =\n
createBinaryKernelConfig(GreaterEqual, supportsFullBroadcast, 'bool');\n","/**\n * @license\n * Copyright 2019
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OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language
governing permissions and\n * limitations under the License.\n *
==========\n
*/\n\nimport {backend_util, KernelConfig, KernelFunc, Max, MaxAttrs, MaxInputs, TensorInfo, util} from
'@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport
{permuteAxesAndTranspose} from './kernel_utils';\nimport {CppDType} from './types';\n\nlet wasmMax: (xId:
number, dtype: number, reduceSize: number, outId: number) =>\n void;\n\nfunction setup(backend:
BackendWasm): void {\n wasmMax = backend.wasm.cwrap(Max, null /*void*/, [\n 'number', // x_id\n
'number', // dtype\n 'number', // reduce_size\n 'number', // out_id\n]);\n}\n\nfunction max(args: {backend:
BackendWasm, inputs: MaxInputs, attrs: MaxAttrs}):\n TensorInfo {\n const {backend, inputs, attrs} = args;\n
const {reductionIndices: axis, keepDims} = attrs;\n const {x} = inputs;\n const xId =
backend.dataIdMap.get(x.dataId).id;\n let inputId = xId;\n let input = x;\n\n const {transposed, axes, originalAxes,
inputWasTransposed}
=\n permuteAxesAndTranspose(x, axis, backend);\n\n if (inputWasTransposed) {\n const transposedId =
backend.dataIdMap.get(transposed.dataId).id;\n input = transposed;\n inputId = transposedId;\n }\n\n const
inputRank = input.shape.length;\n backend_util.assertAxesAreInnerMostDims('max', axes, inputRank);\n const
[outShape, reduceShape] =\n backend_util.computeOutAndReduceShapes(input.shape, axes);\n const
reduceSize = util.sizeFromShape(reduceShape);\n\n const out = backend.makeOutput(outShape, x.dtype);\n if
(util.sizeFromShape(input.shape) !== 0) {\n const outId = backend.dataIdMap.get(out.dataId).id;\n
wasmMax(inputId, CppDType[x.dtype], reduceSize, outId);\n }\n\n if (inputWasTransposed) {\n // dispose of the
transposed tensor.\n backend.disposeData(transposed.dataId);\n }\n\n if (keepDims) {\n // reshape\n const
newShape = backend_util.expandShapeToKeepDim(out.shape, originalAxes);\n out.shape = newShape;\n }\n\n
return out;\n}\n\nexport
const maxConfig: KernelConfig = {\n kernelName: Max,\n backendName: 'wasm',\n setupFunc: setup,\n
kernelFunc: max as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights
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software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES

OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==========\n */\nimport {KernelConfig, Less} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from './binary_kernel';\nconst supportsFullBroadcast = false;\nexport const lessConfig: KernelConfig =\n createBinaryKernelConfig(Less, supportsFullBroadcast, 'bool');\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==========\n */\n\nimport {KernelConfig, LessEqual} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from './binary_kernel';\nconst supportsFullBroadcast = false;\nexport const lessEqualConfig: KernelConfig =\n createBinaryKernelConfig(LessEqual, supportsFullBroadcast, 'bool');\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==========\n */\nimport {KernelConfig, Log} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\nexport const logConfig: KernelConfig = createUnaryKernelConfig(Log);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==========\n */\nimport {KernelConfig, LogicalAnd} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from './binary_kernel';\nconst supportsFullBroadcast = false;\nexport const logicalAndConfig: KernelConfig =\n createBinaryKernelConfig(LogicalAnd, supportsFullBroadcast, 'bool');\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==========\n */\n\nimport {backend_util, KernelConfig, KernelFunc, MaxPool, MaxPoolAttrs, MaxPoolInputs, Tensor4D, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet

wasmMaxPool: (\n xId: number, batchSize: number, inputHeight: number, inputWidth: number,\n filterHeight: number, filterWidth: number, padTop: number, padRight: number,\n padBottom: number, padLeft: number, dilationHeight: number,\n dilationWidth: number, strideHeight: number, strideWidth: number,\n inputChannels: number, outputChannels: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmMaxPool = backend.wasm.cwrap(MaxPool, null /* void */, [\n 'number', // xId\n 'number', // batchSize\n 'number', // inputHeight\n 'number', // inputWidth\n 'number', // filterHeight\n 'number', // filterWidth\n 'number', // padTop\n 'number', // padRight\n 'number', // padBottom\n 'number', // padLeft\n 'number', // dilationHeight\n 'number', // dilationWidth\n 'number', // strideHeight\n 'number', // strideWidth\n 'number', // inputChannels\n 'number', // outputChannels\n 'number', // outId\n]);\n}\n\nfunction maxPool(\n args: {inputs: MaxPoolInputs, backend: BackendWasm, attrs: MaxPoolAttrs}) {\n const {inputs, attrs, backend} = args;\n\n const x = inputs.x as Tensor4D;\n const xId = backend.dataIdMap.get(x.dataId).id;\n\n // TF API supports int32 input. CPU and WebGL backend also support int32\n // input. WASM backend doesn't support it because it uses xnnpack which only\n // supports float32.\n //\n // Add the following assert only for the WASM backend instead of at core op\n // level.\n //\n // TODO: add support for int32 input.\n util.assert(\n x.dtype === 'float32',\n () =>\n `Error in MaxPool: only float32 input is supported. Got ${x.dtype}.`);\n\n const {filterSize, strides, pad, dimRoundingMode} = attrs;\n const convInfo = backend_util.computePool2DInfo(\n x.shape, filterSize, strides, 1 /* dilations */, pad, dimRoundingMode);\n\n const filterHeight = convInfo.filterHeight;\n const filterWidth = convInfo.filterWidth;\n const padTop = convInfo.padInfo.top;\n const padRight = convInfo.padInfo.right;\n const padBottom = convInfo.padInfo.bottom;\n const padLeft = convInfo.padInfo.left;\n const dilationHeight = convInfo.dilationHeight;\n const dilationWidth = convInfo.dilationWidth;\n const strideHeight = convInfo.strideHeight;\n const strideWidth = convInfo.strideWidth;\n const inputChannels = convInfo.inChannels;\n const outputChannels = convInfo.outChannels;\n\n if (convInfo.dataFormat !== 'channelsLast') {\n throw new Error(\n `wasm backend does not support dataFormat:'` +\n `${convInfo.dataFormat}'. Please use 'channelsLast'.`);\n }\n\n const out = backend.makeOutput(convInfo.outShape, 'float32');\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n wasmMaxPool(\n xId, x.shape[0], x.shape[1], x.shape[2], filterHeight, filterWidth,\n padTop, padRight, padBottom, padLeft, dilationHeight, dilationWidth,\n strideHeight, strideWidth, inputChannels, outputChannels, outId);\n return out;\n}\n\nexport const maxPoolConfig: KernelConfig = {\n kernelName: MaxPool,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: maxPool as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\nimport {KernelConfig, Maximum} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from './binary_kernel';\nconst supportsFullBroadcast = false;\nexport const maximumConfig: KernelConfig =\n createBinaryKernelConfig(Maximum, supportsFullBroadcast);\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {backend_util, KernelConfig, KernelFunc, Mean, MeanAttrs, MeanInputs,

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TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\nimport {cast} from './Cast';\n\nimport {permuteAxesAndTranspose} from './kernel_utils';\n\nlet wasmMean: (xId: number, reduceSize: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n  wasmMean =\n    backend.wasm.cwrap(Mean, null /*void*/, ['number, number, number']);\n}\n\nexport function mean(\n    args: {backend: BackendWasm, inputs: MeanInputs, attrs: MeanAttrs}):\n    TensorInfo {\n  const {backend, inputs, attrs} = args;\n  const {axis, keepDims} = attrs;\n  const {x} = inputs;\n  const xId = backend.dataIdMap.get(x.dataId).id;\n  let inputId = xId;\n  let input = x;\n\n  const {transposed, axes, originalAxes, inputWasTransposed} =\n      permuteAxesAndTranspose(x, axis, backend);\n\n  let reductionAxes = axes;\n  if (inputWasTransposed) {\n    const transposedId = backend.dataIdMap.get(transposed.dataId).id;\n    if (transposedId !== xId) {\n      //
  transpose was not a no-op. We will need to dispose of this\n      // once we are done.\n      input = transposed;\n      inputId = transposedId;\n      reductionAxes = backend_util.getInnerMostAxes(\n          reductionAxes.length, input.shape.length);\n    }\n  }\n\n  backend_util.assertAxesAreInnerMostDims(\n      'mean', reductionAxes, input.shape.length);\n  const [outShape, reduceShape] =\n      backend_util.computeOutAndReduceShapes(input.shape, reductionAxes);\n  const reduceSize = util.sizeFromShape(reduceShape);\n  let castedInput = input;\n  if (input.dtype !== 'float32') {\n    castedInput =\n        cast({backend, inputs: {x: input}, attrs: {dtype: 'float32'}});\n    inputId = backend.dataIdMap.get(castedInput.dataId).id;\n  }\n\n  const out = backend.makeOutput(outShape, 'float32');\n  if (util.sizeFromShape(input.shape) !== 0) {\n    const outId = backend.dataIdMap.get(out.dataId).id;\n    wasmMean(inputId, reduceSize, outId);\n  }\n\n  if (inputWasTransposed) {\n    //
  dispose of the transposed tensor.\n    backend.disposeData(transposed.dataId);\n  }\n\n  if (keepDims) {\n    //
  reshape\n    const newShape = backend_util.expandShapeToKeepDim(out.shape, originalAxes);\n    out.shape =
  newShape;\n  }\n\n  if (input.dtype !== 'float32') {\n    backend.disposeData(castedInput.dataId);\n  }\n\n  return
  out;\n}\n\nexport const meanConfig: KernelConfig = {\n  kernelName: Mean,\n  backendName: 'wasm',\n
  setupFunc: setup,\n  kernelFunc: mean as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google
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  http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing,
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  OR CONDITIONS OF ANY KIND,
  either express or implied.\n * See the License for the specific language governing permissions and\n * limitations
  under the License.\n *
  ==========================================================================\n
  */\n\nimport {backend_util, KernelConfig, KernelFunc, Min, MinAttrs, MinInputs, TensorInfo, util} from
  '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport
  {permuteAxesAndTranspose} from './kernel_utils';\nimport {CppDType} from './types';\n\nlet wasmMin: (xId:
  number, dtype: number, reduceSize: number, outId: number) =>\n    void;\n\nfunction setup(backend:
  BackendWasm): void {\n  wasmMin = backend.wasm.cwrap(Min, null /*void*/, [\n    'number',  // x_id\n
  'number',  // dtype\n    'number',  // reduce_size\n    'number',  // out_id\n  ]);\n}\n\nfunction min(args: {backend:
  BackendWasm, inputs: MinInputs, attrs: MinAttrs}):\n    TensorInfo {\n  const {backend, inputs, attrs} = args;\n
  const {axis, keepDims} = attrs;\n  const {x} = inputs;\n
    const xId = backend.dataIdMap.get(x.dataId).id;\n  let inputId = xId;\n  let input = x;\n\n  const {transposed, axes,
  originalAxes, inputWasTransposed} =\n      permuteAxesAndTranspose(x, axis, backend);\n\n  if
  (inputWasTransposed) {\n    const transposedId = backend.dataIdMap.get(transposed.dataId).id;\n    if (transposedId
  !== xId) {\n      // transpose was not a no-op. We will need to dispose of this\n      // once we are done.\n      input =
  transposed;\n      inputId = transposedId;\n    }\n  }\n\n  const inputRank = input.shape.length;\n\n
  backend_util.assertAxesAreInnerMostDims('min', axes, inputRank);\n  const [outShape, reduceShape] =\n
  backend_util.computeOutAndReduceShapes(input.shape, axes);\n  const reduceSize =
```

util.sizeFromShape(reduceShape);\n\n const out = backend.makeOutput(outShape, input.dtype);\n if (util.sizeFromShape(input.shape) !== 0) {\n   const outId = backend.dataIdMap.get(out.dataId).id;\n wasmMin(inputId, CppDType[x.dtype], reduceSize,
 outId);\n }\n\n if (inputWasTransposed) {\n   // dispose of the transposed tensor.\n backend.disposeData(transposed.dataId);\n }\n\n if (keepDims) {\n   // reshape\n   const newShape = backend_util.expandShapeToKeepDim(out.shape, originalAxes);\n   out.shape = newShape;\n }\n\n return out;\n}\n\nexport const minConfig: KernelConfig = {\n kernelName: Min,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: min as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2021 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See
 the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n
/\n\nimport {KernelConfig, KernelFunc, MirrorPad, MirrorPadAttrs, MirrorPadInputs} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {CppDType} from './types';\n\n// Must match enum in MirrorPad.cc\nenum MirrorPaddingMode {\n reflect = 0,\n symmetric = 1\n}\n\nlet wasmMirrorPad: (\n xId: number, xShapeBytes: Uint8Array, xShapeLength: number, xDtype: number,\n   prePaddingsBytes: Uint8Array, postPaddingsBytes: Uint8Array, mode: number,\n   outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmMirrorPad = backend.wasm.cwrap(MirrorPad, null / void */, [\n 'number', // xId\n   'array',   // x.shape\n   'number', // x.shape.length\n   'number', // x.dtype\n   'array',   // pre-paddings\n   'array',   // post-paddings\n   'number', //
 mode\n   'number', // outId\n]);\n}\n\nfunction mirrorPad(args: {\n inputs: MirrorPadInputs,\n backend: BackendWasm,\n attrs: MirrorPadAttrs\n}) {\n const {inputs: {x}, backend, attrs: {paddings, mode}} = args;\n\n const outShape = paddings.map(\n   (p, i) => p[0] /* beforePad */ + x.shape[i] + p[1] /* afterPad */);\n const xId = backend.dataIdMap.get(x.dataId).id;\n const out = backend.makeOutput(outShape, x.dtype);\n const outId = backend.dataIdMap.get(out.dataId).id;\n const xShapeBytes = new Uint8Array(new Int32Array(x.shape).buffer);\n\n const prePaddingsFlat = paddings.map(padTuple => padTuple[0]);\n const postPaddingsFlat = paddings.map(padTuple => padTuple[1]);\n const prePaddingsBytes =\n   new Uint8Array(new Int32Array(prePaddingsFlat).buffer);\n const postPaddingsBytes =\n   new Uint8Array(new Int32Array(postPaddingsFlat).buffer);\n\n wasmMirrorPad(\n   xId, xShapeBytes, x.shape.length, CppDType[x.dtype], prePaddingsBytes,\n   postPaddingsBytes,
 MirrorPaddingMode[mode], outId);\n return out;\n}\n\nexport const mirrorPadConfig: KernelConfig = {\n kernelName: MirrorPad,\n backendName: 'wasm',\n kernelFunc: mirrorPad as {} as KernelFunc,\n setupFunc: setup\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n
*/\nimport {KernelConfig, Minimum} from '@tensorflow/tfjs-core';\n\nimport
 {createBinaryKernelConfig} from './binary_kernel';\nconst supportsFullBroadcast = false;\nexport const minimumConfig: KernelConfig =\n   createBinaryKernelConfig(Minimum, supportsFullBroadcast);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a

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==========\n */\n\nimport {KernelConfig, KernelFunc, NonMaxSuppressionV3,
NonMaxSuppressionV3Attrs, NonMaxSuppressionV3Inputs, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {parseResultStruct} from './NonMaxSuppression_util';\n\nlet wasmFunc: (\n boxesId: number, scoresId: number, maxOutputSize: number,\n iouThreshold: number, scoreThreshold: number) => number;\n\nfunction setup(backend: BackendWasm): void {\n wasmFunc = backend.wasm.cwrap(\n NonMaxSuppressionV3,\n 'number', // Result*\n [\n 'number', // boxesId\n 'number', // scoresId\n 'number', // maxOutputSize\n 'number', // iouThreshold\n 'number', // scoreThreshold\n]);\n}\n\nfunction kernelFunc(args: {\n backend: BackendWasm,\n inputs: NonMaxSuppressionV3Inputs,\n attrs: NonMaxSuppressionV3Attrs\n}): TensorInfo {\n const {backend, inputs, attrs} = args;\n const {iouThreshold, maxOutputSize, scoreThreshold} = attrs;\n const {boxes, scores} = inputs;\n\n const boxesId =
backend.dataIdMap.get(boxes.dataId).id;\n const scoresId = backend.dataIdMap.get(scores.dataId).id;\n\n const resOffset =\n wasmFunc(boxesId, scoresId, maxOutputSize, iouThreshold, scoreThreshold);\n\n const {pSelectedIndices, selectedSize, pSelectedScores, pValidOutputs} =\n parseResultStruct(backend, resOffset);\n\n // Since we are not using scores for V3, we have to delete it from the heap.\n backend.wasm._free(pSelectedScores);\n backend.wasm._free(pValidOutputs);\n\n const selectedIndicesTensor =\n backend.makeOutput([selectedSize], 'int32', pSelectedIndices);\n\n return selectedIndicesTensor;\n}\n\nexport const nonMaxSuppressionV3Config: KernelConfig = {\n kernelName: NonMaxSuppressionV3,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: kernelFunc as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except
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==========\n */\n\nimport {KernelConfig, Multiply} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from './binary_kernel';\n\nconst supportsFullBroadcast = true;\nexport const multiplyConfig: KernelConfig =\n createBinaryKernelConfig(Multiply, supportsFullBroadcast);\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except
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==========\n */\nimport {KernelConfig, Neg} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\nexport const negConfig: KernelConfig = createUnaryKernelConfig(Neg);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n *

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==========\n */\n\nimport {BackendWasm} from '../backend_wasm';\n\n// Analogous to `struct Result` in `non_max_suppression_impl.h`.\ninterface Result {\n pSelectedIndices: number;\n selectedSize: number;\n pSelectedScores: number;\n pValidOutputs: number;\n}\n\n/**\n * Parse the result of the c++ method, which has the shape equivalent to\n * `Result`.\n */\nexport function parseResultStruct(\n backend: BackendWasm, resOffset: number): Result {\n const result = new Int32Array(backend.wasm.HEAPU8.buffer, resOffset, 4);\n const pSelectedIndices
= result[0];\n const selectedSize = result[1];\n const pSelectedScores = result[2];\n const pValidOutputs = result[3];\n // Since the result was allocated on the heap, we have to delete it.\n backend.wasm._free(resOffset);\n return {pSelectedIndices, selectedSize, pSelectedScores, pValidOutputs};\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {KernelConfig, KernelFunc, NonMaxSuppressionV4, NonMaxSuppressionV4Attrs, NonMaxSuppressionV4Inputs, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {parseResultStruct} from './NonMaxSuppression_util';\n\nlet wasmFunc: (\n boxesId: number, scoresId: number, maxOutputSize: number,\n iouThreshold: number, scoreThreshold: number,\n padToMaxOutputSize: boolean) => number;\n\nfunction setup(backend: BackendWasm): void {\n wasmFunc = backend.wasm.cwrap(\n NonMaxSuppressionV4,\n 'number', // Result*\n [\n 'number', // boxesId\n 'number', // scoresId\n 'number', // maxOutputSize\n 'number', // iouThreshold\n 'number', // scoreThreshold\n 'bool', // padToMaxOutputSize\n]);\n}\n\nfunction nonMaxSuppressionV4(args: {\n backend: BackendWasm,\n inputs: NonMaxSuppressionV4Inputs,\n attrs: NonMaxSuppressionV4Attrs\n}): TensorInfo[]
{\n const {backend, inputs, attrs} = args;\n const {iouThreshold, maxOutputSize, scoreThreshold, padToMaxOutputSize} =\n attrs;\n const {boxes, scores} = inputs;\n\n const boxesId = backend.dataIdMap.get(boxes.dataId).id;\n const scoresId = backend.dataIdMap.get(scores.dataId).id;\n\n const resOffset = wasmFunc(\n boxesId, scoresId, maxOutputSize, iouThreshold, scoreThreshold,\n padToMaxOutputSize);\n\n const {pSelectedIndices, selectedSize, pSelectedScores, pValidOutputs} =\n parseResultStruct(backend, resOffset);\n\n // Since we are not using scores for V4, we have to delete it from the heap.\n backend.wasm._free(pSelectedScores);\n\n const selectedIndicesTensor =\n backend.makeOutput([selectedSize], 'int32', pSelectedIndices);\n\n const validOutputsTensor = backend.makeOutput([], 'int32', pValidOutputs);\n\n return [selectedIndicesTensor, validOutputsTensor];\n}\n\nexport const nonMaxSuppressionV4Config: KernelConfig = {\n kernelName: NonMaxSuppressionV4,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: nonMaxSuppressionV4 as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the

License.\n *
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*/\n\nimport {KernelConfig, KernelFunc, NonMaxSuppressionV5, NonMaxSuppressionV5Attrs,
NonMaxSuppressionV5Inputs, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport
{BackendWasm} from '../backend_wasm';\n\nimport {parseResultStruct} from './NonMaxSuppression_util';\n\nlet
wasmFunc:\n (boxesId: number, scoresId: number, maxOutputSize: number,\n iouThreshold: number,
scoreThreshold: number, softNmsSigma: number) =>\n number;\n\nfunction setup(backend: BackendWasm):
void {\n wasmFunc = backend.wasm.cwrap(\n NonMaxSuppressionV5,\n 'number', // Result*\n [\n
'number', // boxesId\n 'number', // scoresId\n 'number', // maxOutputSize\n 'number', //
iouThreshold\n 'number', // scoreThreshold\n 'number', // softNmsSigma\n]);\n}\n\nfunction
kernelFunc(args: {\n backend: BackendWasm,\n inputs: NonMaxSuppressionV5Inputs,\n attrs:
NonMaxSuppressionV5Attrs\n}): TensorInfo[] {\n const {backend, inputs, attrs} = args;\n const {iouThreshold,
maxOutputSize, scoreThreshold, softNmsSigma} = attrs;\n const {boxes, scores} = inputs;\n\n const boxesId =
backend.dataIdMap.get(boxes.dataId).id;\n
const scoresId = backend.dataIdMap.get(scores.dataId).id;\n\n const resOffset = wasmFunc(\n boxesId,
scoresId, maxOutputSize, iouThreshold, scoreThreshold,\n softNmsSigma);\n\n const {pSelectedIndices,
selectedSize, pSelectedScores, pValidOutputs} =\n parseResultStruct(backend, resOffset);\n\n // Since we are
not using validOutputs for V5, we have to delete it from the\n // heap.\n backend.wasm._free(pValidOutputs);\n\n
const selectedIndicesTensor =\n backend.makeOutput([selectedSize], 'int32', pSelectedIndices);\n const
selectedScoresTensor =\n backend.makeOutput([selectedSize], 'float32', pSelectedScores);\n\n return
[selectedIndicesTensor, selectedScoresTensor];\n}\n\nexport const nonMaxSuppressionV5Config: KernelConfig =
{\n kernelName: NonMaxSuppressionV5,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: kernelFunc
as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n
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==========\n
*/\n\nimport {KernelConfig, KernelFunc, OneHot, OneHotAttrs, OneHotInputs} from '@tensorflow/tfjs-
core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmOneHot: (\n indicesId: number, depth:
number, onValue: number, offValue: number,\n outId: number) => void;\n\nfunction setup(backend:
BackendWasm) {\n wasmOneHot = backend.wasm.cwrap(OneHot,
null /* void */, [\n 'number', // indices_id\n 'number', // depth,\n 'number', // onValue\n 'number', //
offValue\n 'number' // out_id\n]);\n}\n\nfunction oneHot(\n args: {inputs: OneHotInputs, attrs: OneHotAttrs,
backend: BackendWasm}) {\n const {inputs, backend, attrs} = args;\n const {indices} = inputs;\n const {depth,
onValue, offValue} = attrs;\n\n const out = backend.makeOutput([...indices.shape, depth], 'int32');\n const outId =
backend.dataIdMap.get(out.dataId).id;\n\n const indicesData = backend.dataIdMap.get(indices.dataId);\n const
indicesId = indicesData.id;\n\n wasmOneHot(indicesId, depth, onValue, offValue, outId);\n\n return
out;\n}\n\nexport const oneHotConfig: KernelConfig = {\n kernelName: OneHot,\n backendName: 'wasm',\n
setupFunc: setup,\n kernelFunc: oneHot as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2020 Google
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```
==========\n
*/\nimport {KernelConfig, NotEqual} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from
'./binary_kernel';\nconst supportsFullBroadcast = false;\nexport const notEqualConfig: KernelConfig =\n
createBinaryKernelConfig(NotEqual, supportsFullBroadcast, 'bool');\n","/**\n * @license\n * Copyright 2020
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the specific language governing permissions and\n * limitations under the License.\n *
==========\n
*/\n\nimport {KernelConfig, KernelFunc, OnesLike, OnesLikeInputs} from '@tensorflow/tfjs-core';\n\nimport
{BackendWasm} from '../backend_wasm';\n\nfunction onesLike(args: {inputs: OnesLikeInputs, backend:
BackendWasm}) {\n  const {inputs: {x}, backend} = args;\n  const out = backend.makeOutput(x.shape, x.dtype);\n
const outVals = backend.typedArrayFromHeap(out);\n  outVals.fill(1);\n  return out;\n}\n\nexport
 const onesLikeConfig: KernelConfig = {\n  kernelName: OnesLike,\n  backendName: 'wasm',\n  kernelFunc:
onesLike as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n *
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http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing,
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OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language
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==========\n
*/\n\nimport {KernelConfig, KernelFunc, Pack, PackAttrs, PackInputs, TensorInfo, util} from '@tensorflow/tfjs-
core';\nimport {BackendWasm}
 from '../backend_wasm';\n\nimport {concat} from './Concat';\nimport {expandDims} from
'./ExpandDims';\n\nexport function pack(\n    args: {inputs: PackInputs, backend: BackendWasm, attrs:
PackAttrs}):\n    TensorInfo {\n  const {inputs, backend, attrs} = args;\n  const {axis} = attrs;\n\n  if (inputs.length
=== 1) {\n    return expandDims(\n        {inputs: {input: inputs[0]}, backend, attrs: {dim: axis}});\n  }\n\n  const
shape = inputs[0].shape;\n  const dtype = inputs[0].dtype;\n\n  inputs.forEach(t => {\n    util.assertShapesMatch(\n
   shape, t.shape,\n        'All tensors passed to stack must have matching shapes');\n    util.assert(\n        dtype ===
t.dtype,\n        () => 'All tensors passed to stack must have matching dtypes');\n  });\n\n  const
intermediateTensorInfos: TensorInfo[] = [];\n  const expandedTensors = inputs.map(t => {\n    const expandedT =\n
     expandDims({inputs: {input: t}, backend, attrs: {dim: axis}});\n    intermediateTensorInfos.push(expandedT);\n
    return expandedT;\n  });\n\n  const result = concat({inputs: expandedTensors, backend, attrs: {axis}});\n\n
intermediateTensorInfos.forEach(t => backend.disposeData(t.dataId));\n\n  return result;\n}\n\nexport const
packConfig: KernelConfig = {\n  kernelName: Pack,\n  backendName: 'wasm',\n  kernelFunc: pack as {} as
KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the
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License.\n *
==========\n
 */\n\nimport {KernelConfig, KernelFunc, PadV2, PadV2Attrs, PadV2Inputs, util} from '@tensorflow/tfjs-
core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {fill} from './Fill';\n\nimport {CppDType}
```

from './types';\n\nlet wasmPadV2: (\n   xId: number, xShapeBytes: Uint8Array, xShapeLength: number, xDtype: number,\n   prePaddingsBytes: Uint8Array, postPaddingsBytes: Uint8Array,\n   constantValue: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmPadV2 = backend.wasm.cwrap(PadV2, null /* void */, [\n   'number', // xId\n   'array',   // x.shape\n   'number', // x.shape.length\n   'number', // x.dtype\n   'array',   // pre-paddings\n   'array',   // post-paddings\n   'number', // constantValue\n   'number', // outId\n]);\n}\n\nfunction pad(\n   args: {inputs: PadV2Inputs, backend: BackendWasm, attrs: PadV2Attrs}) {\n const {inputs: {x}, backend, attrs:
 {paddings, constantValue}} = args;\n\n const outShape = paddings.map(\n   (p, i) => p[0] /* beforePad */ + x.shape[i] + p[1] /* afterPad */);\n\n if (util.sizeFromShape(x.shape) === 0) {\n   // Short-circuit the computation, since x doesn't have value, only\n   // the shape is used to compute output shape to pad.\n   return fill({\n backend,\n   attrs: {shape: outShape, value: constantValue, dtype: x.dtype}\n   });\n }\n\n const xId = backend.dataIdMap.get(x.dataId).id;\n const out = backend.makeOutput(outShape, x.dtype);\n const outTensorData = backend.dataIdMap.get(out.dataId);\n const outId = outTensorData.id;\n\n const xShapeBytes = new Uint8Array(new Int32Array(x.shape).buffer);\n\n const prePaddingsFlat = paddings.map(padTuple => padTuple[0]);\n const postPaddingsFlat = paddings.map(padTuple => padTuple[1]);\n const prePaddingsBytes =\n   new Uint8Array(new Int32Array(prePaddingsFlat).buffer);\n const postPaddingsBytes =\n   new Uint8Array(new Int32Array(postPaddingsFlat).buffer);\n\n
  wasmPadV2(\n   xId, xShapeBytes, x.shape.length, CppDType[x.dtype], prePaddingsBytes,\n postPaddingsBytes, constantValue, outId);\n return out;\n}\n\nexport const padV2Config: KernelConfig = {\n kernelName: PadV2,\n backendName: 'wasm',\n kernelFunc: pad as {} as KernelFunc,\n setupFunc: setup\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n
 /\n\nimport {KernelConfig, KernelFunc, Prelu, PreluInputs} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {cast} from './Cast';\n\nlet wasmPrelu: (xId: number, weightsId: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmPrelu = backend.wasm.cwrap(Prelu, null / void */, [\n   'number', // x_id\n   'number', // weights_id\n   'number'   // out_id\n]);\n}\n\nfunction prelu(args: {inputs: PreluInputs, backend: BackendWasm}) {\n const {inputs, backend} = args;\n const {x, alpha} = inputs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n const weightsId = backend.dataIdMap.get(alpha.dataId).id;\n\n let inputId = xId;\n const input = x;\n let castedInput = input;\n if (input.dtype !== 'float32') {\n   castedInput = cast({backend, inputs: {x}, attrs: {dtype: 'float32'}});\n   inputId = backend.dataIdMap.get(castedInput.dataId).id;\n
  }\n\n const out = backend.makeOutput(x.shape, 'float32');\n const outId = backend.dataIdMap.get(out.dataId).id;\n wasmPrelu(inputId, weightsId, outId);\n\n if (input.dtype !== 'float32') {\n
  backend.disposeData(castedInput.dataId);\n }\n return out;\n}\n\nexport const preluConfig: KernelConfig = {\n kernelName: Prelu,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: prelu as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language

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==========\n
*/\nimport {KernelConfig, Pow} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from
'./binary_kernel';\nconst supportsFullBroadcast = false;\nexport const powConfig: KernelConfig =\n
createBinaryKernelConfig(Pow, supportsFullBroadcast);\n","/**\n * @license\n * Copyright 2020 Google LLC. All
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==========\n
*/\n\nimport {backend_util, KernelConfig, KernelFunc, Prod, ProdAttrs, ProdInputs, TensorInfo, util} from
'@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport
{permuteAxesAndTranspose} from './kernel_utils';\n\nimport {CppDType} from './types';\n\nlet wasmProd: (\n
xId: number, reduceSize: number,\n dtype: number, outId: number) => void;\n\nfunction setup(backend:
BackendWasm): void {\n wasmProd = backend.wasm.cwrap(Prod, null /*void*/, [\n 'number',\n 'number',\n
'number',\n 'number'\n]);\n}\n\nfunction prod(args: {\n backend: BackendWasm,\n inputs: ProdInputs,\n attrs:
ProdAttrs\n}): TensorInfo {\n const {backend, inputs, attrs} = args;\n const {axis, keepDims} = attrs;\n const {x}
= inputs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n let inputId = xId;\n let input = x;\n\n const
{transposed,
axes, originalAxes, inputWasTransposed} =\n permuteAxesAndTranspose(x, axis, backend);\n\n let
reductionAxes = axes;\n if (inputWasTransposed) {\n const transposedId =
backend.dataIdMap.get(transposed.dataId).id;\n if (transposedId !== xId) {\n // transpose was not a no-op. We
will need to dispose of this\n // once we are done.\n input = transposed;\n inputId = transposedId;\n
reductionAxes = backend_util.getInnerMostAxes(\n reductionAxes.length, input.shape.length);\n }\n }\n\n
backend_util.assertAxesAreInnerMostDims(\n 'prod', reductionAxes, input.shape.length);\n const [outShape,
reduceShape] =\n backend_util.computeOutAndReduceShapes(input.shape, reductionAxes);\n const reduceSize
= util.sizeFromShape(reduceShape);\n\n const out = backend.makeOutput(outShape, input.dtype);\n if
(util.sizeFromShape(input.shape) !== 0) {\n const outId = backend.dataIdMap.get(out.dataId).id;\n
wasmProd(inputId, reduceSize,
CppDType[out.dtype], outId);\n }\n\n if (inputWasTransposed) {\n // dispose of the transposed tensor.\n
backend.disposeData(transposed.dataId);\n }\n\n if (keepDims) {\n // reshape\n const newShape =
backend_util.expandShapeToKeepDim(out.shape, originalAxes);\n out.shape = newShape;\n }\n\n return
out;\n}\n\nexport const prodConfig: KernelConfig = {\n kernelName: Prod,\n backendName: 'wasm',\n setupFunc:
setup,\n kernelFunc: prod as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All
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License.\n *
==========\n
*/\n\nimport {KernelConfig, KernelFunc, ResizeBilinear, ResizeBilinearAttrs, ResizeBilinearInputs, TensorInfo,
util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {cast} from
'./Cast';\n\nlet wasmResizeBilinear: (\n xId: number, batch: number, oldHeight: number, oldWidth: number,\n

numChannels: number, newHeight: number, newWidth: number,\n alignCorners: number, halfPixelCenters: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n wasmResizeBilinear = backend.wasm.cwrap(ResizeBilinear, null /*void*/, [\n 'number', // xId\n 'number', // batch\n 'number', // oldHeight\n 'number', // oldWidth\n 'number', // numChannels\n 'number', // newHeight\n 'number', // newWidth\n 'number',
// alignCorners\n 'number', // halfPixelCenters\n 'number' // outId\n]);\n}\n\nfunction resizeBilinear(args: {\n backend: BackendWasm,\n inputs: ResizeBilinearInputs,\n attrs: ResizeBilinearAttrs\n}): TensorInfo {\n const {backend, inputs, attrs} = args;\n\n const {images} = inputs;\n const {alignCorners, halfPixelCenters, size} = attrs;\n const [newHeight, newWidth] = size;\n\n const [batch, oldHeight, oldWidth, numChannels] = images.shape;\n const outShape = [batch, newHeight, newWidth, numChannels];\n\n let xData = backend.dataIdMap.get(images.dataId);\n let castedData;\n if (xData.dtype !== 'float32') {\n castedData =\n cast({backend, inputs: {x: images}, attrs: {dtype: 'float32'}});\n xData = backend.dataIdMap.get(castedData.dataId);\n }\n const xId = xData.id;\n\n const out = backend.makeOutput(outShape, 'float32');\n if (util.sizeFromShape(images.shape) === 0) {\n return out;\n }\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n
wasmResizeBilinear(\n xId, batch, oldHeight, oldWidth, numChannels, newHeight, newWidth,\n alignCorners ? 1 : 0, halfPixelCenters ? 1 : 0, outId);\n\n if (castedData != null) {\n backend.disposeData(castedData.dataId);\n }\n\n return out;\n}\n\nexport const resizeBilinearConfig: KernelConfig = {\n kernelName: ResizeBilinear,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: resizeBilinear as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License
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==\n
*/\n\nimport {KernelConfig, KernelFunc, Range, RangeAttrs, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\nimport {rangeImplCPU} from '../kernel_utils/shared';\n\nexport const range =\n (args: {backend: BackendWasm, attrs: RangeAttrs}): TensorInfo => {\n const {backend, attrs} = args;\n const {start, stop, step, dtype} = attrs;\n const values = rangeImplCPU(start, stop, step, dtype);\n\n const out = backend.makeOutput([values.length], dtype);\n const outVals = backend.typedArrayFromHeap(out);\n outVals.set(values);\n return out;\n };\n\nexport const rangeConfig: KernelConfig = {\n kernelName: Range,\n backendName: 'wasm',\n kernelFunc: range as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights
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==\n
*/\nimport { util } from '@tensorflow/tfjs-core';\nexport function rangeImpl(start, stop, step, dtype) {\n const sameStartStop = start === stop;\n const increasingRangeNegativeStep = start < stop && step < 0;\n const decreasingRangePositiveStep = stop < start && step > 1;\n if (sameStartStop || increasingRangeNegativeStep ||\n decreasingRangePositiveStep) {\n return util.makeZerosTypedArray(0, dtype);\n }\n const numElements = Math.abs(Math.ceil((stop - start) / step));\n const values = util.makeZerosTypedArray(numElements, dtype);\n if (stop < start && step === 1) {\n // Auto adjust the

step's sign if it hasn't been set\n // (or was set to 1)\n step = -1;\n }\n values[0] = start;\n for (let i = 1; i < values.length; i++) {\n values[i] = values[i - 1] + step;\n }\n return values;\n}\n//# sourceMappingURL=data:application/json; base64,eyJ2ZXJzaW9uIjozLCJmaWxlIjoiUmFuZ2VfaW1wbC5qcyIsInNvdXJjZVJvb3QiOiIiLCJzb3VyY2VzIjpbIi4uLy4uLy4uLy4uLy4uLy4uL3RmanMtYmFja2VuZC1jcHUvc3JjL2tlcm5lbHMvUmFuZ2VfaW1wbC50cyJdLCJuYW1lcyI6W10sIm1hcHBpbmdzIjoiQUFBQTs7Ozs7Ozs7Ozs7O0dBZUc7QUFFSCxPQUFPLEVBQWMsTUFBTSxFQUFFLFVBQVUsRUFBRSxNQUFNLHVCQUF1QixDQUFDO0FBQ3ZFLE9BQU8sRUFBRSxnQkFBZ0IsRUFBRSxNQUFNLDRCQUE0QixDQUFDO0FBQzlEL

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==========\n
*/\n\nimport
 {KernelConfig, RealDiv} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from
'./binary_kernel';\n\nconst supportsFullBroadcast = true;\nexport const realDivConfig: KernelConfig =\n
createBinaryKernelConfig(RealDiv, supportsFullBroadcast);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n
*/\nimport
 {KernelConfig, Relu} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from
'./unary_kernel';\nexport const reluConfig: KernelConfig = createUnaryKernelConfig(Relu);\n","/**\n * @license\n
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==========\n
*/\nimport {KernelConfig, Relu6} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig}
 from './unary_kernel';\nexport const relu6Config: KernelConfig = createUnaryKernelConfig(Relu6);\n","/**\n *
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law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n *
WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the
specific language governing permissions and\n * limitations under the License.\n *
==========\n
*/\n\nimport {KernelConfig, KernelFunc, Reverse, ReverseAttrs, ReverseInputs, TensorInfo, util} from
'@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport
 {identity} from './Identity';\nimport {reshape} from './Reshape';\n\nlet wasmReverse: (\n   xId: number, axes:
Uint8Array, axesLength: number, outShape: Uint8Array,\n   outShapeLength: number, outId: number) =>
void;\n\nfunction setup(backend: BackendWasm) {\n wasmReverse = backend.wasm.cwrap(Reverse, null, [\n
'number', // x_id\n   'array',   // axes\n   'number', // axes_length\n   'array',   // out_shape\n   'number', //
out_shape_length\n   'number'   // out_id\n]);\n}\n\nexport function reverse(\n   args: {inputs: ReverseInputs,
backend: BackendWasm, attrs: ReverseAttrs}):\n   TensorInfo {\n const {inputs, backend, attrs} = args;\n const
{x} = inputs;\n const {dims} = attrs;\n\n const axes = util.parseAxisParam(dims, x.shape);\n\n if (x.shape.length
=== 0) {\n   return identity({inputs: {x}, backend});\n }\n\n const out = backend.makeOutput(x.shape, x.dtype);\n

const xId = backend.dataIdMap.get(x.dataId).id;\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n const axesBytes = new Uint8Array(new Int32Array(axes).buffer);\n const outShapeBytes = new Uint8Array(new Int32Array(x.shape).buffer);\n\n wasmReverse(\n   xId, axesBytes, axes.length, outShapeBytes, x.shape.length, outId);\n\n const reshaped =\n   reshape({inputs: {x: out}, attrs: {shape: x.shape}, backend});\n\n backend.disposeData(out.dataId);\n return reshaped;\n}\n\nexport const reverseConfig: KernelConfig = {\n kernelName: Reverse,\n backendName: 'wasm',\n kernelFunc: reverse as {} as KernelFunc,\n setupFunc: setup\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {KernelConfig, KernelFunc, RotateWithOffset, RotateWithOffsetAttrs, RotateWithOffsetInputs, TensorInfo} from '@tensorflow/tfjs-core';\nimport {backend_util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmRotate: (\n   xId: number, batch: number, imageHeight: number, imageWidth: number,\n   numChannels: number, radians: number, centerX: number, centerY: number,\n fillBytes: Uint8Array, fillLength: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmRotate = backend.wasm.cwrap(RotateWithOffset, null /* void */, [\n   'number', // xId\n   'number', // batch\n   'number', // imageHeight\n   'number', // imageWidth\n   'number', // numChannels\n   'number', // radians\n   'number', // centerX\n   'number', // centerY\n   'array',   // fillBytes\n   'number', // fillLength\n   'number', // outId\n]);\n}\n\nexport function rotateWithOffset(args: {\n inputs: RotateWithOffsetInputs,\n backend: BackendWasm,\n attrs: RotateWithOffsetAttrs\n}): TensorInfo {\n const {inputs, backend, attrs} = args;\n const {image} = inputs;\n const {radians, fillValue, center} = attrs;\n\n const out = backend.makeOutput(image.shape, image.dtype);\n const imageId = backend.dataIdMap.get(image.dataId).id;\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n const [batch, imageHeight, imageWidth, numChannels] = image.shape;\n\n const [centerX, centerY] =\n backend_util.getImageCenter(center, imageHeight, imageWidth);\n\n const fillIsBlack = fillValue === 0;\n const fullOpacityValue = 255;\n\n const fillValues = typeof fillValue === 'number' ?\n   [fillValue, fillValue, fillValue, fillIsBlack ? 0 : fullOpacityValue] :\n   [...fillValue, fullOpacityValue];\n const fillBytes = new Uint8Array(new Int32Array(fillValues).buffer);\n\n wasmRotate(\n   imageId, batch, imageHeight, imageWidth, numChannels, radians, centerX,\n   centerY, fillBytes, fillValues.length, outId);\n return out;\n}\n\nexport const rotateWithOffsetConfig: KernelConfig = {\n kernelName: RotateWithOffset,\n backendName: 'wasm',\n kernelFunc: rotateWithOffset as {} as KernelFunc,\n setupFunc: setup\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS
 OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {KernelConfig, KernelFunc, scatter_util, ScatterNd, ScatterNdAttrs, ScatterNdInputs, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {CppDType} from './types';\n\nlet wasmScatterNd: (\n   indicesId: number, updatesId: number, dtype: CppDType, sliceRank: number,\n   numUpdates: number, sliceSize: number, strides: Uint8Array,\n   outputSize: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n wasmScatterNd = backend.wasm.cwrap(ScatterNd,

null /*void*/, [\n 'number', // indicesId\n 'number', // updatesId\n 'number', // dtype\n 'number', // sliceRank\n 'number', // numUpdates\n 'number', // sliceSize\n 'array', // strides\n 'number', // outputSize\n 'number' // outId\n]);\n}\n\nfunction scatterNd(\n args:\n {backend: BackendWasm, inputs: ScatterNdInputs, attrs: ScatterNdAttrs}):\n TensorInfo {\n const {backend, inputs, attrs} = args;\n const {indices, updates} = inputs;\n const {shape} = attrs;\n\n const out = backend.makeOutput(shape, updates.dtype);\n if (util.sizeFromShape(shape) === 0) {\n return out;\n }\n\n const {sliceRank, numUpdates, sliceSize, strides, outputSize} =\n scatter_util.calculateShapes(updates, indices, shape);\n\n const indicesData = backend.dataIdMap.get(indices.dataId);\n const indicesId = indicesData.id;\n\n const updatesData = backend.dataIdMap.get(updates.dataId);\n const updatesId = updatesData.id;\n\n const stridesBytes = new Uint8Array(new Int32Array(strides).buffer);\n\n const outId = backend.dataIdMap.get(out.dataId).id;\n wasmScatterNd(\n indicesId, updatesId, CppDType[updates.dtype], sliceRank, numUpdates,\n sliceSize, stridesBytes, outputSize, outId);\n\n return out;\n}\n\nexport const scatterNdConfig: KernelConfig = {\n kernelName: ScatterNd,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: scatterNd as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2021 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\nimport {KernelConfig, Round} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\n\nexport const roundConfig: KernelConfig = createUnaryKernelConfig(Round);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\nimport {KernelConfig, Rsqrt} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\nexport\n const rsqrtConfig: KernelConfig = createUnaryKernelConfig(Rsqrt);\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {KernelConfig, KernelFunc, Select, SelectInputs, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmSelect: (\n conditionId: number, tId: number, eId: number, offset: number,\n outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmSelect = backend.wasm.cwrap('SelectV2', null, [\n 'number', // conditionId\n 'number', // tId\n 'number', // eId\n 'number', // offset\n 'number', // outId\n]);\n}\n\nfunction select(args: {inputs: SelectInputs, backend: BackendWasm}) {\n const {inputs, backend} = args;\n const {condition, t, e} = inputs;\n\n const conditionId = backend.dataIdMap.get(condition.dataId).id;\n const tId = backend.dataIdMap.get(t.dataId).id;\n const eId =

backend.dataIdMap.get(e.dataId).id;\n const out = backend.makeOutput(t.shape, t.dtype);\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n const cRank = condition.shape.length;\n const tRank = t.shape.length;\n\n const offset = cRank === 0 || cRank > 1 || tRank === 1 ?\n   1 :\n util.sizeFromShape(t.shape.slice(1));\n\n wasmSelect(conditionId, tId, eId, offset, outId);\n return out;\n}\n\nexport const selectConfig:
KernelConfig = {\n kernelName: Select,\n backendName: 'wasm',\n kernelFunc: select as {} as KernelFunc,\n setupFunc: setup\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {KernelConfig, KernelFunc, Sigmoid, SigmoidInputs, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from
'../backend_wasm';\n\nlet wasmFunc: (xId: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n wasmFunc = backend.wasm.cwrap(Sigmoid, null /* void */, ['number', 'number']);\n}\n\nfunction sigmoid(args: {backend: BackendWasm, inputs: SigmoidInputs}):\n   TensorInfo {\n const {backend, inputs: {x}} = args;\n const xId = backend.dataIdMap.get(x.dataId).id;\n const out = backend.makeOutput(x.shape, x.dtype);\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n // Short-circuit zero-sized tensors.\n if (util.sizeFromShape(out.shape) === 0) {\n   return out;\n }\n\n wasmFunc(xId, outId);\n return out;\n}\n\nexport const sigmoidConfig: KernelConfig = {\n kernelName: 'Sigmoid',\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: sigmoid as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except
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==========\n */\n\nimport {KernelConfig, KernelFunc, Softmax, SoftmaxAttrs, SoftmaxInputs, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmFunc: (xId: number, outId: number, channels: number, batch: number) =>\n   void;\n\nfunction setup(backend: BackendWasm): void {\n wasmFunc = backend.wasm.cwrap(Softmax, null /* void */, [\n   'number', // xId\n   'number', // outId\n 'number', // channels\n
    'number'   // batch\n]);\n}\n\nfunction softmax(\n   args: {backend: BackendWasm, inputs: SoftmaxInputs, attrs: SoftmaxAttrs}):\n   TensorInfo {\n const {backend, inputs: {logits}, attrs: {dim}} = args;\n const xId = backend.dataIdMap.get(logits.dataId).id;\n const out = backend.makeOutput(logits.shape, logits.dtype);\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n const channels = logits.shape[dim];\n const batch = util.sizeFromShape(logits.shape) / channels;\n\n // Short-circuit zero-sized tensors.\n if (util.sizeFromShape(out.shape) === 0) {\n   return out;\n }\n\n wasmFunc(xId, outId, channels, batch);\n return out;\n}\n\nexport const softmaxConfig: KernelConfig = {\n kernelName: Softmax,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: softmax as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except

in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\nimport {KernelConfig, Sin} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\nexport const sinConfig: KernelConfig = createUnaryKernelConfig(Sin);\n","/**\n * @license\n * Copyright 2021 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {backend_util, KernelConfig, KernelFunc, ReshapeAttrs, ReshapeInputs, SpaceToBatchND, SpaceToBatchNDAttrs, SpaceToBatchNDInputs, TensorInfo, TransposeAttrs, TransposeInputs, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {padV2Config} from './PadV2';\nimport {reshape} from './Reshape';\nimport {transpose} from './Transpose';\n\nfunction spaceToBatchND(args: {\n inputs: SpaceToBatchNDInputs,\n backend: BackendWasm,\n attrs: SpaceToBatchNDAttrs\n}) {\n const {inputs, backend, attrs} = args;\n const {x} = inputs;\n const {blockShape, paddings} = attrs;\n\n const prod = util.sizeFromShape(blockShape);\n\n const completePaddings: Array<[number, number]> = [[0, 0]];\n completePaddings.push(...(paddings as Array<[number, number]>));\n\n for (let i = 1 + blockShape.length; i < x.shape.length; ++i) {\n   completePaddings.push([0, 0]);\n }\n\n const paddedX = padV2Config.kernelFunc({\n   inputs: {x},\n   backend,\n   attrs: {paddings: completePaddings, constantValue: 0}\n }) as TensorInfo;\n\n const reshapedPaddedShape =\n   backend_util.getReshaped(paddedX.shape, blockShape, prod, false);\n\n const permutedReshapedPaddedPermutation = backend_util.getPermuted(\n   reshapedPaddedShape.length, blockShape.length, false);\n\n const flattenShape =\n   backend_util.getReshapedPermuted(paddedX.shape, blockShape, prod, false);\n\n const reshapeInputs: ReshapeInputs = {x: paddedX};\n const reshapeAttrs: ReshapeAttrs = {shape: reshapedPaddedShape};\n const paddedXReshaped =\n   reshape({inputs: reshapeInputs, backend, attrs: reshapeAttrs});\n\n const transposeInputs: TransposeInputs = {x: paddedXReshaped};\n const transposeAttrs:\n   TransposeAttrs = {perm: permutedReshapedPaddedPermutation};\n const paddedXT =\n   transpose({inputs: transposeInputs, backend, attrs: transposeAttrs});\n\n const resultReshapeInputs: ReshapeInputs = {x: paddedXT};\n const resultReshapeAttrs: ReshapeAttrs = {shape: flattenShape};\n const result = reshape(\n   {inputs: resultReshapeInputs, backend, attrs: resultReshapeAttrs});\n\n backend.disposeData(paddedX.dataId);\n backend.disposeData(paddedXReshaped.dataId);\n backend.disposeData(paddedXT.dataId);\n\n return result;\n}\n\nexport const spaceToBatchNDConfig: KernelConfig = {\n kernelName: SpaceToBatchND,\n backendName: 'wasm',\n kernelFunc: spaceToBatchND as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *

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==========\n*/\n\nimport {KernelConfig, KernelFunc, SplitV, SplitVAttrs, SplitVInputs, util} from '@tensorflow/tfjs-core';\nimport {backend_util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {slice} from './Slice';\n\nexport function splitV(\n    args: {inputs: SplitVInputs, attrs: SplitVAttrs, backend: BackendWasm}) {\n  const {inputs,
 attrs, backend} = args;\n  const {x} = inputs;\n  const {numOrSizeSplits, axis} = attrs;\n\n  const $axis = util.parseAxisParam(axis, x.shape)[0];\n\n  const splitSizes = backend_util.prepareSplitSize(x, numOrSizeSplits, $axis);\n  const begin = new Array(x.shape.length).fill(0);\n  const size = x.shape.slice();\n  return splitSizes.map(s => {\n    const xSliceSize = [...size];\n    xSliceSize[$axis] = s;\n    const xSlice =\n        slice({inputs: {x}, attrs: {begin, size: xSliceSize}, backend});\n    begin[$axis] += s;\n    return xSlice;\n  });\n}\n\nexport const splitVConfig: KernelConfig = {\n  kernelName: SplitV,\n  backendName: 'wasm',\n  kernelFunc: splitV as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n*/\n\nimport {KernelConfig, KernelFunc, Step, StepAttrs, StepInputs, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {CppDType} from './types';\n\nlet wasmStep: (xId: number, alpha: number, dtype: number, outId: number) =>\n    void;\n\nfunction setup(backend: BackendWasm): void {\n  wasmStep = backend.wasm.cwrap(Step, null /*void*/, [\n    'number',  // x_id\n    'number',  // alpha\n    'number',  // dtype\n    'number',  // out_id\n  ]);\n}\n\nfunction step(\n    args: {backend: BackendWasm, inputs: StepInputs, attrs:
 StepAttrs}):\n    TensorInfo {\n  const {backend, inputs, attrs} = args;\n  const {alpha} = attrs;\n  const {x} = inputs;\n  const xId = backend.dataIdMap.get(x.dataId).id;\n\n  const out = backend.makeOutput(x.shape, x.dtype);\n  const outId = backend.dataIdMap.get(out.dataId).id;\n  wasmStep(xId, alpha, CppDType[x.dtype], outId);\n  return out;\n}\n\nexport const stepConfig: KernelConfig = {\n  kernelName: Step,\n  backendName: 'wasm',\n  setupFunc: setup,\n  kernelFunc: step as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS
 OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n*/\n\nimport {KernelConfig, Sqrt} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\nexport const sqrtConfig: KernelConfig = createUnaryKernelConfig(Sqrt);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language
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*/\nimport {KernelConfig, Square} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\nexport const squareConfig: KernelConfig = createUnaryKernelConfig(Square);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n * ==\n */\nimport {KernelConfig, SquaredDifference} from '@tensorflow/tfjs-core';\nimport {createBinaryKernelConfig} from './binary_kernel';\nconst supportsFullBroadcast = true;\nexport const squaredDifferenceConfig: KernelConfig =\n createBinaryKernelConfig(SquaredDifference, supportsFullBroadcast);\n","/**\n * @license\n * Copyright 2021 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==\n */\n\nimport {KernelConfig, KernelFunc, slice_util, StridedSlice, StridedSliceAttrs, StridedSliceInputs, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\nimport {reshape} from './Reshape';\nimport {slice} from './Slice';\n\nlet wasmStridedSlice: (\n xId: number, xStridesBytes: Uint8Array, xRank: number,\n beginBytes: Uint8Array, endBytes: Uint8Array, stridesBytes: Uint8Array,\n outShapeBytes: Uint8Array, outStridesBytes: Uint8Array,\n outShapeLength: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n wasmStridedSlice = backend.wasm.cwrap(StridedSlice, null /*void*/, [\n 'number', // xId\n 'array', // xStrides\n 'number', // xRank\n 'array', // beginBytes\n 'array', // endBytes\n 'array', // stridesBytes\n 'array', // outShapeBytes\n 'array', // outStridesBytes\n 'number',\n // outShapeLength\n 'number', // outId\n]);\n}\n\nexport function stridedSlice(args: {\n backend: BackendWasm,\n inputs: StridedSliceInputs,\n attrs: StridedSliceAttrs\n}): TensorInfo {\n const {backend, inputs, attrs} = args;\n const {x} = inputs;\n\n const {\n begin,\n end,\n strides,\n beginMask,\n endMask,\n ellipsisMask,\n newAxisMask,\n shrinkAxisMask\n } = attrs;\n\n const {\n finalShapeSparse,\n finalShape,\n isIdentity,\n sliceDim0,\n isSimpleSlice,\n begin: $begin,\n end: $end,\n strides: $strides\n } =\n slice_util.sliceInfo(\n x.shape, begin, end, strides, beginMask, endMask, ellipsisMask,\n newAxisMask, shrinkAxisMask);\n\n let result;\n\n if (isIdentity) {\n // Optimization #1, slice is a no-op plus reshape\n result = reshape({inputs: {x}, backend, attrs: {shape: finalShape}});\n } else if (sliceDim0 || isSimpleSlice) {\n // Optimization #2, slice is memory contiguous (only occurs in dim 0)\n util.assert(\n x.shape.length >= 1,\n () => `Input must have rank at least 1, got: ${x.shape.length}`);\n\n const size = slice_util.computeOutShape($begin, $end, $strides);\n // To tolerate begin[0] > end[0] (a 0-output slice), we min(begin, end).\n const sliced = slice({inputs: {x}, backend, attrs: {begin: $begin, size}});\n result =\n reshape({inputs: {x: sliced}, backend, attrs: {shape: finalShape}});\n backend.disposeData(sliced.dataId);\n } else {\n const out = backend.makeOutput(finalShapeSparse, 'float32');\n\n const xId = backend.dataIdMap.get(x.dataId).id;\n const xStridesBytes =\n new Uint8Array(new Int32Array(util.computeStrides(x.shape)).buffer);\n const beginBytes = new Uint8Array(new Int32Array($begin).buffer);\n const endBytes = new Uint8Array(new Int32Array($end).buffer);\n const stridesBytes = new Uint8Array(new Int32Array($strides).buffer);\n\n const outputShapeBytes =\n new Uint8Array(new Int32Array(finalShapeSparse).buffer);\n const outStridesBytes = new Uint8Array(\n new Int32Array(util.computeStrides(finalShapeSparse)).buffer);\n const outId =\n backend.dataIdMap.get(out.dataId).id;\n\n wasmStridedSlice(\n xId, xStridesBytes, x.shape.length,

beginBytes, endBytes, stridesBytes,\n outputShapeBytes, outStridesBytes, finalShapeSparse.length, outId);\n\n result = reshape({inputs: {x: out}, backend, attrs: {shape: finalShape}});\n\n backend.disposeData(out.dataId);\n }\n\n return result;\n}\n\nexport const stridedSliceConfig: KernelConfig = {\n kernelName: StridedSlice,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: stridedSlice as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License

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'number', // dtype\n 'number', // out_id\n]);\n}\n\nfunction sum(args: {backend: BackendWasm, inputs: SumInputs, attrs: SumAttrs}):\n TensorInfo {\n const {backend, inputs, attrs} = args;\n const {axis, keepDims} = attrs;\n const {x} = inputs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n let inputId = xId;\n let input = x;\n\n const {transposed, axes, originalAxes, inputWasTransposed} =\n permuteAxesAndTranspose(x, axis, backend);\n\n let reductionAxes = axes;\n if (inputWasTransposed) {\n const transposedId = backend.dataIdMap.get(transposed.dataId).id;\n if (transposedId !== xId) {\n // transpose was not a no-op. We will need to dispose of this\n // once we are done.\n input = transposed;\n inputId = transposedId;\n reductionAxes = backend_util.getInnerMostAxes(\n reductionAxes.length, input.shape.length);\n }\n }\n\n backend_util.assertAxesAreInnerMostDims(\n 'sum', reductionAxes, input.shape.length);\n

const [outShape, reduceShape] =\n backend_util.computeOutAndReduceShapes(input.shape, reductionAxes);\n const reduceSize = util.sizeFromShape(reduceShape);\n\n const out = backend.makeOutput(outShape, input.dtype);\n if (util.sizeFromShape(input.shape) !== 0) {\n const outId = backend.dataIdMap.get(out.dataId).id;\n wasmSum(inputId, reduceSize, CppDType[out.dtype], outId);\n }\n\n if (inputWasTransposed) {\n // dispose of the transposed tensor.\n backend.disposeData(transposed.dataId);\n }\n\n if (keepDims) {\n // reshape\n const newShape = backend_util.expandShapeToKeepDim(out.shape, originalAxes);\n out.shape = newShape;\n }\n\n return out;\n}\n\nexport const sumConfig: KernelConfig = {\n kernelName: Sum,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: sum as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not

use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\nimport {KernelConfig, Sub} from '@tensorflow/tfjs-core';\nimport {createBinaryKernelConfig} from './binary_kernel';\nconst supportsFullBroadcast = true;\nexport const subConfig: KernelConfig =\n createBinaryKernelConfig(Sub, supportsFullBroadcast);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except

in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {KernelConfig, KernelFunc, Tile, TileAttrs, TileInputs} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {CppDType} from './types';\n\nlet wasmTile: (\n xId: number, xShape: Uint8Array, xShapeSize: number, newShape: Uint8Array,\n newShapeSize: number, dtype: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmTile = backend.wasm.cwrap(Tile, null /* void */, [\n 'number',
// x_id\n 'array', // x_shape\n 'number', // x_shape.length\n 'array', // new_shape\n 'number', // new_shape.length\n 'number' // out_id\n]);\n}\n\nfunction tile(\n args: {inputs: TileInputs, backend: BackendWasm, attrs: TileAttrs}) {\n const {inputs, backend, attrs} = args;\n const {x} = inputs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n const {reps} = attrs;\n\n const newShape: number[] = new Array(x.shape.length);\n for (let i = 0; i < newShape.length; i++) {\n newShape[i] = x.shape[i] * reps[i];\n }\n const xShapeBytes = new Uint8Array(new Int32Array(x.shape).buffer);\n const newShapeBytes = new Uint8Array(new Int32Array(newShape).buffer);\n\n const out = backend.makeOutput(newShape, x.dtype);\n const outId = backend.dataIdMap.get(out.dataId).id;\n wasmTile(\n xId, xShapeBytes, x.shape.length, newShapeBytes, newShape.length,\n CppDType[out.dtype], outId);\n return out;\n}\n\nexport const tileConfig: KernelConfig
= {\n kernelName: Tile,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: tile as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2021 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\nimport {KernelConfig, Tan} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\nexport const tanConfig: KernelConfig =
createUnaryKernelConfig(Tan);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\nimport {KernelConfig, Tanh} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\nexport const tanhConfig: KernelConfig = createUnaryKernelConfig(Tanh);\n","/**\n * @license\n * Copyright 2020 Google LLC. All
Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language

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*/\n\nimport {KernelConfig, KernelFunc, TensorInfo, TopK, TopKAttrs, TopKInputs} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\nimport {CppDType} from './types';\n\nlet wasmTopK: (\n xId: number, xShapeBytes: Uint8Array, xShapeLength: number,\n xDtype: CppDType, k: number, sorted: boolean, outValuesId:
number,\n outIndicesId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmTopK = backend.wasm.cwrap(TopK, null /* void */, [\n 'number', // xId\n 'array', // x.shape\n 'number', // x.shape.length\n 'number', // x.dtype\n 'number', // k\n 'bool', // sorted\n 'number', // outValuesId\n 'number', // outIndicesId\n]);\n}\n\nexport const topk:\n (args: {inputs: TopKInputs, backend: BackendWasm, attrs: TopKAttrs}) =>\n TensorInfo[] | TensorInfo = ({inputs, backend, attrs}) => {\n const {x} = inputs;\n const {k, sorted} = attrs;\n\n const xId = backend.dataIdMap.get(x.dataId).id;\n const xShapeBytes = new Uint8Array(new Int32Array(x.shape).buffer);\n const outputShape = x.shape.slice();\n outputShape[outputShape.length - 1] = k;\n const outValues = backend.makeOutput(outputShape, x.dtype);\n const outValuesId = backend.dataIdMap.get(outValues.dataId).id;\n
const outIndices = backend.makeOutput(outputShape, 'int32');\n const outIndicesId = backend.dataIdMap.get(outIndices.dataId).id;\n\n wasmTopK(\n xId, xShapeBytes, x.shape.length, CppDType[x.dtype], k, sorted,\n outValuesId, outIndicesId);\n\n return [outValues, outIndices];\n};\n\nexport const topKConfig: KernelConfig = {\n kernelName: TopK,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: topk as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2021 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS
OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
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*/\n\nimport {KernelConfig, KernelFunc, TensorInfo, Transform, TransformAttrs, TransformInputs, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmTransform: (\n imageId: number, transformsId: number, isBatchTransform: boolean,\n batch: number, outHeight: number, outWidth: number, numChannels: number,\n imageWidth: number, imageHeight: number, strides: Uint8Array,\n stridesLength: number, interpolationModeId: number, fillModeId: number,\n fillValue: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n wasmTransform = backend.wasm.cwrap(Transform, null /*void*/, [\n 'number', // imageId\n 'number', // transformsId\n 'bool', // isBatchTransform\n 'number', // batch\n 'number', // outHeight\n 'number', // outWidth\n 'number', // numChannels\n 'number', // imageWidth\n 'number', // imageHeight\n 'array', // strides\n 'number', // stridesLength\n 'number', // interpolationModeId\n 'number', // fillModeId\n 'number', // fillValue\n 'number' // outId\n]);\n}\n\nfunction transform(\n args:\n {backend: BackendWasm, inputs: TransformInputs, attrs: TransformAttrs}):\n TensorInfo {\n const {backend, inputs, attrs} = args;\n const {image, transforms} = inputs;\n const {interpolation, fillMode, fillValue, outputShape} = attrs;\n\n const [batch, imageHeight, imageWidth, numChannels] = image.shape;\n const [outHeight, outWidth] =\n outputShape != null ? outputShape : [imageHeight, imageWidth];\n const outShape =\n [batch, outHeight, outWidth,\n numChannels] as [number, number, number, number];\n const strides =\n new Uint8Array(new Int32Array(util.computeStrides(image.shape)).buffer);\n\n
const out = backend.makeOutput(outShape, image.dtype);\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n const imageData = backend.dataIdMap.get(image.dataId);\n const imageId = imageData.id;\n\n const transformsData = backend.dataIdMap.get(transforms.dataId);\n const

transformsId = transformsData.id;\n\n const interpolationModeId = interpolation === 'nearest' ? 1 : 2;\n let fillModeId;\n switch (fillMode) {\n   case 'constant':\n   fillModeId = 1;\n   break;\n   case 'reflect':\n   fillModeId = 2;\n   break;\n   case 'wrap':\n   fillModeId = 3;\n   break;\n   case 'nearest':\n   fillModeId = 4;\n   break;\n   default:\n   fillModeId = 1;\n   break;\n }\n\n wasmTransform(\n   imageId, transformsId, (transforms.shape[0] > 1), batch, outHeight,\n   outWidth, numChannels, imageWidth, imageHeight, strides,\n   image.shape.length - 1, interpolationModeId, fillModeId, fillValue,\n   outId);\n\n return out;\n}\n\nexport const transformConfig: KernelConfig = {\n kernelName: Transform,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: transform as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {KernelConfig, KernelFunc, TensorInfo, Unpack, UnpackAttrs, UnpackInputs} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {slice} from './Slice';\n\nfunction unpack(\n   args: {inputs: UnpackInputs, backend: BackendWasm, attrs: UnpackAttrs}):\n   TensorInfo[] {\n const {inputs, backend, attrs} = args;\n const {value} = inputs;\n let {axis} = attrs;\n\n if (axis < 0) {\n   axis += value.shape.length;\n }\n\n const numOutputs = value.shape[axis];\n const rank = value.shape.length;\n const outShape: number[] = new Array(rank - 1);\n let outIndex = 0;\n for (let i = 0; i < rank; i++) {\n   if (i !== axis) {\n   outShape[outIndex++] = value.shape[i];\n   }\n }\n const outs: TensorInfo[] = new Array(numOutputs);\n const begin = new Array(rank).fill(0);\n const size = value.shape.slice();\n size[axis] = 1;\n for (let i = 0; i < outs.length; i++) {\n   begin[axis] = i;\n   outs[i] = slice({inputs: {x: value}, attrs: {begin, size}, backend});\n }\n return outs.map(({dataId, dtype}) => ({dataId, dtype, shape: outShape}));\n}\n\nexport const unpackConfig: KernelConfig = {\n kernelName: Unpack,\n backendName: 'wasm',\n kernelFunc: unpack as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\n// We explicitly import the modular kernels so they get registered in the\n// global registry when we compile the library. A modular build would replace\n// the contents of this file and import only the kernels that are needed.\nimport {KernelConfig, registerKernel} from '@tensorflow/tfjs-core';\n\nimport {fusedMatMulConfig} from './kernels/_FusedMatMul';\nimport {absConfig} from './kernels/Abs';\nimport {addConfig} from './kernels/Add';\nimport {addNConfig} from './kernels/AddN';\nimport {allConfig} from './kernels/All';\nimport {anyConfig} from './kernels/Any';\nimport {argMaxConfig} from './kernels/ArgMax';\nimport {avgPoolConfig} from './kernels/AvgPool';\nimport {batchMatMulConfig} from './kernels/BatchMatMul';\nimport {batchToSpaceNDConfig} from './kernels/BatchToSpaceND';\nimport {castConfig} from './kernels/Cast';\nimport {ceilConfig} from './kernels/Ceil';\nimport {clipByValueConfig} from './kernels/ClipByValue';\nimport {concatConfig} from './kernels/Concat';\nimport {conv2DConfig} from './kernels/Conv2D';\nimport {conv2DBackpropInputConfig} from './kernels/Conv2DBackpropInput';\nimport {cosConfig} from './kernels/Cos';\nimport {coshConfig} from './kernels/Cosh';\nimport {cropAndResizeConfig} from './kernels/CropAndResize';\nimport {cumsumConfig} from './kernels/Cumsum';\nimport {depthToSpaceConfig} from './kernels/DepthToSpace';\nimport {depthwiseConv2dNativeConfig} from

'./kernels/DepthwiseConv2dNative';\nimport {eluConfig} from './kernels/Elu';\nimport {equalConfig} from
'./kernels/Equal';\nimport {expConfig} from './kernels/Exp';\nimport {expandDimsConfig} from
'./kernels/ExpandDims';\nimport {fillConfig} from './kernels/Fill';\nimport {flipLeftRightConfig} from
'./kernels/FlipLeftRight';\nimport {floorConfig} from './kernels/Floor';\nimport {floorDivConfig} from
'./kernels/FloorDiv';\nimport {fusedBatchNormConfig} from './kernels/FusedBatchNorm';\nimport
{fusedConv2DConfig} from './kernels/FusedConv2D';\nimport {fusedDepthwiseConv2DConfig} from
'./kernels/FusedDepthwiseConv2D';\nimport {gatherNdConfig} from './kernels/GatherNd';\nimport
{gatherV2Config} from
'./kernels/GatherV2';\nimport {greaterConfig} from './kernels/Greater';\nimport {greaterEqualConfig} from
'./kernels/GreaterEqual';\nimport {identityConfig} from './kernels/Identity';\nimport {leakyReluConfig} from
'./kernels/LeakyRelu';\nimport {lessConfig} from './kernels/Less';\nimport {lessEqualConfig} from
'./kernels/LessEqual';\nimport {logConfig} from './kernels/Log';\nimport {logicalAndConfig} from
'./kernels/LogicalAnd';\nimport {maxConfig} from './kernels/Max';\nimport {maximumConfig} from
'./kernels/Maximum';\nimport {maxPoolConfig} from './kernels/MaxPool';\nimport {meanConfig} from
'./kernels/Mean';\nimport {minConfig} from './kernels/Min';\nimport {minimumConfig} from
'./kernels/Minimum';\nimport {mirrorPadConfig} from './kernels/MirrorPad';\nimport {multiplyConfig} from
'./kernels/Multiply';\nimport {negConfig} from './kernels/Neg';\nimport {nonMaxSuppressionV3Config} from
'./kernels/NonMaxSuppressionV3';\nimport {nonMaxSuppressionV4Config} from
'./kernels/NonMaxSuppressionV4';\nimport
{nonMaxSuppressionV5Config} from './kernels/NonMaxSuppressionV5';\nimport {notEqualConfig} from
'./kernels/NotEqual';\nimport {oneHotConfig} from './kernels/OneHot';\nimport {onesLikeConfig} from
'./kernels/OnesLike';\nimport {packConfig} from './kernels/Pack';\nimport {padV2Config} from
'./kernels/PadV2';\nimport {powConfig} from './kernels/Pow';\nimport {preluConfig} from './kernels/Prelu';\nimport
{prodConfig} from './kernels/Prod';\nimport {rangeConfig} from './kernels/Range';\nimport {realDivConfig} from
'./kernels/RealDiv';\nimport {reluConfig} from './kernels/Relu';\nimport {relu6Config} from
'./kernels/Relu6';\nimport {reshapeConfig} from './kernels/Reshape';\nimport {resizeBilinearConfig} from
'./kernels/ResizeBilinear';\nimport {reverseConfig} from './kernels/Reverse';\nimport {rotateWithOffsetConfig}
from './kernels/RotateWithOffset';\nimport {roundConfig} from './kernels/Round';\nimport {rsqrtConfig} from
'./kernels/Rsqrt';\nimport {scatterNdConfig} from './kernels/ScatterNd';\nimport
{selectConfig} from './kernels/Select';\nimport {sigmoidConfig} from './kernels/Sigmoid';\nimport {sinConfig}
from './kernels/Sin';\nimport {sliceConfig} from './kernels/Slice';\nimport {softmaxConfig} from
'./kernels/Softmax';\nimport {spaceToBatchNDConfig} from './kernels/SpaceToBatchND';\nimport {splitVConfig}
from './kernels/SplitV';\nimport {sqrtConfig} from './kernels/Sqrt';\nimport {squareConfig} from
'./kernels/Square';\nimport {squaredDifferenceConfig} from './kernels/SquaredDifference';\nimport {stepConfig}
from './kernels/Step';\nimport {stridedSliceConfig} from './kernels/StridedSlice';\nimport {subConfig} from
'./kernels/Sub';\nimport {sumConfig} from './kernels/Sum';\nimport {tanConfig} from './kernels/Tan';\nimport
{tanhConfig} from './kernels/Tanh';\nimport {tileConfig} from './kernels/Tile';\nimport {topKConfig} from
'./kernels/TopK';\nimport {transformConfig} from './kernels/Transform';\nimport {transposeConfig} from
'./kernels/Transpose';\nimport
{unpackConfig} from './kernels/Unpack';\nimport {zerosLikeConfig} from './kernels/ZerosLike';\n\n// List all
kernel configs here\nconst kernelConfigs: KernelConfig[] = [\n absConfig,\n addConfig,\n addNConfig,\n
allConfig,\n anyConfig,\n argMaxConfig,\n avgPoolConfig,\n batchMatMulConfig,\n batchToSpaceNDConfig,\n
castConfig,\n ceilConfig,\n clipByValueConfig,\n concatConfig,\n conv2DConfig,\n
conv2DBackpropInputConfig,\n cosConfig,\n coshConfig,\n cropAndResizeConfig,\n cumsumConfig,\n
depthToSpaceConfig,\n depthwiseConv2dNativeConfig,\n eluConfig,\n equalConfig,\n expConfig,\n
expandDimsConfig,\n fillConfig,\n flipLeftRightConfig,\n floorConfig,\n floorDivConfig,\n
fusedMatMulConfig,\n fusedBatchNormConfig,\n fusedConv2DConfig,\n fusedDepthwiseConv2DConfig,\n
gatherNdConfig,\n gatherV2Config,\n greaterConfig,\n greaterEqualConfig,\n identityConfig,\n

leakyReluConfig,\n lessConfig,\n lessEqualConfig,\n logConfig,\n logicalAndConfig,\n maxConfig,\n maximumConfig,\n maxPoolConfig,\n meanConfig,\n minConfig,\n minimumConfig,\n mirrorPadConfig,\n multiplyConfig,\n negConfig,\n nonMaxSuppressionV3Config,\n nonMaxSuppressionV4Config,\n nonMaxSuppressionV5Config,\n notEqualConfig,\n oneHotConfig,\n onesLikeConfig,\n packConfig,\n padV2Config,\n powConfig,\n preluConfig,\n prodConfig,\n rangeConfig,\n realDivConfig,\n reluConfig,\n relu6Config,\n reshapeConfig,\n resizeBilinearConfig,\n reverseConfig,\n rotateWithOffsetConfig,\n rsqrtConfig,\n roundConfig,\n scatterNdConfig,\n selectConfig,\n sigmoidConfig,\n sinConfig,\n sliceConfig,\n softmaxConfig,\n spaceToBatchNDConfig,\n splitVConfig,\n sqrtConfig,\n squareConfig,\n squaredDifferenceConfig,\n stepConfig,\n stridedSliceConfig,\n subConfig,\n sumConfig,\n tanConfig,\n tanhConfig,\n tileConfig,\n topKConfig,\n transformConfig,\n transposeConfig,\n unpackConfig,\n zerosLikeConfig\n];\n\nfor (const kernelConfig of kernelConfigs) {\n registerKernel(kernelConfig);\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {KernelConfig, KernelFunc, ZerosLike, ZerosLikeInputs} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nfunction zerosLike(args: {inputs: ZerosLikeInputs, backend: BackendWasm}) {\n const {inputs: {x}, backend} = args;\n const out = backend.makeOutput(x.shape, x.dtype);\n const outVals = backend.typedArrayFromHeap(out);\n outVals.fill(0);\n return out;\n}\n\nexport const zerosLikeConfig: KernelConfig = {\n kernelName: ZerosLike,\n backendName: 'wasm',\n kernelFunc: zerosLike as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {env} from '@tensorflow/tfjs-core';\n\nconst ENV = env();\n\n/**\n * True if SIMD is supported.\n */\n// From: https://github.com/GoogleChromeLabs/wasm-feature-detect\nENV.registerFlag(\n // This typed array passed in to WebAssembly.validate is WebAssembly binary\n // code. In this case it is a small program that contains SIMD\n // instructions.\n 'WASM_HAS_SIMD_SUPPORT', async () => WebAssembly.validate(new Uint8Array([\n 0, 97, 115, 109, 1, 0, 0, 0, 1, 4, 1, 96, 0, 0, 3,\n 2, 1, 0, 10, 9, 1, 7, 0, 65, 0, 253, 15, 26, 11\n])));\n\n/**\n * True if threads are supported.\n */\n// From: https://github.com/GoogleChromeLabs/wasm-feature-detect\nENV.registerFlag('WASM_HAS_MULTITHREAD_SUPPORT', async () => {\n // TODO(annxingyuan): Enable node support once this is resolved:\n // https://github.com/tensorflow/tfjs/issues/3830\n if (ENV.get('IS_NODE')) {\n return false;\n }\n\n try {\n // Test for transferability of SABs (needed for Firefox)\n // https://groups.google.com/forum/#!msg/mozilla.dev.platform/IHkBZlHETpA/dwsMNchWEQAJ\n new MessageChannel().port1.postMessage(new SharedArrayBuffer(1));\n // This typed array is a WebAssembly program containing threaded\n // instructions.\n return WebAssembly.validate(new Uint8Array([\n 0, 97, 115, 109, 1, 0, 0, 0, 1, 4, 1, 96, 0, 0, 3, 2, 1, 0, 5,\n 4, 1, 3, 1, 1, 10, 11, 1, 9, 0, 65, 0, 254, 16, 2, 0, 26, 11\n]));\n } catch (e) {\n return false;\n }\n});\n","\nvar WasmBackendModuleThreadedSimd = (function() {\n

var _scriptDir = typeof document !== 'undefined' && document.currentScript ? document.currentScript.src : undefined;\n if (typeof __filename !== 'undefined') _scriptDir = _scriptDir || __filename;\n return (\nfunction(WasmBackendModuleThreadedSimd) {\n WasmBackendModuleThreadedSimd = WasmBackendModuleThreadedSimd || {};\n\nfunction GROWABLE_HEAP_I8(){if(wasmMemory.buffer!=buffer){updateGlobalBufferAndViews(wasmMemory.buffer)}return HEAP8}function GROWABLE_HEAP_U8(){if(wasmMemory.buffer!=buffer){updateGlobalBufferAndViews(wasmMemory.buffer)}return HEAPU8}function GROWABLE_HEAP_I32(){if(wasmMemory.buffer!=buffer){updateGlobalBufferAndViews(wasmMemory.buffer)}return HEAP32}function GROWABLE_HEAP_U32(){if(wasmMemory.buffer!=buffer){updateGlobalBufferAndViews(wasmMemory.buffer)}return HEAPU32}function GROWABLE_HEAP_F64(){if(wasmMemory.buffer!=buffer){updateGlobalBufferAndViews(wasmMemory.buffer)}return HEAPF64}var Module=typeof WasmBackendModuleThreadedSimd!==\"undefined\"?WasmBackendModuleThreadedSimd:{};var readyPromiseResolve,readyPromiseReject;Module[\"ready\"]=new Promise(function(resolve,reject){readyPromiseResolve=resolve;readyPromiseReject=reject});var moduleOverrides={};var key;for(key in Module){if(Module.hasOwnProperty(key)){moduleOverrides[key]=Module[key]}}var arguments_=[];var thisProgram=\"./this.program\";var quit_=function(status,toThrow){throw toThrow};var ENVIRONMENT_IS_WEB=false;var ENVIRONMENT_IS_WORKER=false;var ENVIRONMENT_IS_NODE=false;var ENVIRONMENT_IS_SHELL=false;ENVIRONMENT_IS_WEB=typeof window===\"object\";ENVIRONMENT_IS_WORKER=typeof importScripts===\"function\";ENVIRONMENT_IS_NODE=typeof process===\"object\"&&typeof process.versions===\"object\"&&typeof process.versions.node===\"string\";ENVIRONMENT_IS_SHELL=!ENVIRONMENT_IS_WEB&&!ENVIRONMENT_IS_NODE&&!ENVIRONMENT_IS_WORKER;var ENVIRONMENT_IS_PTHREAD=Module[\"ENVIRONMENT_IS_PTHREAD\"]||false;if(ENVIRONMENT_IS_PTHREAD){buffer=Module[\"buffer\"]}var scriptDirectory=\"\";function locateFile(path){if(Module[\"locateFile\"]){return Module[\"locateFile\"](path,scriptDirectory)}return scriptDirectory+path}var read_,readAsync,readBinary,setWindowTitle;var nodeFS;var nodePath;if(ENVIRONMENT_IS_NODE){if(ENVIRONMENT_IS_WORKER){scriptDirectory=require(\"path\").dirname(scriptDirectory)+\"/\"}else{scriptDirectory=__dirname+\"/\"}read_=function shell_read(filename,binary){if(!nodeFS)nodeFS=require(\"fs\");if(!nodePath)nodePath=require(\"path\");filename=nodePath[\"normalize\"](filename);return nodeFS[\"readFileSync\"](filename,binary?null:\"utf8\")};readBinary=function readBinary(filename){var ret=read_(filename,true);if(!ret.buffer){ret=new Uint8Array(ret)}assert(ret.buffer);return ret};if(process[\"argv\"].length>1){thisProgram=process[\"argv\"][1].replace(/\\\\/g,\"/\")}arguments_=process[\"argv\"].slice(2);process[\"on\"](\"uncaughtException\",function(ex){if(!(ex instanceof ExitStatus)){throw ex}});process[\"on\"](\"unhandledRejection\",abort);quit_=function(status){process[\"exit\"](status)};Module[\"inspect\"]=function(){return\"[Emscripten Module object]\"};var nodeWorkerThreads;try{nodeWorkerThreads=require(\"worker_threads\")}catch(e){console.error('The \"worker_threads\" module is not supported in this node.js build - perhaps a newer version is needed?');throw e}global.Worker=nodeWorkerThreads.Worker}else if(ENVIRONMENT_IS_SHELL){if(typeof read!=\"undefined\"){read_=function shell_read(f){return read(f)}}readBinary=function readBinary(f){var data;if(typeof readbuffer===\"function\"){return new Uint8Array(readbuffer(f))}data=read(f,\"binary\");assert(typeof data===\"object\");return data};if(typeof

scriptArgs!=\"undefined\"){arguments_=scriptArgs}else if(typeof
arguments!=\"undefined\"){arguments_=arguments}if(typeof
quit===\"function\"){quit_=function(status){quit(status)}}if(typeof print!==\"undefined\"){if(typeof
console===\"undefined\")console={};console.log=print;console.warn=console.error=typeof
printErr!==\"undefined\"?printErr:print}}else
if(ENVIRONMENT_IS_WEB||ENVIRONMENT_IS_WORKER){if(ENVIRONMENT_IS_WORKER){scriptDire
ctory=self.location.href}else if(typeof
document!==\"undefined\"&&document.currentScript){scriptDirectory=document.currentScript.src}if(typeof
_scriptDir !== \"undefined\" &&
_scriptDir){scriptDirectory=_scriptDir}if(scriptDirectory.indexOf(\"blob:\")!==0){scriptDirectory=scriptDirectory.s
ubstr(0,scriptDirectory.lastIndexOf(\"/\")+1)}else{scriptDirectory=\"\"}if(ENVIRONMENT_IS_NODE){read_=fun
ction
shell_read(filename,binary){if(!nodeFS)nodeFS=require(\"fs\");if(!nodePath)nodePath=require(\"path\");filename=n
odePath[\"normalize\"](filename);return
nodeFS[\"readFileSync\"](filename,binary?null:\"utf8\")};readBinary=function readBinary(filename){var
ret=read_(filename,true);if(!ret.buffer){ret=new Uint8Array(ret)}assert(ret.buffer);return
ret}}else{read_=function(url){var xhr=new XMLHttpRequest;xhr.open(\"GET\",url,false);xhr.send(null);return
xhr.responseText};if(ENVIRONMENT_IS_WORKER){readBinary=function(url){var xhr=new
XMLHttpRequest;xhr.open(\"GET\",url,false);xhr.responseType=\"arraybuffer\";xhr.send(null);return new
Uint8Array(xhr.response)}}readAsync=function(url,onload,onerror){var xhr=new
XMLHttpRequest;xhr.open(\"GET\",url,true);xhr.responseType=\"arraybuffer\";xhr.onload=function(){if(xhr.status
==200||xhr.status==0&&xhr.response){onload(xhr.response);return}onerror()};xhr.onerror=onerror;xhr.send(null)}
}setWindowTitle=function(title){document.title=title}}else{}if(ENVIRONMENT_IS_NODE){if(typeof
performance===\"undefined\"){global.performance=require(\"perf_hooks\").performance}}var
out=Module[\"print\"]||console.log.bind(console);var err=Module[\"printErr\"]||console.warn.bind(console);for(key
in
moduleOverrides){if(moduleOverrides.hasOwnProperty(key)){Module[key]=moduleOverrides[key]}}moduleOverr
ides=null;if(Module[\"arguments\"])arguments_=Module[\"arguments\"];if(Module[\"thisProgram\"])thisProgram=
Module[\"thisProgram\"];if(Module[\"quit\"])quit_=Module[\"quit\"];function
warnOnce(text){if(!warnOnce.shown)warnOnce.shown={};if(!warnOnce.shown[text]){warnOnce.shown[text]=1;er
r(text)}}var Atomics_load=Atomics.load;var Atomics_store=Atomics.store;var
Atomics_compareExchange=Atomics.compareExchange;var
wasmBinary;if(Module[\"wasmBinary\"])wasmBinary=Module[\"wasmBinary\"];var
noExitRuntime=Module[\"noExitRuntime\"]||true;if(typeof WebAssembly!==\"object\"){abort(\"no
native wasm support detected\")}var wasmMemory;var wasmModule;var ABORT=false;var
EXITSTATUS;function assert(condition,text){if(!condition){abort(\"Assertion failed: \"+text)}}function
getCFunc(ident){var func=Module[\"_\"+ident];assert(func,\"Cannot call unknown function \"+ident+\", make sure
it is exported\");return func}function ccall(ident,returnType,argTypes,args,opts){var
toC={\"string\":function(str){var ret=0;if(str!==null&&str!==undefined&&str!==0){var
len=(str.length<<2)+1;ret=stackAlloc(len);stringToUTF8(str,ret,len)}return ret},\"array\":function(arr){var
ret=stackAlloc(arr.length);writeArrayToMemory(arr,ret);return ret}};function
convertReturnValue(ret){if(returnType===\"string\")return UTF8ToString(ret);if(returnType===\"boolean\")return
Boolean(ret);return ret}var func=getCFunc(ident);var cArgs=[];var stack=0;if(args){for(var
i=0;i<args.length;i++){var
converter=toC[argTypes[i]];if(converter){if(stack===0)stack=stackSave();cArgs[i]=converter(args[i])}else{cArgs[i
]=args[i]}}}var
ret=func.apply(null,cArgs);ret=convertReturnValue(ret);if(stack!==0)stackRestore(stack);return ret}function
cwrap(ident,returnType,argTypes,opts){argTypes=argTypes||[];var

numericArgs=argTypes.every(function(type){return type===\"number\"});var numericRet=returnType!==\"string\";if(numericRet&&numericArgs&&!opts){return getCFunc(ident)}return function(){return ccall(ident,returnType,argTypes,arguments,opts)}}function UTF8ArrayToString(heap,idx,maxBytesToRead){var endIdx=idx+maxBytesToRead;var str=\"\";while(!(idx>=endIdx)){var u0=heap[idx++];if(!u0)return str;if(!(u0&128)){str+=String.fromCharCode(u0);continue}var u1=heap[idx++]&63;if((u0&224)==192){str+=String.fromCharCode((u0&31)<<6|u1);continue}var u2=heap[idx++]&63;if((u0&240)==224){u0=(u0&15)<<12|u1<<6|u2}else{u0=(u0&7)<<18|u1<<12|u2<<6|heap[idx++]&63}if(u0<65536){str+=String.fromCharCode(u0)}else{var ch=u0-65536;str+=String.fromCharCode(55296|ch>>10,56320|ch&1023)}}return str}function UTF8ToString(ptr,maxBytesToRead){return ptr?UTF8ArrayToString(GROWABLE_HEAP_U8(),ptr,maxBytesToRead):\"\"}function stringToUTF8Array(str,heap,outIdx,maxBytesToWrite){if(!(maxBytesToWrite>0))return 0;var startIdx=outIdx;var endIdx=outIdx+maxBytesToWrite-1;for(var i=0;i<str.length;++i){var u=str.charCodeAt(i);if(u>=55296&&u<=57343){var u1=str.charCodeAt(++i);u=65536+((u&1023)<<10)|u1&1023}if(u<=127){if(outIdx>=endIdx)break;heap[outIdx++]=u}else if(u<=2047){if(outIdx+1>=endIdx)break;heap[outIdx++]=192|u>>6;heap[outIdx++]=128|u&63}else if(u<=65535){if(outIdx+2>=endIdx)break;heap[outIdx++]=224|u>>12;heap[outIdx++]=128|u>>6&63;heap[outIdx++]=128|u&63}else{if(outIdx+3>=endIdx)break;heap[outIdx++]=240|u>>18;heap[outIdx++]=128|u>>12&63;heap[outIdx++]=128|u>>6&63;heap[outIdx++]=128|u&63}}heap[outIdx]=0;return outIdx-startIdx}function stringToUTF8(str,outPtr,maxBytesToWrite){return stringToUTF8Array(str,GROWABLE_HEAP_U8(),outPtr,maxBytesToWrite)}function lengthBytesUTF8(str){var len=0;for(var i=0;i<str.length;++i){var u=str.charCodeAt(i);if(u>=55296&&u<=57343)u=65536+((u&1023)<<10)|str.charCodeAt(++i)&1023;if(u<=127)++len;else if(u<=2047)len+=2;else if(u<=65535)len+=3;else len+=4}return len}function writeArrayToMemory(array,buffer){GROWABLE_HEAP_I8().set(array,buffer)}function alignUp(x,multiple){if(x%multiple>0){x+=multiple-x%multiple}return x}var buffer,HEAP8,HEAPU8,HEAP16,HEAPU16,HEAP32,HEAPU32,HEAPF32,HEAPF64;function updateGlobalBufferAndViews(buf){buffer=buf;Module[\"HEAP8\"]=HEAP8=new Int8Array(buf);Module[\"HEAP16\"]=HEAP16=new Int16Array(buf);Module[\"HEAP32\"]=HEAP32=new Int32Array(buf);Module[\"HEAPU8\"]=HEAPU8=new Uint8Array(buf);Module[\"HEAPU16\"]=HEAPU16=new Uint16Array(buf);Module[\"HEAPU32\"]=HEAPU32=new Uint32Array(buf);Module[\"HEAPF32\"]=HEAPF32=new Float32Array(buf);Module[\"HEAPF64\"]=HEAPF64=new Float64Array(buf)}var INITIAL_MEMORY=Module[\"INITIAL_MEMORY\"]||16777216;if(ENVIRONMENT_IS_PTHREAD){wasmMemory=Module[\"wasmMemory\"];buffer=Module[\"buffer\"]}else{if(Module[\"wasmMemory\"]){wasmMemory=Module[\"wasmMemory\"]}else{wasmMemory=new WebAssembly.Memory({\"initial\":INITIAL_MEMORY/65536,\"maximum\":2147483648/65536,\"shared\":true});if(!(wasmMemory.buffer instanceof SharedArrayBuffer)){err(\"requested a shared WebAssembly.Memory but the returned buffer is not a SharedArrayBuffer, indicating that while the browser has SharedArrayBuffer it does not have WebAssembly threads support - you may need to set a flag\");if(ENVIRONMENT_IS_NODE){console.log(\"(on node you may need: --experimental-wasm-threads --experimental-wasm-bulk-memory and also use a recent version)\")}throw Error(\"bad memory\")}}}if(wasmMemory){buffer=wasmMemory.buffer}INITIAL_MEMORY=buffer.byteLength;updateGlobalBufferAndViews(buffer);var wasmTable;var __ATPRERUN__=[];var __ATINIT__=[];var __ATMAIN__=[];var __ATEXIT__=[];var __ATPOSTRUN__=[];var runtimeInitialized=false;var runtimeExited=false;if(!ENVIRONMENT_IS_PTHREAD)__ATINIT__.push({func:function(){___wasm_call_ctors()}});function

preRun(){if(ENVIRONMENT_IS_PTHREAD)return;if(Module[\"preRun\"]){if(typeof Module[\"preRun\"]==\"function\")Module[\"preRun\"]=[Module[\"preRun\"]];while(Module[\"preRun\"].length){addOnPreRun(Module[\"preRun\"].shift())}}callRuntimeCallbacks(__ATPRERUN__)}function initRuntime(){runtimeInitialized=true;if(ENVIRONMENT_IS_PTHREAD)return;callRuntimeCallbacks(__ATINIT__)}function preMain(){if(ENVIRONMENT_IS_PTHREAD)return;callRuntimeCallbacks(__ATMAIN__)}function exitRuntime(){if(ENVIRONMENT_IS_PTHREAD)return;runtimeExited=true}function postRun(){if(ENVIRONMENT_IS_PTHREAD)return;if(Module[\"postRun\"]){if(typeof Module[\"postRun\"]==\"function\")Module[\"postRun\"]=[Module[\"postRun\"]];while(Module[\"postRun\"].length){addOnPostRun(Module[\"postRun\"].shift())}}callRuntimeCallbacks(__ATPOSTRUN__)}function addOnPreRun(cb){__ATPRERUN__.unshift(cb)}function addOnPostRun(cb){__ATPOSTRUN__.unshift(cb)}var runDependencies=0;var runDependencyWatcher=null;var dependenciesFulfilled=null;function addRunDependency(id){assert(!ENVIRONMENT_IS_PTHREAD,\"addRunDependency cannot be used in a pthread worker\");runDependencies++;if(Module[\"monitorRunDependencies\"]){Module[\"monitorRunDependencies\"](runDependencies)}}function removeRunDependency(id){runDependencies--;if(Module[\"monitorRunDependencies\"]){Module[\"monitorRunDependencies\"](runDependencies)}if(runDependencies==0){if(runDependencyWatcher!==null){clearInterval(runDependencyWatcher);runDependencyWatcher=null}if(dependenciesFulfilled){var callback=dependenciesFulfilled;dependenciesFulfilled=null;callback()}}}Module[\"preloadedImages\"]={};Module[\"preloadedAudios\"]={};function abort(what){if(Module[\"onAbort\"]){Module[\"onAbort\"](what)}if(ENVIRONMENT_IS_PTHREAD)console.error(\"Pthread aborting at \"+(new Error).stack);what+=\"\";err(what);ABORT=true;EXITSTATUS=1;what=\"abort(\"+what+\"). Build with -s ASSERTIONS=1 for more info.\";var e=new WebAssembly.RuntimeError(what);readyPromiseReject(e);throw e}function hasPrefix(str,prefix){return String.prototype.startsWith?str.startsWith(prefix):str.indexOf(prefix)===0}var dataURIPrefix=\"data:application/octet-stream; base64,\";function isDataURI(filename){return hasPrefix(filename,dataURIPrefix)}var fileURIPrefix=\"file://\";function isFileURI(filename){return hasPrefix(filename,fileURIPrefix)}var wasmBinaryFile=\"tfjs-backend-wasm-threaded-simd.wasm\";if(!isDataURI(wasmBinaryFile)){wasmBinaryFile=locateFile(wasmBinaryFile)}function getBinary(file){try{if(file==wasmBinaryFile&&wasmBinary){return new Uint8Array(wasmBinary)}if(readBinary){return readBinary(file)}else{throw\"both async and sync fetching of the wasm failed\"}}catch(err){abort(err)}}function getBinaryPromise(){if(!wasmBinary&&(ENVIRONMENT_IS_WEB||ENVIRONMENT_IS_WORKER)){if(typeof fetch===\"function\"&&!isFileURI(wasmBinaryFile)){return fetch(wasmBinaryFile,{credentials:\"same-origin\"}).then(function(response){if(!response[\"ok\"]){throw\"failed to load wasm binary file at '\"+wasmBinaryFile+\"'\"}return response[\"arrayBuffer\"]()}).catch(function(){return getBinary(wasmBinaryFile)})}else{if(readAsync){return new Promise(function(resolve,reject){readAsync(wasmBinaryFile,function(response){resolve(new Uint8Array(response))},reject)})}}}return Promise.resolve().then(function(){return getBinary(wasmBinaryFile)})}function createWasm(){var info={\"a\":asmLibraryArg};function receiveInstance(instance,module){var exports=instance.exports;Module[\"asm\"]=exports;wasmTable=Module[\"asm\"][\"I\"];wasmModule=module;if(!ENVIRONMENT_IS_PTHREAD){var numWorkersToLoad=PThread.unusedWorkers.length;PThread.unusedWorkers.forEach(function(w){PThread.loadWasmModuleToWorker(w,function(){if(!--numWorkersToLoad)removeRunDependency(\"wasm-instantiate\")})})}if(!ENVIRONMENT_IS_PTHREAD){addRunDependency(\"wasm-instantiate\")}function

receiveInstantiatedSource(output){receiveInstance(output[\"instance\"],output[\"module\"])}function instantiateArrayBuffer(receiver){return getBinaryPromise().then(function(binary){return WebAssembly.instantiate(binary,info)}).then(receiver,function(reason){err(\"failed to asynchronously prepare wasm: \"+reason);abort(reason)})}function instantiateAsync(){if(!wasmBinary&&typeof WebAssembly.instantiateStreaming===\"function\"&&!isDataURI(wasmBinaryFile)&&!isFileURI(wasmBinaryFile)&&typeof fetch===\"function\"){return fetch(wasmBinaryFile,{credentials:\"same-origin\"}).then(function(response){var result=WebAssembly.instantiateStreaming(response,info);return result.then(receiveInstantiatedSource,function(reason){err(\"wasm streaming compile failed: \"+reason);err(\"falling back to ArrayBuffer instantiation\");return instantiateArrayBuffer(receiveInstantiatedSource)})})}else{return instantiateArrayBuffer(receiveInstantiatedSource)}}if(Module[\"instantiateWasm\"]){try{var exports=Module[\"instantiateWasm\"](info,receiveInstance);return exports}catch(e){err(\"Module.instantiateWasm callback failed with error: \"+e);return false}}instantiateAsync().catch(readyPromiseReject);return{}}var ASM_CONSTS={10520:function(){throw\"Canceled!\"},10538:function($0,$1){setTimeout(function(){__emscripten_do_dispatch_to_thread($0,$1)},0)}};function initPthreadsJS(){PThread.initRuntime()}function callRuntimeCallbacks(callbacks){while(callbacks.length>0){var callback=callbacks.shift();if(typeof callback==\"function\"){callback(Module);continue}var func=callback.func;if(typeof func===\"number\"){if(callback.arg===undefined){wasmTable.get(func)()}else{wasmTable.get(func)(callback.arg)}}else{func(callback.arg===undefined?null:callback.arg)}}}var ERRNO_CODES={EPERM:63,ENOENT:44,ESRCH:71,EINTR:27,EIO:29,ENXIO:60,E2BIG:1,ENOEXEC:45,EBADF:8,ECHILD:12,EAGAIN:6,EWOULDBLOCK:6,ENOMEM:48,EACCES:2,EFAULT:21,ENOTBLK:105,EBUSY:10,EEXIST:20,EXDEV:75,ENODEV:43,ENOTDIR:54,EISDIR:31,EINVAL:28,ENFILE:41,EMFILE:33,ENOTTY:59,ETXTBSY:74,EFBIG:22,ENOSPC:51,ESPIPE:70,EROFS:69,EMLINK:34,EPIPE:64,EDOM:18,ERANGE:68,ENOMSG:49,EIDRM:24,ECHRNG:106,EL2NSYNC:156,EL3HLT:107,EL3RST:108,ELNRNG:109,EUNATCH:110,ENOCSI:111,EL2HLT:112,EDEADLK:16,ENOLCK:46,EBADE:113,EBADR:114,EXFULL:115,ENOANO:104,EBADRQC:103,EBADSLT:102,EDEADLOCK:16,EBFONT:101,ENOSTR:100,ENODATA:116,ETIME:117,ENOSR:118,ENONET:119,ENOPKG:120,EREMOTE:121,ENOLINK:47,EADV:122,ESRMNT:123,ECOMM:124,EPROTO:65,EMULTIHOP:36,EDOTDOT:125,EBADMSG:9,ENOTUNIQ:126,EBADFD:127,EREMCHG:128,ELIBACC:129,ELIBBAD:130,ELIBSCN:131,ELIBMAX:132,ELIBEXEC:133,ENOSYS:52,ENOTEMPTY:55,ENAMETOOLONG:37,ELOOP:32,EOPNOTSUPP:138,EPFNOSUPPORT:139,ECONNRESET:15,ENOBUFS:42,EAFNOSUPPORT:5,EPROTOTYPE:67,ENOTSOCK:57,ENOPROTOOPT:50,ESHUTDOWN:140,ECONNREFUSED:14,EADDRINUSE:3,ECONNABORTED:13,ENETUNREACH:40,ENETDOWN:38,ETIMEDOUT:73,EHOSTDOWN:142,EHOSTUNREACH:23,EINPROGRESS:26,EALREADY:7,EDESTADDRREQ:17,EMSGSIZE:35,EPROTONOSUPPORT:66,ESOCKTNOSUPPORT:137,EADDRNOTAVAIL:4,ENETRESET:39,EISCONN:30,ENOTCONN:53,ETOOMANYREFS:141,EUSERS:136,EDQUOT:19,ESTALE:72,ENOTSUP:138,ENOMEDIUM:148,EILSEQ:25,EOVERFLOW:61,ECANCELED:11,ENOTRECOVERABLE:56,EOWNERDEAD:62,ESTRPIPE:135};function _emscripten_futex_wake(addr,count){if(addr<=0||addr>GROWABLE_HEAP_I8().length||addr&3!=0||count<0)return-28;if(count==0)return 0;if(count>=2147483647)count=Infinity;var mainThreadWaitAddress=Atomics.load(GROWABLE_HEAP_I32(),__emscripten_main_thread_futex>>2);var mainThreadWoken=0;if(mainThreadWaitAddress==addr){var loadedAddr=Atomics.compareExchange(GROWABLE_HEAP_I32(),__emscripten_main_thread_futex>>2,mainThreadWaitAddress,0);if(loadedAddr==mainThreadWaitAddress){--count;mainThreadWoken=1;if(count<=0)return 1}}var ret=Atomics.notify(GROWABLE_HEAP_I32(),addr>>2,count);if(ret>=0)return ret+mainThreadWoken;throw\"Atomics.notify returned an unexpected value \"+ret}Module[\"_emscripten_futex_wake\"]=_emscripten_futex_wake;function killThread(pthread_ptr){if(ENVIRONMENT_IS_PTHREAD)throw\"Internal Error! killThread() can only ever be called from main application thread!\";if(!pthread_ptr)throw\"Internal Error! Null pthread_ptr in killThread!\";GROWABLE_HEAP_I32()[pthread_ptr+12>>2]=0;var

pthread=PThread.pthreads[pthread_ptr];pthread.worker.terminate();PThread.freeThreadData(pthread);PThread.runningWorkers.splice(PThread.runningWorkers.indexOf(pthread.worker),1);pthread.worker.pthread=undefined}function cancelThread(pthread_ptr){if(ENVIRONMENT_IS_PTHREAD)throw\"Internal Error! cancelThread() can only ever be called from main application thread!\";if(!pthread_ptr)throw\"Internal Error! Null pthread_ptr in cancelThread!\";var pthread=PThread.pthreads[pthread_ptr];pthread.worker.postMessage({\"cmd\":\"cancel\"})}function cleanupThread(pthread_ptr){if(ENVIRONMENT_IS_PTHREAD)throw\"Internal Error! cleanupThread() can only ever be called from main application thread!\";if(!pthread_ptr)throw\"Internal Error! Null pthread_ptr in cleanupThread!\";var pthread=PThread.pthreads[pthread_ptr];if(pthread){GROWABLE_HEAP_I32()[pthread_ptr+12>>2]=0;var worker=pthread.worker;PThread.returnWorkerToPool(worker)}}var PThread={unusedWorkers:[],runningWorkers:[],initMainThreadBlock:function(){var pthreadPoolSize=8;for(var i=0;i<pthreadPoolSize;++i){PThread.allocateUnusedWorker()}},initRuntime:function(){var tb=_malloc(228);for(var i=0;i<228/4;++i)GROWABLE_HEAP_U32()[tb/4+i]=0;GROWABLE_HEAP_I32()[tb+12>>2]=tb;var headPtr=tb+152;GROWABLE_HEAP_I32()[headPtr>>2]=headPtr;var tlsMemory=_malloc(512);for(var i=0;i<128;++i)GROWABLE_HEAP_U32()[tlsMemory/4+i]=0;Atomics.store(GROWABLE_HEAP_U32(),tb+100>>2,tlsMemory);Atomics.store(GROWABLE_HEAP_U32(),tb+40>>2,tb);__emscripten_thread_init(tb,!ENVIRONMENT_IS_WORKER,1);_emscripten_register_main_browser_thread_id(tb)},initWorker:function(){},pthreads:{},threadExitHandlers:[],setThreadStatus:function(){},runExitHandlers:function(){while(PThread.threadExitHandlers.length>0){PThread.threadExitHandlers.pop()()}if(ENVIRONMENT_IS_PTHREAD&&_pthread_self())___pthread_tsd_run_dtors()},runExitHandlersAndDeinitThread:function(tb,exitCode){Atomics.store(GROWABLE_HEAP_U32(),tb+56>>2,1);Atomics.store(GROWABLE_HEAP_U32(),tb+60>>2,0);PThread.runExitHandlers();Atomics.store(GROWABLE_HEAP_U32(),tb+4>>2,exitCode);Atomics.store(GROWABLE_HEAP_U32(),tb+0>>2,1);_emscripten_futex_wake(tb+0,2147483647);__emscripten_thread_init(0,0,0)},threadExit:function(exitCode){var tb=_pthread_self();if(tb){PThread.runExitHandlersAndDeinitThread(tb,exitCode);if(ENVIRONMENT_IS_PTHREAD){postMessage({\"cmd\":\"exit\"})}}},threadCancel:function(){PThread.runExitHandlersAndDeinitThread(_pthread_self(),-1);postMessage({\"cmd\":\"cancelDone\"})},terminateAllThreads:function(){for(var t in PThread.pthreads){var pthread=PThread.pthreads[t];if(pthread&&pthread.worker){PThread.returnWorkerToPool(pthread.worker)}}PThread.pthreads={};for(var i=0;i<PThread.unusedWorkers.length;++i){var worker=PThread.unusedWorkers[i];worker.terminate()}PThread.unusedWorkers=[];for(var i=0;i<PThread.runningWorkers.length;++i){var worker=PThread.runningWorkers[i];var pthread=worker.pthread;PThread.freeThreadData(pthread);worker.terminate()}PThread.runningWorkers=[]},freeThreadData:function(pthread){if(!pthread)return;if(pthread.threadInfoStruct){var tlsMemory=GROWABLE_HEAP_I32()[pthread.threadInfoStruct+100>>2];GROWABLE_HEAP_I32()[pthread.threadInfoStruct+100>>2]=0;_free(tlsMemory);_free(pthread.threadInfoStruct)}pthread.threadInfoStruct=0;if(pthread.allocatedOwnStack&&pthread.stackBase)_free(pthread.stackBase);pthread.stackBase=0;if(pthread.worker)pthread.worker.pthread=null},returnWorkerToPool:function(worker){PThread.runWithoutMainThreadQueuedCalls(function(){delete PThread.pthreads[worker.pthread.threadInfoStruct];PThread.unusedWorkers.push(worker);PThread.runningWorkers.splice(PThread.runningWorkers.indexOf(worker),1);PThread.freeThreadData(worker.pthread);worker.pthread=undefined})},runWithoutMainThreadQueuedCalls:function(func){GROWABLE_HEAP_I32()[__emscripten_allow_main_runtime_queued_calls>>2]=0;try{func()}finally{GROWABLE_HEAP_I32()[__emscripten_allow_main_runtime_queued_calls>>2]=1}},receiveObjectTransfer:function(data){},loadWasmModuleToWorker:function(worker,onFinishedLoading){worker.onmessage=function(e){var

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d=e[\"data\"];var
cmd=d[\"cmd\"];if(worker.pthread)PThread.currentProxiedOperationCallerThread=worker.pthread.threadInfoStruct;
if(d[\"targetThread\"]&&d[\"targetThread\"]!=_pthread_self()){var
thread=PThread.pthreads[d.targetThread];if(thread){thread.worker.postMessage(e.data,d[\"transferList\"])}else{con
sole.error('Internal error! Worker sent a message \"'+cmd+'\" to target pthread '+d[\"targetThread\"]+\", but that
thread no longer
exists!\")}PThread.currentProxiedOperationCallerThread=undefined;return}if(cmd===\"processQueuedMainThread
Work\"){_emscripten_main_thread_process_queued_calls()}else
if(cmd===\"spawnThread\"){spawnThread(e.data)}else
if(cmd===\"cleanupThread\"){cleanupThread(d[\"thread\"])}else
if(cmd===\"killThread\"){killThread(d[\"thread\"])}else
if(cmd===\"cancelThread\"){cancelThread(d[\"thread\"])}else
if(cmd===\"loaded\"){worker.loaded=true;if(onFinishedLoading)onFinishedLoading(worker);if(worker.runPthread)
{worker.runPthread();delete
 worker.runPthread}}else if(cmd===\"print\"){out(\"Thread \"+d[\"threadId\"]+\": \"+d[\"text\"])}else
if(cmd===\"printErr\"){err(\"Thread \"+d[\"threadId\"]+\": \"+d[\"text\"])}else if(cmd===\"alert\"){alert(\"Thread
\"+d[\"threadId\"]+\": \"+d[\"text\"])}else if(cmd===\"exit\"){var
detached=worker.pthread&&Atomics.load(GROWABLE_HEAP_U32(),worker.pthread.threadInfoStruct+64>>2);if
(detached){PThread.returnWorkerToPool(worker)}}else
if(cmd===\"exitProcess\"){try{exit(d[\"returnCode\"])}catch(e){if(e instanceof ExitStatus)return;throw e}}else
if(cmd===\"cancelDone\"){PThread.returnWorkerToPool(worker)}else
if(cmd===\"objectTransfer\"){PThread.receiveObjectTransfer(e.data)}else
if(e.data.target===\"setimmediate\"){worker.postMessage(e.data)}else{err(\"worker sent an unknown command
\"+cmd)}PThread.currentProxiedOperationCallerThread=undefined};worker.onerror=function(e){err(\"pthread sent
an error! \"+e.filename+\":\"+e.lineno+\":
\"+e.message)};if(ENVIRONMENT_IS_NODE){worker.on(\"message\",function(data){worker.onmessage({data:d
ata})});worker.on(\"error\",function(data){worker.onerror(data)});worker.on(\"exit\",function(data){})}worker.post
Message({\"cmd\":\"load\",\"urlOrBlob\":Module[\"mainScriptUrlOrBlob\"]||_scriptDir,\"wasmMemory\":wasmMe
mory,\"wasmModule\":wasmModule})},allocateUnusedWorker:function(){var
 pthreadMainJs=locateFile(\"tfjs-backend-wasm-threaded-simd.worker.js\");PThread.unusedWorkers.push(new
Worker(pthreadMainJs))},getNewWorker:function(){if(PThread.unusedWorkers.length==0){PThread.allocateUnus
edWorker();PThread.loadWasmModuleToWorker(PThread.unusedWorkers[0])}if(PThread.unusedWorkers.length>
0)return PThread.unusedWorkers.pop();else return null},busySpinWait:function(msecs){var
t=performance.now()+msecs;while(performance.now()<t){}}};function
establishStackSpace(stackTop,stackMax){_emscripten_stack_set_limits(stackTop,stackMax);stackRestore(stackTop
)}Module[\"establishStackSpace\"]=establishStackSpace;function getNoExitRuntime(){return
 noExitRuntime}Module[\"getNoExitRuntime\"]=getNoExitRuntime;function invokeEntryPoint(ptr,arg){return
wasmTable.get(ptr)(arg)}Module[\"invokeEntryPoint\"]=invokeEntryPoint;function
___assert_fail(condition,filename,line,func){abort(\"Assertion failed: \"+UTF8ToString(condition)+\", at:
\"+[filename?UTF8ToString(filename):\"unknown filename\",line,func?UTF8ToString(func):\"unknown
function\"])}function ___call_main(argc,argv){var returnCode=_main(argc,argv)}var
_emscripten_get_now;if(ENVIRONMENT_IS_NODE){_emscripten_get_now=function(){var
t=process[\"hrtime\"]();return t[0]*1e3+t[1]/1e6}}else
if(ENVIRONMENT_IS_PTHREAD){_emscripten_get_now=function(){return performance.now()-
Module[\"__performance_now_clock_drift\"]}}else if(typeof
dateNow!==\"undefined\"){_emscripten_get_now=dateNow}else _emscripten_get_now=function(){return
performance.now()};function setErrNo(value){GROWABLE_HEAP_I32()[___errno_location()>>2]=value;return
value}function _atexit(func,arg){if(ENVIRONMENT_IS_PTHREAD)return
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 _emscripten_proxy_to_main_thread_js(1,1,func,arg)}function
__emscripten_notify_thread_queue(targetThreadId,mainThreadId){if(targetThreadId==mainThreadId){postMessag
e({\"cmd\":\"processQueuedMainThreadWork\"})}else
if(ENVIRONMENT_IS_PTHREAD){postMessage({\"targetThread\":targetThreadId,\"cmd\":\"processThreadQueu
e\"})}else{var pthread=PThread.pthreads[targetThreadId];var
worker=pthread&&pthread.worker;if(!worker){return}worker.postMessage({\"cmd\":\"processThreadQueue\"})}ret
urn 1}function _abort(){abort()}function _emscripten_asm_const_int(code,sigPtr,argbuf){var
args=readAsmConstArgs(sigPtr,argbuf);return ASM_CONSTS[code].apply(null,args)}function
_emscripten_conditional_set_current_thread_status(expectedStatus,newStatus){}function
_emscripten_futex_wait(addr,val,timeout){if(addr<=0||addr>GROWABLE_HEAP_I8().length||addr&3!=0)return-
28;if(!ENVIRONMENT_IS_WEB){var
ret=Atomics.wait(GROWABLE_HEAP_I32(),addr>>2,val,timeout);if(ret===\"timed-out\")return-
73;if(ret===\"not-equal\")return-6;if(ret===\"ok\")return
 0;throw\"Atomics.wait returned an unexpected value
\"+ret}else{if(Atomics.load(GROWABLE_HEAP_I32(),addr>>2)!=val){return-6}var
tNow=performance.now();var tEnd=tNow+timeout;var
lastAddr=Atomics.exchange(GROWABLE_HEAP_I32(),__emscripten_main_thread_futex>>2,addr);while(1){tNo
w=performance.now();if(tNow>tEnd){lastAddr=Atomics.exchange(GROWABLE_HEAP_I32(),__emscripten_mai
n_thread_futex>>2,0);return-
73}lastAddr=Atomics.exchange(GROWABLE_HEAP_I32(),__emscripten_main_thread_futex>>2,0);if(lastAddr==
0){break}_emscripten_main_thread_process_queued_calls();if(Atomics.load(GROWABLE_HEAP_I32(),addr>>2)!
=val){return-
6}lastAddr=Atomics.exchange(GROWABLE_HEAP_I32(),__emscripten_main_thread_futex>>2,addr)}return
0}}function
_emscripten_memcpy_big(dest,src,num){GROWABLE_HEAP_U8().copyWithin(dest,src,src+num)}function
_emscripten_num_logical_cores(){if(ENVIRONMENT_IS_NODE)return require(\"os\").cpus().length;return
navigator[\"hardwareConcurrency\"]}function
 _emscripten_proxy_to_main_thread_js(index,sync){var numCallArgs=arguments.length-2;var
stack=stackSave();var serializedNumCallArgs=numCallArgs;var args=stackAlloc(serializedNumCallArgs*8);var
b=args>>3;for(var i=0;i<numCallArgs;i++){var arg=arguments[2+i];GROWABLE_HEAP_F64()[b+i]=arg}var
ret=_emscripten_run_in_main_runtime_thread_js(index,serializedNumCallArgs,args,sync);stackRestore(stack);retur
n ret}var _emscripten_receive_on_main_thread_js_callArgs=[];var readAsmConstArgsArray=[];function
readAsmConstArgs(sigPtr,buf){readAsmConstArgsArray.length=0;var
ch;buf>>=2;while(ch=GROWABLE_HEAP_U8()[sigPtr++]){var
double=ch<105;if(double&&buf&1)buf++;readAsmConstArgsArray.push(double?GROWABLE_HEAP_F64()[buf
++>>1]:GROWABLE_HEAP_I32()[buf]);++buf}return readAsmConstArgsArray}function
_emscripten_receive_on_main_thread_js(index,numCallArgs,args){_emscripten_receive_on_main_thread_js_callA
rgs.length=numCallArgs;var b=args>>3;for(var
i=0;i<numCallArgs;i++){_emscripten_receive_on_main_thread_js_callArgs[i]=GROWABLE_HEAP_F64()[b+i]}v
ar
 isEmAsmConst=index<0;var func=!isEmAsmConst?proxiedFunctionTable[index]:ASM_CONSTS[-index-
1];return func.apply(null,_emscripten_receive_on_main_thread_js_callArgs)}function
_emscripten_get_heap_size(){return GROWABLE_HEAP_U8().length}function
emscripten_realloc_buffer(size){try{wasmMemory.grow(size-
buffer.byteLength+65535>>>16);updateGlobalBufferAndViews(wasmMemory.buffer);return
1}catch(e){}}function _emscripten_resize_heap(requestedSize){var
oldSize=_emscripten_get_heap_size();if(requestedSize<=oldSize){return false}var
maxHeapSize=2147483648;if(requestedSize>maxHeapSize){return false}for(var
```

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cutDown=1;cutDown<=4;cutDown*=2){var
overGrownHeapSize=oldSize*(1+.2/cutDown);overGrownHeapSize=Math.min(overGrownHeapSize,requestedSize
+100663296);var
newSize=Math.min(maxHeapSize,alignUp(Math.max(requestedSize,overGrownHeapSize),65536));var
replacement=emscripten_realloc_buffer(newSize);if(replacement){return true}}return false}var
JSEvents={inEventHandler:0,removeAllEventListeners:function(){for(var
 i=JSEvents.eventHandlers.length-1;i>=0;--
i){JSEvents._removeHandler(i)}JSEvents.eventHandlers=[];JSEvents.deferredCalls=[]},registerRemoveEventListen
ers:function(){if(!JSEvents.removeEventListenersRegistered){__ATEXIT__.push(JSEvents.removeAllEventListene
rs);JSEvents.removeEventListenersRegistered=true}},deferredCalls:[],deferCall:function(targetFunction,precedence
,argsList){function arraysHaveEqualContent(arrA,arrB){if(arrA.length!=arrB.length)return false;for(var i in
arrA){if(arrA[i]!=arrB[i])return false}return true}for(var i in JSEvents.deferredCalls){var
call=JSEvents.deferredCalls[i];if(call.targetFunction==targetFunction&&arraysHaveEqualContent(call.argsList,args
List)){return}}JSEvents.deferredCalls.push({targetFunction:targetFunction,precedence:precedence,argsList:argsList
});JSEvents.deferredCalls.sort(function(x,y){return
x.precedence<y.precedence})},removeDeferredCalls:function(targetFunction){for(var
i=0;i<JSEvents.deferredCalls.length;++i){if(JSEvents.deferredCalls[i].targetFunction==targetFunction){JSEvents.d
eferredCalls.splice(i,1);--i}}},canPerformEventHandlerRequests:function(){return
JSEvents.inEventHandler&&JSEvents.currentEventHandler.allowsDeferredCalls},runDeferredCalls:function(){if(!J
SEvents.canPerformEventHandlerRequests()){return}for(var i=0;i<JSEvents.deferredCalls.length;++i){var
call=JSEvents.deferredCalls[i];JSEvents.deferredCalls.splice(i,1);--
i;call.targetFunction.apply(null,call.argsList)}},eventHandlers:[],removeAllHandlersOnTarget:function(target,event
TypeString){for(var
i=0;i<JSEvents.eventHandlers.length;++i){if(JSEvents.eventHandlers[i].target==target&&(!eventTypeString||event
TypeString==JSEvents.eventHandlers[i].eventTypeString)){JSEvents._removeHandler(i--
)}}},_removeHandler:function(i){var
h=JSEvents.eventHandlers[i];h.target.removeEventListener(h.eventTypeString,h.eventListenerFunc,h.useCapture);J
SEvents.eventHandlers.splice(i,1)},registerOrRemoveHandler:function(eventHandler){var
 jsEventHandler=function
jsEventHandler(event){++JSEvents.inEventHandler;JSEvents.currentEventHandler=eventHandler;JSEvents.runDef
erredCalls();eventHandler.handlerFunc(event);JSEvents.runDeferredCalls();--
JSEvents.inEventHandler};if(eventHandler.callbackfunc){eventHandler.eventListenerFunc=jsEventHandler;eventH
andler.target.addEventListener(eventHandler.eventTypeString,jsEventHandler,eventHandler.useCapture);JSEvents.e
ventHandlers.push(eventHandler);JSEvents.registerRemoveEventListeners()}else{for(var
i=0;i<JSEvents.eventHandlers.length;++i){if(JSEvents.eventHandlers[i].target==eventHandler.target&&JSEvents.e
ventHandlers[i].eventTypeString==eventHandler.eventTypeString){JSEvents._removeHandler(i--
)}}}},queueEventHandlerOnThread_iiii:function(targetThread,eventHandlerFunc,eventTypeId,eventData,userData)
{var stackTop=stackSave();var
varargs=stackAlloc(12);GROWABLE_HEAP_I32()[varargs>>2]=eventTypeId;GROWABLE_HEAP_I32()[varargs
+4>>2]=eventData;GROWABLE_HEAP_I32()[varargs+8>>2]=userData;__emscripten_call_on_thread(0,targetThr
ead,637534208,eventHandlerFunc,eventData,varargs);stackRestore(stackTop)},getTargetThreadForEventCallback:f
unction(targetThread){switch(targetThread){case
 1:return 0;case 2:return PThread.currentProxiedOperationCallerThread;default:return
targetThread}},getNodeNameForTarget:function(target){if(!target)return\"\";if(target==window)return\"#window\";
if(target==screen)return\"#screen\";return
target&&target.nodeName?target.nodeName:\"\"},fullscreenEnabled:function(){return
document.fullscreenEnabled||document.webkitFullscreenEnabled}};function stringToNewUTF8(jsString){var
length=lengthBytesUTF8(jsString)+1;var cString=_malloc(length);stringToUTF8(jsString,cString,length);return
```

cString}function
_emscripten_set_offscreencanvas_size_on_target_thread_js(targetThread,targetCanvas,width,height){var
stackTop=stackSave();var varargs=stackAlloc(12);var
targetCanvasPtr=0;if(targetCanvas){targetCanvasPtr=stringToNewUTF8(targetCanvas)}GROWABLE_HEAP_I32(
)[varargs>>2]=targetCanvasPtr;GROWABLE_HEAP_I32()[varargs+4>>2]=width;GROWABLE_HEAP_I32()[var
args+8>>2]=height;__emscripten_call_on_thread(0,targetThread,657457152,0,targetCanvasPtr,varargs);stackRestor
e(stackTop)}function
_emscripten_set_offscreencanvas_size_on_target_thread(targetThread,targetCanvas,width,height){targetCanvas=tar
getCanvas?UTF8ToString(targetCanvas):\"\";_emscripten_set_offscreencanvas_size_on_target_thread_js(targetThr
ead,targetCanvas,width,height)}function maybeCStringToJsString(cString){return
cString>2?UTF8ToString(cString):cString}var specialHTMLTargets=[0,typeof
document!==\"undefined\"?document:0,typeof window!==\"undefined\"?window:0];function
findEventTarget(target){target=maybeCStringToJsString(target);var
domElement=specialHTMLTargets[target]||(typeof
document!==\"undefined\"?document.querySelector(target):undefined);return domElement}function
findCanvasEventTarget(target){return findEventTarget(target)}function
_emscripten_set_canvas_element_size_calling_thread(target,width,height){var
canvas=findCanvasEventTarget(target);if(!canvas)return-
4;if(canvas.canvasSharedPtr){GROWABLE_HEAP_I32()[canvas.canvasSharedPtr>>2]=width;GROWABLE_HEA
P_I32()[canvas.canvasSharedPtr+4>>2]=height}if(canvas.offscreenCanvas||!canvas.controlTransferredOffscreen){if
(canvas.offscreenCanvas)canvas=canvas.offscreenCanvas;var
autoResizeViewport=false;if(canvas.GLctxObject&&canvas.GLctxObject.GLctx){var
prevViewport=canvas.GLctxObject.GLctx.getParameter(2978);autoResizeViewport=prevViewport[0]===0&&prev
Viewport[1]===0&&prevViewport[2]===canvas.width&&prevViewport[3]===canvas.height}canvas.width=width;
canvas.height=height;if(autoResizeViewport){canvas.GLctxObject.GLctx.viewport(0,0,width,height)}}else
if(canvas.canvasSharedPtr){var
targetThread=GROWABLE_HEAP_I32()[canvas.canvasSharedPtr+8>>2];_emscripten_set_offscreencanvas_size_o
n_target_thread(targetThread,target,width,height);return 1}else{return-4}return 0}function
_emscripten_set_canvas_element_size_main_thread(target,width,height){if(ENVIRONMENT_IS_PTHREAD)retur
n
_emscripten_proxy_to_main_thread_js(2,1,target,width,height);return
_emscripten_set_canvas_element_size_calling_thread(target,width,height)}function
_emscripten_set_canvas_element_size(target,width,height){var
canvas=findCanvasEventTarget(target);if(canvas){return
_emscripten_set_canvas_element_size_calling_thread(target,width,height)}else{return
_emscripten_set_canvas_element_size_main_thread(target,width,height)}}function
_emscripten_set_current_thread_status(newStatus){}function
_emscripten_set_thread_name(threadId,name){}function __webgl_enable_ANGLE_instanced_arrays(ctx){var
ext=ctx.getExtension(\"ANGLE_instanced_arrays\");if(ext){ctx[\"vertexAttribDivisor\"]=function(index,divisor){ex
t[\"vertexAttribDivisorANGLE\"](index,divisor)};ctx[\"drawArraysInstanced\"]=function(mode,first,count,primcou
nt){ext[\"drawArraysInstancedANGLE\"](mode,first,count,primcount)};ctx[\"drawElementsInstanced\"]=function(
mode,count,type,indices,primcount){ext[\"drawElementsInstancedANGLE\"](mode,count,type,indices,primcount)};
return
1}}function __webgl_enable_OES_vertex_array_object(ctx){var
ext=ctx.getExtension(\"OES_vertex_array_object\");if(ext){ctx[\"createVertexArray\"]=function(){return
ext[\"createVertexArrayOES\"]()};ctx[\"deleteVertexArray\"]=function(vao){ext[\"deleteVertexArrayOES\"](vao)};
ctx[\"bindVertexArray\"]=function(vao){ext[\"bindVertexArrayOES\"](vao)};ctx[\"isVertexArray\"]=function(vao)
{return ext[\"isVertexArrayOES\"](vao)};return 1}}function __webgl_enable_WEBGL_draw_buffers(ctx){var

ext=ctx.getExtension(\"WEBGL_draw_buffers\");if(ext){ctx[\"drawBuffers\"]=function(n,bufs){ext[\"drawBuffers WEBGL\"](n,bufs)};return 1}}function __webgl_enable_WEBGL_multi_draw(ctx){return!!(ctx.multiDrawWebgl=ctx.getExtension(\"WEBGL_multi_draw\"))}var GL={counter:1,buffers:[],programs:[],framebuffers:[],renderbuffers:[],textures:[],uniforms:[],shaders:[],vaos:[],contexts:{},offscreenCanvases:{},timerQueriesEXT:[],programInfos:{},stringCache:{},unpackAlignment:4,recordError:function recordError(errorCode){if(!GL.lastError){GL.lastError=errorCode}},getNewId:function(table){var ret=GL.counter++;for(var i=table.length;i<ret;i++){table[i]=null}return ret},getSource:function(shader,count,string,length){var source=\"\";for(var i=0;i<count;++i){var len=length?GROWABLE_HEAP_I32()[length+i*4>>2]:-1;source+=UTF8ToString(GROWABLE_HEAP_I32()[string+i*4>>2],len<0?undefined:len)}return source},createContext:function(canvas,webGLContextAttributes){var ctx=canvas.getContext(\"webgl\",webGLContextAttributes);if(!ctx)return 0;var handle=GL.registerContext(ctx,webGLContextAttributes);return handle},registerContext:function(ctx,webGLContextAttributes){var handle=_malloc(8);GROWABLE_HEAP_I32()[handle+4>>2]=_pthread_self();var context={handle:handle,attributes:webGLContextAttributes,version:webGLContextAttributes.majorVersion,GLctx:ctx};if(ctx.canvas)ctx.canvas.GLctxObject=context;GL.contexts[handle]=context;if(typeof webGLContextAttributes.enableExtensionsByDefault===\"undefined\"||webGLContextAttributes.enableExtensionsByDefault){GL.initExtensions(context)}return handle},makeContextCurrent:function(contextHandle){GL.currentContext=GL.contexts[contextHandle];Module.ctx=GLctx=GL.currentContext&&GL.currentContext.GLctx;return!(contextHandle&&!GLctx)},getContext:function(contextHandle){return GL.contexts[contextHandle]},deleteContext:function(contextHandle){if(GL.currentContext===GL.contexts[contextHandle])GL.currentContext=null;if(typeof JSEvents===\"object\")JSEvents.removeAllHandlersOnTarget(GL.contexts[contextHandle].GLctx.canvas);if(GL.contexts[contextHandle]&&GL.contexts[contextHandle].GLctx.canvas)GL.contexts[contextHandle].GLctx.canvas.GLctxObject=undefined;_free(GL.contexts[contextHandle].handle);GL.contexts[contextHandle]=null},initExtensions:function(context){if(!context)context=GL.currentContext;if(context.initExtensionsDone)return;context.initExtensionsDone=true;var GLctx=context.GLctx;__webgl_enable_ANGLE_instanced_arrays(GLctx);__webgl_enable_OES_vertex_array_object(GLctx);__webgl_enable_WEBGL_draw_buffers(GLctx);GLctx.disjointTimerQueryExt=GLctx.getExtension(\"EXT_disjoint_timer_query\");__webgl_enable_WEBGL_multi_draw(GLctx);var exts=GLctx.getSupportedExtensions()||[];exts.forEach(function(ext){if(ext.indexOf(\"lose_context\")<0&&ext.indexOf(\"debug\")<0){GLctx.getExtension(ext)}})},populateUniformTable:function(program){var p=GL.programs[program];var ptable=GL.programInfos[program]={uniforms:{},maxUniformLength:0,maxAttributeLength:-1,maxUniformBlockNameLength:-1};var utable=ptable.uniforms;var numUniforms=GLctx.getProgramParameter(p,35718);for(var i=0;i<numUniforms;++i){var u=GLctx.getActiveUniform(p,i);var name=u.name;ptable.maxUniformLength=Math.max(ptable.maxUniformLength,name.length+1);if(name.slice(-1)==\"]\"){name=name.slice(0,name.lastIndexOf(\"[\"))}var loc=GLctx.getUniformLocation(p,name);if(loc){var id=GL.getNewId(GL.uniforms);utable[name]=[u.size,id];GL.uniforms[id]=loc;for(var j=1;j<u.size;++j){var n=name+\"[\"+j+\"]\";loc=GLctx.getUniformLocation(p,n);id=GL.getNewId(GL.uniforms);GL.uniforms[id]=loc}}}};var __emscripten_webgl_power_preferences=[\"default\",\"low-power\",\"high-performance\"];function _emscripten_webgl_do_create_context(target,attributes){var a=attributes>>2;var

powerPreference=GROWABLE_HEAP_I32()[a+(24>>2)];var
contextAttributes={\"alpha\":!!GROWABLE_HEAP_I32()[a+(0>>2)],\"depth\":!!GROWABLE_HEAP_I32()[a+(4
>>2)],\"stencil\":!!GROWABLE_HEAP_I32()[a+(8>>2)],\"antialias\":!!GROWABLE_HEAP_I32()[a+(12>>2)],\"p
remultipliedAlpha\":!!GROWABLE_HEAP_I32()[a+(16>>2)],\"preserveDrawingBuffer\":!!GROWABLE_HEAP_
I32()[a+(20>>2)],\"powerPreference\":__emscripten_webgl_power_preferences[powerPreference],\"failIfMajorPerf
ormanceCaveat\":!!GROWABLE_HEAP_I32()[a+(28>>2)],majorVersion:GROWABLE_HEAP_I32()[a+(32>>2)],
minorVersion:GROWABLE_HEAP_I32()[a+(36>>2)],enableExtensionsByDefault:GROWABLE_HEAP_I32()[a+(
40>>2)],explicitSwapControl:GROWABLE_HEAP_I32()[a+(44>>2)],proxyContextToMainThread:GROWABLE_
HEAP_I32()[a+(48>>2)],renderViaOffscreenBackBuffer:GROWABLE_HEAP_I32()[a+(52>>2)]};var
canvas=findCanvasEventTarget(target);if(!canvas){return 0}if(contextAttributes.explicitSwapControl){return
0}var contextHandle=GL.createContext(canvas,contextAttributes);return contextHandle}function
_emscripten_webgl_create_context(a0,a1){return _emscripten_webgl_do_create_context(a0,a1)}var
SYSCALLS={mappings:{},buffers:[null,[],[]],printChar:function(stream,curr){var
buffer=SYSCALLS.buffers[stream];if(curr===0||curr===10){(stream===1?out:err)(UTF8ArrayToString(buffer,0));
buffer.length=0}else{buffer.push(curr)}},varargs:undefined,get:function(){SYSCALLS.varargs+=4;var
ret=GROWABLE_HEAP_I32()[SYSCALLS.varargs-4>>2];return ret},getStr:function(ptr){var
ret=UTF8ToString(ptr);return ret},get64:function(low,high){return low}};function
_fd_close(fd){if(ENVIRONMENT_IS_PTHREAD)return _emscripten_proxy_to_main_thread_js(3,1,fd);return
0}function _fd_seek(fd,offset_low,offset_high,whence,newOffset){if(ENVIRONMENT_IS_PTHREAD)return
_emscripten_proxy_to_main_thread_js(4,1,fd,offset_low,offset_high,whence,newOffset)}function
_fd_write(fd,iov,iovcnt,pnum){if(ENVIRONMENT_IS_PTHREAD)return
_emscripten_proxy_to_main_thread_js(5,1,fd,iov,iovcnt,pnum);var num=0;for(var i=0;i<iovcnt;i++){var
ptr=GROWABLE_HEAP_I32()[iov+i*8>>2];var len=GROWABLE_HEAP_I32()[iov+(i*8+4)>>2];for(var
j=0;j<len;j++){SYSCALLS.printChar(fd,GROWABLE_HEAP_U8()[ptr+j])}num+=len}GROWABLE_HEAP_I32
()[pnum>>2]=num;return 0}function _pthread_cleanup_pop(execute){var
routine=PThread.threadExitHandlers.pop();if(execute)routine()}function
_pthread_cleanup_push(routine,arg){PThread.threadExitHandlers.push(function(){wasmTable.get(routine)(arg)})}f
unction spawnThread(threadParams){if(ENVIRONMENT_IS_PTHREAD)throw\"Internal Error! spawnThread()
can only ever be called from main application thread!\";var
worker=PThread.getNewWorker();if(worker.pthread!==undefined)throw\"Internal
error!\";if(!threadParams.pthread_ptr)throw\"Internal
error, no pthread ptr!\";PThread.runningWorkers.push(worker);var tlsMemory=_malloc(128*4);for(var
i=0;i<128;++i){GROWABLE_HEAP_I32()[tlsMemory+i*4>>2]=0}var
stackHigh=threadParams.stackBase+threadParams.stackSize;var
pthread=PThread.pthreads[threadParams.pthread_ptr]={worker:worker,stackBase:threadParams.stackBase,stackSize
:threadParams.stackSize,allocatedOwnStack:threadParams.allocatedOwnStack,threadInfoStruct:threadParams.pthrea
d_ptr};var
tis=pthread.threadInfoStruct>>2;Atomics.store(GROWABLE_HEAP_U32(),tis+(64>>2),threadParams.detached);A
tomics.store(GROWABLE_HEAP_U32(),tis+(100>>2),tlsMemory);Atomics.store(GROWABLE_HEAP_U32(),tis
+(40>>2),pthread.threadInfoStruct);Atomics.store(GROWABLE_HEAP_U32(),tis+(80>>2),threadParams.stackSiz
e);Atomics.store(GROWABLE_HEAP_U32(),tis+(76>>2),stackHigh);Atomics.store(GROWABLE_HEAP_U32(),t
is+(104>>2),threadParams.stackSize);Atomics.store(GROWABLE_HEAP_U32(),tis+(104+8>>2),stackHigh);Atom
ics.store(GROWABLE_HEAP_U32(),tis+(104+12>>2),threadParams.detached);var
global_libc=_emscripten_get_global_libc();var
global_locale=global_libc+40;Atomics.store(GROWABLE_HEAP_U32(),tis+(172>>2),global_locale);worker.pthr
ead=pthread;var
msg={\"cmd\":\"run\",\"start_routine\":threadParams.startRoutine,\"arg\":threadParams.arg,\"threadInfoStruct\":thre
adParams.pthread_ptr,\"stackBase\":threadParams.stackBase,\"stackSize\":threadParams.stackSize};worker.runPthre

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ad=function(){msg.time=performance.now();worker.postMessage(msg,threadParams.transferList)};if(worker.loaded
){worker.runPthread();delete worker.runPthread}}function
_pthread_create(pthread_ptr,attr,start_routine,arg){if(typeof SharedArrayBuffer===\"undefined\"){err(\"Current
environment does not support SharedArrayBuffer, pthreads are not available!\");return
6}if(!pthread_ptr){err(\"pthread_create called with a null thread pointer!\");return 28}var transferList=[];var
error=0;if(ENVIRONMENT_IS_PTHREAD&&(transferList.length===0||error)){return
_emscripten_sync_run_in_main_thread_4(687865856,pthread_ptr,attr,start_routine,arg)}if(error)return
 error;var stackSize=0;var stackBase=0;var detached=0;if(attr&&attr!=-
1){stackSize=GROWABLE_HEAP_I32()[attr>>2];stackSize+=81920;stackBase=GROWABLE_HEAP_I32()[attr+
8>>2];detached=GROWABLE_HEAP_I32()[attr+12>>2]!==0}else{stackSize=2097152}var
allocatedOwnStack=stackBase==0;if(allocatedOwnStack){stackBase=_memalign(16,stackSize)}else{stackBase-
=stackSize;assert(stackBase>0)}var threadInfoStruct=_malloc(228);for(var
i=0;i<228>>2;++i)GROWABLE_HEAP_U32()[(threadInfoStruct>>2)+i]=0;GROWABLE_HEAP_I32()[pthread_p
tr>>2]=threadInfoStruct;GROWABLE_HEAP_I32()[threadInfoStruct+12>>2]=threadInfoStruct;var
headPtr=threadInfoStruct+152;GROWABLE_HEAP_I32()[headPtr>>2]=headPtr;var
threadParams={stackBase:stackBase,stackSize:stackSize,allocatedOwnStack:allocatedOwnStack,detached:detached
,startRoutine:start_routine,pthread_ptr:threadInfoStruct,arg:arg,transferList:transferList};if(ENVIRONMENT_IS_P
THREAD){threadParams.cmd=\"spawnThread\";postMessage(threadParams,transferList)}else{spawnThread(thread
Params)}return
 0}function __pthread_testcancel_js(){if(!ENVIRONMENT_IS_PTHREAD)return;var
tb=_pthread_self();if(!tb)return;var
cancelDisabled=Atomics.load(GROWABLE_HEAP_U32(),tb+56>>2);if(cancelDisabled)return;var
canceled=Atomics.load(GROWABLE_HEAP_U32(),tb+0>>2);if(canceled==2)throw\"Canceled!\"}function
_emscripten_check_blocking_allowed(){if(ENVIRONMENT_IS_NODE)return;if(ENVIRONMENT_IS_WORKE
R)return;warnOnce(\"Blocking on the main thread is very dangerous, see
https://emscripten.org/docs/porting/pthreads.html#blocking-on-the-main-browser-thread\")}function
__emscripten_do_pthread_join(thread,status,block){if(!thread){err(\"pthread_join attempted on a null thread
pointer!\");return
ERRNO_CODES.ESRCH}if(ENVIRONMENT_IS_PTHREAD&&_pthread_self()==thread){err(\"PThread
\"+thread+\" is attempting to join to itself!\");return ERRNO_CODES.EDEADLK}else
if(!ENVIRONMENT_IS_PTHREAD&&_emscripten_main_browser_thread_id()==thread){err(\"Main
 thread \"+thread+\" is attempting to join to itself!\");return ERRNO_CODES.EDEADLK}var
self=GROWABLE_HEAP_I32()[thread+12>>2];if(self!==thread){err(\"pthread_join attempted on thread
\"+thread+\", which does not point to a valid thread, or does not exist anymore!\");return
ERRNO_CODES.ESRCH}var
detached=Atomics.load(GROWABLE_HEAP_U32(),thread+64>>2);if(detached){err(\"Attempted to join thread
\"+thread+\", which was already detached!\");return
ERRNO_CODES.EINVAL}if(block){_emscripten_check_blocking_allowed()}for(;;){var
threadStatus=Atomics.load(GROWABLE_HEAP_U32(),thread+0>>2);if(threadStatus==1){var
threadExitCode=Atomics.load(GROWABLE_HEAP_U32(),thread+4>>2);if(status)GROWABLE_HEAP_I32()[sta
tus>>2]=threadExitCode;Atomics.store(GROWABLE_HEAP_U32(),thread+64>>2,1);if(!ENVIRONMENT_IS_PT
HREAD)cleanupThread(thread);else postMessage({\"cmd\":\"cleanupThread\",\"thread\":thread});return
0}if(!block){return
ERRNO_CODES.EBUSY}__pthread_testcancel_js();if(!ENVIRONMENT_IS_PTHREAD)_emscripten_main_thre
ad_process_queued_calls();_emscripten_futex_wait(thread+0,threadStatus,ENVIRONMENT_IS_PTHREAD?100:1
)}}function
 _pthread_join(thread,status){return __emscripten_do_pthread_join(thread,status,true)}function
_sysconf(name){if(ENVIRONMENT_IS_PTHREAD)return
```

_emscripten_proxy_to_main_thread_js(6,1,name);switch(name){case 30:return 16384;case 85:var maxHeapSize=2147483648;return maxHeapSize/16384;case 132:case 133:case 12:case 137:case 138:case 15:case 235:case 16:case 17:case 18:case 19:case 20:case 149:case 13:case 10:case 236:case 153:case 9:case 21:case 22:case 159:case 154:case 14:case 77:case 78:case 139:case 82:case 68:case 67:case 164:case 11:case 29:case 47:case 48:case 95:case 52:case 51:case 46:return 200809;case 27:case 246:case 127:case 128:case 23:case 24:case 160:case 161:case 181:case 182:case 242:case 183:case 184:case 243:case 244:case 245:case 165:case 178:case 179:case 49:case 50:case 168:case 169:case 175:case 170:case 171:case 172:case 97:case 76:case 32:case 173:case 35:case 80:case 81:case 79:return-1;case 176:case 177:case 7:case 155:case 8:case 157:case 125:case 126:case 92:case 93:case 129:case 130:case 131:case 94:case 91:return 1;case 74:case 60:case 69:case 70:case 4:return 1024;case 31:case 42:case 72:return 32;case 87:case 26:case 33:return 2147483647;case 34:case 1:return 47839;case 38:case 36:return 99;case 43:case 37:return 2048;case 0:return 2097152;case 3:return 65536;case 28:return 32768;case 44:return 32767;case 75:return 16384;case 39:return 1e3;case 89:return 700;case 71:return 256;case 40:return 255;case 2:return 100;case 180:return 64;case 25:return 20;case 5:return 16;case 6:return 6;case 73:return 4;case 84:{if(typeof navigator===\"object\")return navigator[\"hardwareConcurrency\"]||1;return 1}}setErrNo(28);return-1}if(!ENVIRONMENT_IS_PTHREAD)PThread.initMainThreadBlock();var GLctx;var proxiedFunctionTable=[null,_atexit,_emscripten_set_canvas_element_size_main_thread,_fd_close,_fd_seek,_fd_write,_sysconf];var asmLibraryArg={\"e\":___assert_fail,\"r\":___call_main,\"x\":__emscripten_notify_thread_queue,\"b\":_abort,\"y\":_emscripten_asm_const_int,\"j\":_emscripten_conditional_set_current_thread_status,\"d\":_emscripten_futex_wait,\"c\":_emscripten_futex_wake,\"f\":_emscripten_get_now,\"p\":_emscripten_memcpy_big,\"A\":_emscripten_num_logical_cores,\"u\":_emscripten_receive_on_main_thread_js,\"q\":_emscripten_resize_heap,\"v\":_emscripten_set_canvas_element_size,\"i\":_emscripten_set_current_thread_status,\"s\":_emscripten_set_thread_name,\"w\":_emscripten_webgl_create_context,\"l\":_fd_close,\"n\":_fd_seek,\"g\":_fd_write,\"o\":initPthreadsJS,\"a\":wasmMemory||Module[\"wasmMemory\"],\"z\":_pthread_cleanup_pop,\"k\":_pthread_cleanup_push,\"h\":_pthread_create,\"m\":_pthread_join,\"t\":_sysconf};var asm=createWasm();var ___wasm_call_ctors=Module[\"___wasm_call_ctors\"]=function(){return(___wasm_call_ctors=Module[\"___wasm_call_ctors\"]=Module[\"asm\"][\"B\"]).apply(null,arguments)};var _init=Module[\"_init\"]=function(){return(_init=Module[\"_init\"]=Module[\"asm\"][\"C\"]).apply(null,arguments)};var _init_with_threads_count=Module[\"_init_with_threads_count\"]=function(){return(_init_with_threads_count=Module[\"_init_with_threads_count\"]=Module[\"asm\"][\"D\"]).apply(null,arguments)};var _get_threads_count=Module[\"_get_threads_count\"]=function(){return(_get_threads_count=Module[\"_get_threads_count\"]=Module[\"asm\"][\"E\"]).apply(null,arguments)};var _register_tensor=Module[\"_register_tensor\"]=function(){return(_register_tensor=Module[\"_register_tensor\"]=Module[\"asm\"][\"F\"]).apply(null,arguments)};var _dispose_data=Module[\"_dispose_data\"]=function(){return(_dispose_data=Module[\"_dispose_data\"]=Module[\"asm\"][\"G\"]).apply(null,arguments)};var _dispose=Module[\"_dispose\"]=function(){return(_dispose=Module[\"_dispose\"]=Module[\"asm\"][\"H\"]).apply(null,arguments)};var _Abs=Module[\"_Abs\"]=function(){return(_Abs=Module[\"_Abs\"]=Module[\"asm\"][\"J\"]).apply(null,arguments)};var _Add=Module[\"_Add\"]=function(){return(_Add=Module[\"_Add\"]=Module[\"asm\"][\"K\"]).apply(null,arguments)};var _AddN=Module[\"_AddN\"]=function(){return(_AddN=Module[\"_AddN\"]=Module[\"asm\"][\"L\"]).apply(null,arguments)};var _All=Module[\"_All\"]=function(){return(_All=Module[\"_All\"]=Module[\"asm\"][\"M\"]).apply(null,arguments)};var

_Any=Module[\"_Any\"]=function(){return(_Any=Module[\"_Any\"]=Module[\"asm\"][\"N\"]).apply(null,arguments)};var
_ArgMax=Module[\"_ArgMax\"]=function(){return(_ArgMax=Module[\"_ArgMax\"]=Module[\"asm\"][\"O\"]).apply(null,arguments)};var
_AvgPool=Module[\"_AvgPool\"]=function(){return(_AvgPool=Module[\"_AvgPool\"]=Module[\"asm\"][\"P\"]).apply(null,arguments)};var
_BatchMatMul=Module[\"_BatchMatMul\"]=function(){return(_BatchMatMul=Module[\"_BatchMatMul\"]=Module[\"asm\"][\"Q\"]).apply(null,arguments)};var
_Ceil=Module[\"_Ceil\"]=function(){return(_Ceil=Module[\"_Ceil\"]=Module[\"asm\"][\"R\"]).apply(null,arguments)};var
_ClipByValue=Module[\"_ClipByValue\"]=function(){return(_ClipByValue=Module[\"_ClipByValue\"]=Module[\"asm\"][\"S\"]).apply(null,arguments)};var
_Conv2D=Module[\"_Conv2D\"]=function(){return(_Conv2D=Module[\"_Conv2D\"]=Module[\"asm\"][\"T\"]).apply(null,arguments)};var
_Conv2DBackpropInput=Module[\"_Conv2DBackpropInput\"]=function(){return(_Conv2DBackpropInput=Module[\"_Conv2DBackpropInput\"]=Module[\"asm\"][\"U\"]).apply(null,arguments)};var
_Cos=Module[\"_Cos\"]=function(){return(_Cos=Module[\"_Cos\"]=Module[\"asm\"][\"V\"]).apply(null,arguments)};var
_Cosh=Module[\"_Cosh\"]=function(){return(_Cosh=Module[\"_Cosh\"]=Module[\"asm\"][\"W\"]).apply(null,arguments)};var
_CropAndResize=Module[\"_CropAndResize\"]=function(){return(_CropAndResize=Module[\"_CropAndResize\"]=Module[\"asm\"][\"X\"]).apply(null,arguments)};var
_Cumsum=Module[\"_Cumsum\"]=function(){return(_Cumsum=Module[\"_Cumsum\"]=Module[\"asm\"][\"Y\"]).apply(null,arguments)};var
_DepthToSpace=Module[\"_DepthToSpace\"]=function(){return(_DepthToSpace=Module[\"_DepthToSpace\"]=Module[\"asm\"][\"Z\"]).apply(null,arguments)};var
_DepthwiseConv2dNative=Module[\"_DepthwiseConv2dNative\"]=function(){return(_DepthwiseConv2dNative=Module[\"_DepthwiseConv2dNative\"]=Module[\"asm\"][\"_\"]).apply(null,arguments)};var
_Elu=Module[\"_Elu\"]=function(){return(_Elu=Module[\"_Elu\"]=Module[\"asm\"][\"$\"]).apply(null,arguments)};var
_Equal=Module[\"_Equal\"]=function(){return(_Equal=Module[\"_Equal\"]=Module[\"asm\"][\"aa\"]).apply(null,arguments)};var
_Exp=Module[\"_Exp\"]=function(){return(_Exp=Module[\"_Exp\"]=Module[\"asm\"][\"ba\"]).apply(null,arguments)};var
_FlipLeftRight=Module[\"_FlipLeftRight\"]=function(){return(_FlipLeftRight=Module[\"_FlipLeftRight\"]=Module[\"asm\"][\"ca\"]).apply(null,arguments)};var
_Floor=Module[\"_Floor\"]=function(){return(_Floor=Module[\"_Floor\"]=Module[\"asm\"][\"da\"]).apply(null,arguments)};var
_FloorDiv=Module[\"_FloorDiv\"]=function(){return(_FloorDiv=Module[\"_FloorDiv\"]=Module[\"asm\"][\"ea\"]).apply(null,arguments)};var
_FusedBatchNorm=Module[\"_FusedBatchNorm\"]=function(){return(_FusedBatchNorm=Module[\"_FusedBatchNorm\"]=Module[\"asm\"][\"fa\"]).apply(null,arguments)};var
_FusedConv2D=Module[\"_FusedConv2D\"]=function(){return(_FusedConv2D=Module[\"_FusedConv2D\"]=Module[\"asm\"][\"ga\"]).apply(null,arguments)};var
_FusedDepthwiseConv2D=Module[\"_FusedDepthwiseConv2D\"]=function(){return(_FusedDepthwiseConv2D=Module[\"_FusedDepthwiseConv2D\"]=Module[\"asm\"][\"ha\"]).apply(null,arguments)};var
_Gather=Module[\"_Gather\"]=function(){return(_Gather=Module[\"_Gather\"]=Module[\"asm\"][\"ia\"]).apply(null,arguments)};var

_GatherNd=Module[\"_GatherNd\"]=function(){return(_GatherNd=Module[\"_GatherNd\"]=Module[\"asm\"][\"ja\"]).apply(null,arguments)};var
_Greater=Module[\"_Greater\"]=function(){return(_Greater=Module[\"_Greater\"]=Module[\"asm\"][\"ka\"]).apply(null,arguments)};var
_GreaterEqual=Module[\"_GreaterEqual\"]=function(){return(_GreaterEqual=Module[\"_GreaterEqual\"]=Module[\"asm\"][\"la\"]).apply(null,arguments)};var
_LeakyRelu=Module[\"_LeakyRelu\"]=function(){return(_LeakyRelu=Module[\"_LeakyRelu\"]=Module[\"asm\"][\"ma\"]).apply(null,arguments)};var
_Less=Module[\"_Less\"]=function(){return(_Less=Module[\"_Less\"]=Module[\"asm\"][\"na\"]).apply(null,arguments)};var
_LessEqual=Module[\"_LessEqual\"]=function(){return(_LessEqual=Module[\"_LessEqual\"]=Module[\"asm\"][\"oa\"]).apply(null,arguments)};var
_Log=Module[\"_Log\"]=function(){return(_Log=Module[\"_Log\"]=Module[\"asm\"][\"pa\"]).apply(null,arguments)};var
_LogicalAnd=Module[\"_LogicalAnd\"]=function(){return(_LogicalAnd=Module[\"_LogicalAnd\"]=Module[\"asm\"][\"qa\"]).apply(null,arguments)};var
_Max=Module[\"_Max\"]=function(){return(_Max=Module[\"_Max\"]=Module[\"asm\"][\"ra\"]).apply(null,arguments)};var
_MaxPool=Module[\"_MaxPool\"]=function(){return(_MaxPool=Module[\"_MaxPool\"]=Module[\"asm\"][\"sa\"]).apply(null,arguments)};var
_Maximum=Module[\"_Maximum\"]=function(){return(_Maximum=Module[\"_Maximum\"]=Module[\"asm\"][\"ta\"]).apply(null,arguments)};var
_Mean=Module[\"_Mean\"]=function(){return(_Mean=Module[\"_Mean\"]=Module[\"asm\"][\"ua\"]).apply(null,arguments)};var
_Min=Module[\"_Min\"]=function(){return(_Min=Module[\"_Min\"]=Module[\"asm\"][\"va\"]).apply(null,arguments)};var
_Minimum=Module[\"_Minimum\"]=function(){return(_Minimum=Module[\"_Minimum\"]=Module[\"asm\"][\"wa\"]).apply(null,arguments)};var
_MirrorPad=Module[\"_MirrorPad\"]=function(){return(_MirrorPad=Module[\"_MirrorPad\"]=Module[\"asm\"][\"xa\"]).apply(null,arguments)};var
_Multiply=Module[\"_Multiply\"]=function(){return(_Multiply=Module[\"_Multiply\"]=Module[\"asm\"][\"ya\"]).apply(null,arguments)};var
_Neg=Module[\"_Neg\"]=function(){return(_Neg=Module[\"_Neg\"]=Module[\"asm\"][\"za\"]).apply(null,arguments)};var
_NonMaxSuppressionV3=Module[\"_NonMaxSuppressionV3\"]=function(){return(_NonMaxSuppressionV3=Module[\"_NonMaxSuppressionV3\"]=Module[\"asm\"][\"Aa\"]).apply(null,arguments)};var
_NonMaxSuppressionV4=Module[\"_NonMaxSuppressionV4\"]=function(){return(_NonMaxSuppressionV4=Module[\"_NonMaxSuppressionV4\"]=Module[\"asm\"][\"Ba\"]).apply(null,arguments)};var
_NonMaxSuppressionV5=Module[\"_NonMaxSuppressionV5\"]=function(){return(_NonMaxSuppressionV5=Module[\"_NonMaxSuppressionV5\"]=Module[\"asm\"][\"Ca\"]).apply(null,arguments)};var
_NotEqual=Module[\"_NotEqual\"]=function(){return(_NotEqual=Module[\"_NotEqual\"]=Module[\"asm\"][\"Da\"]).apply(null,arguments)};var
_OneHot=Module[\"_OneHot\"]=function(){return(_OneHot=Module[\"_OneHot\"]=Module[\"asm\"][\"Ea\"]).apply(null,arguments)};var
_PadV2=Module[\"_PadV2\"]=function(){return(_PadV2=Module[\"_PadV2\"]=Module[\"asm\"][\"Fa\"]).apply(null,arguments)};var
_Pow=Module[\"_Pow\"]=function(){return(_Pow=Module[\"_Pow\"]=Module[\"asm\"][\"Ga\"]).apply(null,arguments)};var

_Prelu=Module[\"_Prelu\"]=function(){return(_Prelu=Module[\"_Prelu\"]=Module[\"asm\"][\"Ha\"]).apply(null,arguments)};var
_Prod=Module[\"_Prod\"]=function(){return(_Prod=Module[\"_Prod\"]=Module[\"asm\"][\"Ia\"]).apply(null,arguments)};var
_RealDiv=Module[\"_RealDiv\"]=function(){return(_RealDiv=Module[\"_RealDiv\"]=Module[\"asm\"][\"Ja\"]).apply(null,arguments)};var
_Relu=Module[\"_Relu\"]=function(){return(_Relu=Module[\"_Relu\"]=Module[\"asm\"][\"Ka\"]).apply(null,arguments)};var
_Relu6=Module[\"_Relu6\"]=function(){return(_Relu6=Module[\"_Relu6\"]=Module[\"asm\"][\"La\"]).apply(null,arguments)};var
_ResizeBilinear=Module[\"_ResizeBilinear\"]=function(){return(_ResizeBilinear=Module[\"_ResizeBilinear\"]=Module[\"asm\"][\"Ma\"]).apply(null,arguments)};var
_Reverse=Module[\"_Reverse\"]=function(){return(_Reverse=Module[\"_Reverse\"]=Module[\"asm\"][\"Na\"]).apply(null,arguments)};var
_RotateWithOffset=Module[\"_RotateWithOffset\"]=function(){return(_RotateWithOffset=Module[\"_RotateWithOffset\"]=Module[\"asm\"][\"Oa\"]).apply(null,arguments)};var
_Round=Module[\"_Round\"]=function(){return(_Round=Module[\"_Round\"]=Module[\"asm\"][\"Pa\"]).apply(null,arguments)};var
_Rsqrt=Module[\"_Rsqrt\"]=function(){return(_Rsqrt=Module[\"_Rsqrt\"]=Module[\"asm\"][\"Qa\"]).apply(null,arguments)};var
_ScatterNd=Module[\"_ScatterNd\"]=function(){return(_ScatterNd=Module[\"_ScatterNd\"]=Module[\"asm\"][\"Ra\"]).apply(null,arguments)};var
_SelectV2=Module[\"_SelectV2\"]=function(){return(_SelectV2=Module[\"_SelectV2\"]=Module[\"asm\"][\"Sa\"]).apply(null,arguments)};var
_Sigmoid=Module[\"_Sigmoid\"]=function(){return(_Sigmoid=Module[\"_Sigmoid\"]=Module[\"asm\"][\"Ta\"]).apply(null,arguments)};var
_Sin=Module[\"_Sin\"]=function(){return(_Sin=Module[\"_Sin\"]=Module[\"asm\"][\"Ua\"]).apply(null,arguments)};var
_Softmax=Module[\"_Softmax\"]=function(){return(_Softmax=Module[\"_Softmax\"]=Module[\"asm\"][\"Va\"]).apply(null,arguments)};var
_Sqrt=Module[\"_Sqrt\"]=function(){return(_Sqrt=Module[\"_Sqrt\"]=Module[\"asm\"][\"Wa\"]).apply(null,arguments)};var
_Square=Module[\"_Square\"]=function(){return(_Square=Module[\"_Square\"]=Module[\"asm\"][\"Xa\"]).apply(null,arguments)};var
_SquaredDifference=Module[\"_SquaredDifference\"]=function(){return(_SquaredDifference=Module[\"_SquaredDifference\"]=Module[\"asm\"][\"Ya\"]).apply(null,arguments)};var
_Step=Module[\"_Step\"]=function(){return(_Step=Module[\"_Step\"]=Module[\"asm\"][\"Za\"]).apply(null,arguments)};var
_StridedSlice=Module[\"_StridedSlice\"]=function(){return(_StridedSlice=Module[\"_StridedSlice\"]=Module[\"asm\"][\"_a\"]).apply(null,arguments)};var
_Sub=Module[\"_Sub\"]=function(){return(_Sub=Module[\"_Sub\"]=Module[\"asm\"][\"$a\"]).apply(null,arguments)};var
_Sum=Module[\"_Sum\"]=function(){return(_Sum=Module[\"_Sum\"]=Module[\"asm\"][\"ab\"]).apply(null,arguments)};var
_Tan=Module[\"_Tan\"]=function(){return(_Tan=Module[\"_Tan\"]=Module[\"asm\"][\"bb\"]).apply(null,arguments)};var
_Tanh=Module[\"_Tanh\"]=function(){return(_Tanh=Module[\"_Tanh\"]=Module[\"asm\"][\"cb\"]).apply(null,arguments)};var

_Tile=Module[\"_Tile\"]=function(){return(_Tile=Module[\"_Tile\"]=Module[\"asm\"][\"db\"]).apply(null,arguments)};var
_TopK=Module[\"_TopK\"]=function(){return(_TopK=Module[\"_TopK\"]=Module[\"asm\"][\"eb\"]).apply(null,arguments)};var
_Transform=Module[\"_Transform\"]=function(){return(_Transform=Module[\"_Transform\"]=Module[\"asm\"][\"fb\"]).apply(null,arguments)};var
_Transpose=Module[\"_Transpose\"]=function(){return(_Transpose=Module[\"_Transpose\"]=Module[\"asm\"][\"gb\"]).apply(null,arguments)};var
__FusedMatMul=Module[\"__FusedMatMul\"]=function(){return(__FusedMatMul=Module[\"__FusedMatMul\"]=Module[\"asm\"][\"hb\"]).apply(null,arguments)};var
_malloc=Module[\"_malloc\"]=function(){return(_malloc=Module[\"_malloc\"]=Module[\"asm\"][\"ib\"]).apply(null,arguments)};var
_free=Module[\"_free\"]=function(){return(_free=Module[\"_free\"]=Module[\"asm\"][\"jb\"]).apply(null,arguments)};var
___errno_location=Module[\"___errno_location\"]=function(){return(___errno_location=Module[\"___errno_location\"]=Module[\"asm\"][\"kb\"]).apply(null,arguments)};var
_emscripten_get_global_libc=Module[\"_emscripten_get_global_libc\"]=function(){return(_emscripten_get_global_libc=Module[\"_emscripten_get_global_libc\"]=Module[\"asm\"][\"lb\"]).apply(null,arguments)};var
_pthread_self=Module[\"_pthread_self\"]=function(){return(_pthread_self=Module[\"_pthread_self\"]=Module[\"asm\"][\"mb\"]).apply(null,arguments)};var
___pthread_tsd_run_dtors=Module[\"___pthread_tsd_run_dtors\"]=function(){return(___pthread_tsd_run_dtors=Module[\"___pthread_tsd_run_dtors\"]=Module[\"asm\"][\"nb\"]).apply(null,arguments)};var
_emscripten_main_thread_process_queued_calls=Module[\"_emscripten_main_thread_process_queued_calls\"]=function(){return(_emscripten_main_thread_process_queued_calls=Module[\"_emscripten_main_thread_process_queued_calls\"]=Module[\"asm\"][\"ob\"]).apply(null,arguments)};var
_emscripten_current_thread_process_queued_calls=Module[\"_emscripten_current_thread_process_queued_calls\"]=function(){return(_emscripten_current_thread_process_queued_calls=Module[\"_emscripten_current_thread_process_queued_calls\"]=Module[\"asm\"][\"pb\"]).apply(null,arguments)};var
_emscripten_register_main_browser_thread_id=Module[\"_emscripten_register_main_browser_thread_id\"]=function(){return(_emscripten_register_main_browser_thread_id=Module[\"_emscripten_register_main_browser_thread_id\"]=Module[\"asm\"][\"qb\"]).apply(null,arguments)};var
_emscripten_main_browser_thread_id=Module[\"_emscripten_main_browser_thread_id\"]=function(){return(_emscripten_main_browser_thread_id=Module[\"_emscripten_main_browser_thread_id\"]=Module[\"asm\"][\"rb\"]).apply(null,arguments)};var
__emscripten_do_dispatch_to_thread=Module[\"__emscripten_do_dispatch_to_thread\"]=function(){return(__emscripten_do_dispatch_to_thread=Module[\"__emscripten_do_dispatch_to_thread\"]=Module[\"asm\"][\"sb\"]).apply(null,arguments)};var
_emscripten_sync_run_in_main_thread_4=Module[\"_emscripten_sync_run_in_main_thread_4\"]=function(){return(_emscripten_sync_run_in_main_thread_4=Module[\"_emscripten_sync_run_in_main_thread_4\"]=Module[\"asm\"][\"tb\"]).apply(null,arguments)};var
_emscripten_run_in_main_runtime_thread_js=Module[\"_emscripten_run_in_main_runtime_thread_js\"]=function(){return(_emscripten_run_in_main_runtime_thread_js=Module[\"_emscripten_run_in_main_runtime_thread_js\"]=Module[\"asm\"][\"ub\"]).apply(null,arguments)};var
__emscripten_call_on_thread=Module[\"__emscripten_call_on_thread\"]=function(){return(__emscripten_call_on_thread=Module[\"__emscripten_call_on_thread\"]=Module[\"asm\"][\"vb\"]).apply(null,arguments)};var
_emscripten_tls_init=Module[\"_emscripten_tls_init\"]=function(){return(_emscripten_tls_init=Module[\"_emscripten_tls_init\"]=Module[\"asm\"][\"wb\"]).apply(null,arguments)};var
__emscripten_thread_init=Module[\"__emscripten_thread_init\"]=function(){return(__emscripten_thread_init=Mod

ule[\"__emscripten_thread_init\"]=Module[\"asm\"][\"xb\"]).apply(null,arguments)};var stackSave=Module[\"stackSave\"]=function(){return(stackSave=Module[\"stackSave\"]=Module[\"asm\"][\"yb\"]).apply(null,arguments)};var stackRestore=Module[\"stackRestore\"]=function(){return(stackRestore=Module[\"stackRestore\"]=Module[\"asm\"][\"zb\"]).apply(null,arguments)};var stackAlloc=Module[\"stackAlloc\"]=function(){return(stackAlloc=Module[\"stackAlloc\"]=Module[\"asm\"][\"Ab\"]).apply(null,arguments)};var _emscripten_stack_set_limits=Module[\"_emscripten_stack_set_limits\"]=function(){return(_emscripten_stack_set_limits=Module[\"_emscripten_stack_set_limits\"]=Module[\"asm\"][\"Bb\"]).apply(null,arguments)};var _memalign=Module[\"_memalign\"]=function(){return(_memalign=Module[\"_memalign\"]=Module[\"asm\"][\"Cb\"]).apply(null,arguments)};var __emscripten_allow_main_runtime_queued_calls=Module[\"__emscripten_allow_main_runtime_queued_calls\"]=10512;var __emscripten_main_thread_futex=Module[\"__emscripten_main_thread_futex\"]=12148;Module[\"cwrap\"]=cwrap;Module[\"PThread\"]=PThread;Module[\"PThread\"]=PThread;Module[\"wasmMemory\"]=wasmMemory;Module[\"ExitStatus\"]=ExitStatus;var calledRun;function ExitStatus(status){this.name=\"ExitStatus\";this.message=\"Program terminated with exit(\"+status+\")\";this.status=status}dependenciesFulfilled=function runCaller(){if(!calledRun)run();if(!calledRun)dependenciesFulfilled=runCaller};function run(args){args=args||arguments_;if(runDependencies>0){return}if(ENVIRONMENT_IS_PTHREAD){readyPromiseResolve(Module);initRuntime();postMessage({\"cmd\":\"loaded\"});return}preRun();if(runDependencies>0){return}function doRun(){if(calledRun)return;calledRun=true;Module[\"calledRun\"]=true;if(ABORT)return;initRuntime();preMain();readyPromiseResolve(Module);if(Module[\"onRuntimeInitialized\"])Module[\"onRuntimeInitialized\"]();postRun()}if(Module[\"setStatus\"]){Module[\"setStatus\"](\"Running...\");setTimeout(function(){setTimeout(function(){Module[\"setStatus\"](\"\")},1);doRun()},1)}else{doRun()}}Module[\"run\"]=run;function exit(status,implicit){if(implicit&&noExitRuntime&&status===0){return}if(!implicit){if(ENVIRONMENT_IS_PTHREAD){postMessage({\"cmd\":\"exitProcess\",\"returnCode\":status});throw new ExitStatus(status)}else{}}if(noExitRuntime){}else{PThread.terminateAllThreads();EXITSTATUS=status;exitRuntime();if(Module[\"onExit\"])Module[\"onExit\"](status);ABORT=true}quit_(status,new ExitStatus(status))}if(Module[\"preInit\"]){if(typeof Module[\"preInit\"]==\"function\")Module[\"preInit\"]=[Module[\"preInit\"]];while(Module[\"preInit\"].length>0){Module[\"preInit\"].pop()()}}if(ENVIRONMENT_IS_PTHREAD){noExitRuntime=false;PThread.initWorker()}run();\n\n\n return WasmBackendModuleThreadedSimd.ready\n}\n);\n})();\nif (typeof exports === 'object' && typeof module === 'object')\n module.exports = WasmBackendModuleThreadedSimd;\nelse if (typeof define === 'function' && define['amd'])\n define([], function() { return WasmBackendModuleThreadedSimd; });\nelse if (typeof exports === 'object')\n exports[\"WasmBackendModuleThreadedSimd\"] = WasmBackendModuleThreadedSimd;\n","\nvar WasmBackendModule = (function() {\n var _scriptDir = typeof document !== 'undefined' && document.currentScript ? document.currentScript.src : undefined;\n if (typeof __filename !== 'undefined') _scriptDir = _scriptDir || __filename;\n return (\nfunction(WasmBackendModule) {\n WasmBackendModule = WasmBackendModule || {};\n\n\nvar Module=typeof WasmBackendModule!==\"undefined\"?WasmBackendModule:{};var readyPromiseResolve,readyPromiseReject;Module[\"ready\"]=new Promise(function(resolve,reject){readyPromiseResolve=resolve;readyPromiseReject=reject});var moduleOverrides={};var key;for(key in Module){if(Module.hasOwnProperty(key)){moduleOverrides[key]=Module[key]}}var arguments_=[];var thisProgram=\"./this.program\";var quit_=function(status,toThrow){throw toThrow};var

ENVIRONMENT_IS_WEB=false;var ENVIRONMENT_IS_WORKER=false;var ENVIRONMENT_IS_NODE=false;var ENVIRONMENT_IS_SHELL=false;ENVIRONMENT_IS_WEB=typeof window===\"object\";ENVIRONMENT_IS_WORKER=typeof importScripts===\"function\";ENVIRONMENT_IS_NODE=typeof process===\"object\"&&typeof process.versions===\"object\"&&typeof process.versions.node===\"string\";ENVIRONMENT_IS_SHELL=!ENVIRONMENT_IS_WEB&&!ENVIRONMENT_IS_NODE&&!ENVIRONMENT_IS_WORKER;var scriptDirectory=\"\";function locateFile(path){if(Module[\"locateFile\"]){return Module[\"locateFile\"](path,scriptDirectory)}return scriptDirectory+path}var read_,readAsync,readBinary,setWindowTitle;var nodeFS;var nodePath;if(ENVIRONMENT_IS_NODE){if(ENVIRONMENT_IS_WORKER){scriptDirectory=require(\"path\").dirname(scriptDirectory)+\"/\"}else{scriptDirectory=__dirname+\"/\"}read_=function shell_read(filename,binary){if(!nodeFS)nodeFS=require(\"fs\");if(!nodePath)nodePath=require(\"path\");filename=nodePath[\"normalize\"](filename);return nodeFS[\"readFileSync\"](filename,binary?null:\"utf8\")};readBinary=function readBinary(filename){var ret=read_(filename,true);if(!ret.buffer){ret=new Uint8Array(ret)}assert(ret.buffer);return ret};if(process[\"argv\"].length>1){thisProgram=process[\"argv\"][1].replace(/\\\\/g,\"/\")}arguments_=process[\"argv\"].slice(2);process[\"on\"](\"uncaughtException\",function(ex){if(!(ex instanceof ExitStatus)){throw ex}});process[\"on\"](\"unhandledRejection\",abort);quit_=function(status){process[\"exit\"](status)};Module[\"inspect\"]=function(){return\"[Emscripten Module object]\"}}else if(ENVIRONMENT_IS_SHELL){if(typeof read!=\"undefined\"){read_=function shell_read(f){return read(f)}}readBinary=function readBinary(f){var data;if(typeof readbuffer===\"function\"){return new Uint8Array(readbuffer(f))}data=read(f,\"binary\");assert(typeof data===\"object\");return data};if(typeof scriptArgs!=\"undefined\"){arguments_=scriptArgs}else if(typeof arguments!=\"undefined\"){arguments_=arguments}if(typeof quit===\"function\"){quit_=function(status){quit(status)}}if(typeof print!==\"undefined\"){if(typeof console===\"undefined\")console={};console.log=print;console.warn=console.error=typeof printErr!==\"undefined\"?printErr:print}}else if(ENVIRONMENT_IS_WEB||ENVIRONMENT_IS_WORKER){if(ENVIRONMENT_IS_WORKER){scriptDirectory=self.location.href}else if(typeof document!==\"undefined\"&&document.currentScript){scriptDirectory=document.currentScript.src}if(_scriptDir){scriptDirectory=_scriptDir}if(scriptDirectory.indexOf(\"blob:\")!==0){scriptDirectory=scriptDirectory.substr(0,scriptDirectory.lastIndexOf(\"/\")+1)}else{scriptDirectory=\"\"}{read_=function(url){var xhr=new XMLHttpRequest;xhr.open(\"GET\",url,false);xhr.send(null);return xhr.responseText};if(ENVIRONMENT_IS_WORKER){readBinary=function(url){var xhr=new XMLHttpRequest;xhr.open(\"GET\",url,false);xhr.responseType=\"arraybuffer\";xhr.send(null);return new Uint8Array(xhr.response)}}readAsync=function(url,onload,onerror){var xhr=new XMLHttpRequest;xhr.open(\"GET\",url,true);xhr.responseType=\"arraybuffer\";xhr.onload=function(){if(xhr.status==200||xhr.status==0&&xhr.response){onload(xhr.response);return}onerror()};xhr.onerror=onerror;xhr.send(null)}}setWindowTitle=function(title){document.title=title}}else{}var out=Module[\"print\"]||console.log.bind(console);var err=Module[\"printErr\"]||console.warn.bind(console);for(key in moduleOverrides){if(moduleOverrides.hasOwnProperty(key)){Module[key]=moduleOverrides[key]}}moduleOverrides=null;if(Module[\"arguments\"])arguments_=Module[\"arguments\"];if(Module[\"thisProgram\"])thisProgram=Module[\"thisProgram\"];if(Module[\"quit\"])quit_=Module[\"quit\"];var wasmBinary;if(Module[\"wasmBinary\"])wasmBinary=Module[\"wasmBinary\"];var noExitRuntime=Module[\"noExitRuntime\"]||true;if(typeof WebAssembly!==\"object\"){abort(\"no native wasm support detected\")}var wasmMemory;var ABORT=false;var EXITSTATUS;function assert(condition,text){if(!condition){abort(\"Assertion failed: \"+text)}}function getCFunc(ident){var

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func=Module[\"_\"+ident];assert(func,\"Cannot call unknown function \"+ident+\", make sure it is exported\");return
func}function ccall(ident,returnType,argTypes,args,opts){var
 toC={\"string\":function(str){var ret=0;if(str!==null&&str!==undefined&&str!==0){var
len=(str.length<<2)+1;ret=stackAlloc(len);stringToUTF8(str,ret,len)}return ret},\"array\":function(arr){var
ret=stackAlloc(arr.length);writeArrayToMemory(arr,ret);return ret}};function
convertReturnValue(ret){if(returnType===\"string\")return UTF8ToString(ret);if(returnType===\"boolean\")return
Boolean(ret);return ret}var func=getCFunc(ident);var cArgs=[];var stack=0;if(args){for(var
i=0;i<args.length;i++){var
converter=toC[argTypes[i]];if(converter){if(stack===0)stack=stackSave();cArgs[i]=converter(args[i])}else{cArgs[i
]=args[i]}}}var ret=func.apply(null,cArgs);ret=convertReturnValue(ret);if(stack!==0)stackRestore(stack);return
ret}function cwrap(ident,returnType,argTypes,opts){argTypes=argTypes||[];var
numericArgs=argTypes.every(function(type){return type===\"number\"});var
numericRet=returnType!==\"string\";if(numericRet&&numericArgs&&!opts){return getCFunc(ident)}return
 function(){return ccall(ident,returnType,argTypes,arguments,opts)}}var UTF8Decoder=typeof
TextDecoder!==\"undefined\"?new TextDecoder(\"utf8\"):undefined;function
UTF8ArrayToString(heap,idx,maxBytesToRead){var endIdx=idx+maxBytesToRead;var
endPtr=idx;while(heap[endPtr]&&!(endPtr>=endIdx))++endPtr;if(endPtr-
idx>16&&heap.subarray&&UTF8Decoder){return UTF8Decoder.decode(heap.subarray(idx,endPtr))}else{var
str=\"\";while(idx<endPtr){var u0=heap[idx++];if(!(u0&128)){str+=String.fromCharCode(u0);continue}var
u1=heap[idx++]&63;if((u0&224)==192){str+=String.fromCharCode((u0&31)<<6|u1);continue}var
u2=heap[idx++]&63;if((u0&240)==224){u0=(u0&15)<<12|u1<<6|u2}else{u0=(u0&7)<<18|u1<<12|u2<<6|heap[id
x++]&63}if(u0<65536){str+=String.fromCharCode(u0)}else{var ch=u0-
65536;str+=String.fromCharCode(55296|ch>>10,56320|ch&1023)}}}return str}function
UTF8ToString(ptr,maxBytesToRead){return
ptr?UTF8ArrayToString(HEAPU8,ptr,maxBytesToRead):\"\"}function
stringToUTF8Array(str,heap,outIdx,maxBytesToWrite){if(!(maxBytesToWrite>0))return
 0;var startIdx=outIdx;var endIdx=outIdx+maxBytesToWrite-1;for(var i=0;i<str.length;++i){var
u=str.charCodeAt(i);if(u>=55296&&u<=57343){var
u1=str.charCodeAt(++i);u=65536+((u&1023)<<10)|u1&1023}if(u<=127){if(outIdx>=endIdx)break;heap[outIdx++]
=u}else if(u<=2047){if(outIdx+1>=endIdx)break;heap[outIdx++]=192|u>>6;heap[outIdx++]=128|u&63}else
if(u<=65535){if(outIdx+2>=endIdx)break;heap[outIdx++]=224|u>>12;heap[outIdx++]=128|u>>6&63;heap[outIdx
++]=128|u&63}else{if(outIdx+3>=endIdx)break;heap[outIdx++]=240|u>>18;heap[outIdx++]=128|u>>12&63;heap[
outIdx++]=128|u>>6&63;heap[outIdx++]=128|u&63}}heap[outIdx]=0;return outIdx-startIdx}function
stringToUTF8(str,outPtr,maxBytesToWrite){return
stringToUTF8Array(str,HEAPU8,outPtr,maxBytesToWrite)}function
writeArrayToMemory(array,buffer){HEAP8.set(array,buffer)}function
alignUp(x,multiple){if(x%multiple>0){x+=multiple-x%multiple}return x}var
buffer,HEAP8,HEAPU8,HEAP16,HEAPU16,HEAP32,HEAPU32,HEAPF32,HEAPF64;function
 updateGlobalBufferAndViews(buf){buffer=buf;Module[\"HEAP8\"]=HEAP8=new
Int8Array(buf);Module[\"HEAP16\"]=HEAP16=new Int16Array(buf);Module[\"HEAP32\"]=HEAP32=new
Int32Array(buf);Module[\"HEAPU8\"]=HEAPU8=new Uint8Array(buf);Module[\"HEAPU16\"]=HEAPU16=new
Uint16Array(buf);Module[\"HEAPU32\"]=HEAPU32=new
Uint32Array(buf);Module[\"HEAPF32\"]=HEAPF32=new
Float32Array(buf);Module[\"HEAPF64\"]=HEAPF64=new Float64Array(buf)}var
INITIAL_MEMORY=Module[\"INITIAL_MEMORY\"]||16777216;var wasmTable;var __ATPRERUN__=[];var
__ATINIT__=[];var __ATMAIN__=[];var __ATPOSTRUN__=[];var
runtimeInitialized=false;__ATINIT__.push({func:function(){___wasm_call_ctors()}});function
preRun(){if(Module[\"preRun\"]){if(typeof
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Module[\"preRun\"]==\"function\")Module[\"preRun\"]=[Module[\"preRun\"]];while(Module[\"preRun\"].length){addOnPreRun(Module[\"preRun\"].shift())}}callRuntimeCallbacks(__ATPRERUN__)}function initRuntime(){runtimeInitialized=true;callRuntimeCallbacks(__ATINIT__)}function preMain(){callRuntimeCallbacks(__ATMAIN__)}function postRun(){if(Module[\"postRun\"]){if(typeof Module[\"postRun\"]==\"function\")Module[\"postRun\"]=[Module[\"postRun\"]];while(Module[\"postRun\"].length){addOnPostRun(Module[\"postRun\"].shift())}}callRuntimeCallbacks(__ATPOSTRUN__)}function addOnPreRun(cb){__ATPRERUN__.unshift(cb)}function addOnPostRun(cb){__ATPOSTRUN__.unshift(cb)}var runDependencies=0;var runDependencyWatcher=null;var dependenciesFulfilled=null;function addRunDependency(id){runDependencies++;if(Module[\"monitorRunDependencies\"]){Module[\"monitorRunDependencies\"](runDependencies)}}function removeRunDependency(id){runDependencies--;if(Module[\"monitorRunDependencies\"]){Module[\"monitorRunDependencies\"](runDependencies)}if(runDependencies==0){if(runDependencyWatcher!==null){clearInterval(runDependencyWatcher);runDependencyWatcher=null}if(dependenciesFulfilled){var callback=dependenciesFulfilled;dependenciesFulfilled=null;callback()}}}Module[\"preloadedImages\"]={};Module[\"preloadedAudios\"]={};function abort(what){if(Module[\"onAbort\"]){Module[\"onAbort\"](what)}what+=\"\";err(what);ABORT=true;EXITSTATUS=1;what=\"abort(\"+what+\"). Build with -s ASSERTIONS=1 for more info.\";var e=new WebAssembly.RuntimeError(what);readyPromiseReject(e);throw e}function hasPrefix(str,prefix){return String.prototype.startsWith?str.startsWith(prefix):str.indexOf(prefix)===0}var dataURIPrefix=\"data:application/octet-stream; base64,\";function isDataURI(filename){return hasPrefix(filename,dataURIPrefix)}var fileURIPrefix=\"file://\";function isFileURI(filename){return hasPrefix(filename,fileURIPrefix)}var wasmBinaryFile=\"tfjs-backend-wasm.wasm\";if(!isDataURI(wasmBinaryFile)){wasmBinaryFile=locateFile(wasmBinaryFile)}function getBinary(file){try{if(file==wasmBinaryFile&&wasmBinary){return new Uint8Array(wasmBinary)}if(readBinary){return readBinary(file)}else{throw\"both async and sync fetching of the wasm failed\"}}catch(err){abort(err)}}function getBinaryPromise(){if(!wasmBinary&&(ENVIRONMENT_IS_WEB||ENVIRONMENT_IS_WORKER)){if(typeof fetch===\"function\"&&!isFileURI(wasmBinaryFile)){return fetch(wasmBinaryFile,{credentials:\"same-origin\"}).then(function(response){if(!response[\"ok\"]){throw\"failed to load wasm binary file at '\"+wasmBinaryFile+\"'\"}return response[\"arrayBuffer\"]()}).catch(function(){return getBinary(wasmBinaryFile)})}else{if(readAsync){return new Promise(function(resolve,reject){readAsync(wasmBinaryFile,function(response){resolve(new Uint8Array(response))},reject)})}}}return Promise.resolve().then(function(){return getBinary(wasmBinaryFile)})}function createWasm(){var info={\"a\":asmLibraryArg};function receiveInstance(instance,module){var exports=instance.exports;Module[\"asm\"]=exports;wasmMemory=Module[\"asm\"][\"j\"];updateGlobalBufferAndViews(wasmMemory.buffer);wasmTable=Module[\"asm\"][\"r\"];removeRunDependency(\"wasm-instantiate\")}addRunDependency(\"wasm-instantiate\");function receiveInstantiatedSource(output){receiveInstance(output[\"instance\"])}function instantiateArrayBuffer(receiver){return getBinaryPromise().then(function(binary){return WebAssembly.instantiate(binary,info)}).then(receiver,function(reason){err(\"failed to asynchronously prepare wasm: \"+reason);abort(reason)})}function instantiateAsync(){if(!wasmBinary&&typeof WebAssembly.instantiateStreaming===\"function\"&&!isDataURI(wasmBinaryFile)&&!isFileURI(wasmBinaryFile)&&typeof fetch===\"function\"){return fetch(wasmBinaryFile,{credentials:\"same-origin\"}).then(function(response){var result=WebAssembly.instantiateStreaming(response,info);return result.then(receiveInstantiatedSource,function(reason){err(\"wasm streaming compile failed: \"+reason);err(\"falling back to ArrayBuffer instantiation\");return instantiateArrayBuffer(receiveInstantiatedSource)})})}else{return

instantiateArrayBuffer(receiveInstantiatedSource)}}if(Module[\"instantiateWasm\"]){try{var exports=Module[\"instantiateWasm\"](info,receiveInstance);return exports}catch(e){err(\"Module.instantiateWasm callback failed with error: \"+e);return false}}instantiateAsync().catch(readyPromiseReject);return{}}function callRuntimeCallbacks(callbacks){while(callbacks.length>0){var callback=callbacks.shift();if(typeof callback==\"function\"){callback(Module);continue}var func=callback.func;if(typeof func===\"number\"){if(callback.arg===undefined){wasmTable.get(func)()}else{wasmTable.get(func)(callback.arg)}}else{func(callback.arg===undefined?null:callback.arg)}}}function _abort(){abort()}function _emscripten_memcpy_big(dest,src,num){HEAPU8.copyWithin(dest,src,src+num)}function _emscripten_get_heap_size(){return HEAPU8.length}function emscripten_realloc_buffer(size){try{wasmMemory.grow(size-buffer.byteLength+65535>>>16);updateGlobalBufferAndViews(wasmMemory.buffer);return 1}catch(e){}}function _emscripten_resize_heap(requestedSize){var oldSize=_emscripten_get_heap_size();var maxHeapSize=2147483648;if(requestedSize>maxHeapSize){return false}for(var cutDown=1;cutDown<=4;cutDown*=2){var overGrownHeapSize=oldSize*(1+.2/cutDown);overGrownHeapSize=Math.min(overGrownHeapSize,requestedSize+100663296);var newSize=Math.min(maxHeapSize,alignUp(Math.max(requestedSize,overGrownHeapSize),65536));var replacement=emscripten_realloc_buffer(newSize);if(replacement){return true}}return false}var SYSCALLS={mappings:{},buffers:[null,[],[]],printChar:function(stream,curr){var buffer=SYSCALLS.buffers[stream];if(curr===0||curr===10){(stream===1?out:err)(UTF8ArrayToString(buffer,0));buffer.length=0}else{buffer.push(curr)}},varargs:undefined,get:function(){SYSCALLS.varargs+=4;var ret=HEAP32[SYSCALLS.varargs-4>>2];return ret},getStr:function(ptr){var ret=UTF8ToString(ptr);return ret},get64:function(low,high){return low}};function _fd_close(fd){return 0}function _fd_seek(fd,offset_low,offset_high,whence,newOffset){}function _fd_write(fd,iov,iovcnt,pnum){var num=0;for(var i=0;i<iovcnt;i++){var ptr=HEAP32[iov+i*8>>2];var len=HEAP32[iov+(i*8+4)>>2];for(var j=0;j<len;j++){SYSCALLS.printChar(fd,HEAPU8[ptr+j])}num+=len}HEAP32[pnum>>2]=num;return 0}function _pthread_create(){return 6}function _pthread_join(){return 28}function setErrNo(value){HEAP32[___errno_location()>>2]=value;return value}function _sysconf(name){switch(name){case 30:return 16384;case 85:var maxHeapSize=2147483648;return maxHeapSize/16384;case 132:case 133:case 12:case 137:case 138:case 15:case 235:case 16:case 17:case 18:case 19:case 20:case 149:case 13:case 10:case 236:case 153:case 9:case 21:case 22:case 159:case 154:case 14:case 77:case 78:case 139:case 82:case 68:case 67:case 164:case 11:case 29:case 47:case 48:case 95:case 52:case 51:case 46:return 200809;case 27:case 246:case 127:case 128:case 23:case 24:case 160:case 161:case 181:case 182:case 242:case 183:case 184:case 243:case 244:case 245:case 165:case 178:case 179:case 49:case 50:case 168:case 169:case 175:case 170:case 171:case 172:case 97:case 76:case 32:case 173:case 35:case 80:case 81:case 79:return-1;case 176:case 177:case 7:case 155:case 8:case 157:case 125:case 126:case 92:case 93:case 129:case 130:case 131:case 94:case 91:return 1;case 74:case 60:case 69:case 70:case 4:return 1024;case 31:case 42:case 72:return 32;case 87:case 26:case 33:return 2147483647;case 34:case 1:return 47839;case 38:case 36:return 99;case 43:case 37:return 2048;case 0:return 2097152;case 3:return 65536;case 28:return 32768;case 44:return 32767;case 75:return 16384;case 39:return 1e3;case 89:return 700;case 71:return 256;case 40:return 255;case 2:return 100;case 180:return 64;case 25:return 20;case 5:return 16;case 6:return 6;case 73:return 4;case 84:{if(typeof navigator===\"object\")return navigator[\"hardwareConcurrency\"]||1;return 1}}setErrNo(28);return-1}var asmLibraryArg={\"a\":_abort,\"d\":_emscripten_memcpy_big,\"e\":_emscripten_resize_heap,\"f\":_fd_close,\"c\":_fd_seek,\"b\":_fd_write,\"h\":_pthread_create,\"g\":_pthread_join,\"i\":_sysconf};var asm=createWasm();var ___wasm_call_ctors=Module[\"___wasm_call_ctors\"]=function(){return(___wasm_call_ctors=Module[\"___wasm_call_ctors\"]=Module[\"asm\"][\"k\"]).apply(null,arguments)};var

_init=Module[\"_init\"]=function(){return(_init=Module[\"_init\"]=Module[\"asm\"][\"l\"]).apply(null,arguments)};
var
_init_with_threads_count=Module[\"_init_with_threads_count\"]=function(){return(_init_with_threads_count=Mod
ule[\"_init_with_threads_count\"]=Module[\"asm\"][\"m\"]).apply(null,arguments)};var
_get_threads_count=Module[\"_get_threads_count\"]=function(){return(_get_threads_count=Module[\"_get_threads
_count\"]=Module[\"asm\"][\"n\"]).apply(null,arguments)};var
_register_tensor=Module[\"_register_tensor\"]=function(){return(_register_tensor=Module[\"_register_tensor\"]=M
odule[\"asm\"][\"o\"]).apply(null,arguments)};var
_dispose_data=Module[\"_dispose_data\"]=function(){return(_dispose_data=Module[\"_dispose_data\"]=Module[\"
asm\"][\"p\"]).apply(null,arguments)};var
_dispose=Module[\"_dispose\"]=function(){return(_dispose=Module[\"_dispose\"]=Module[\"asm\"][\"q\"]).apply(n
ull,arguments)};var
_Abs=Module[\"_Abs\"]=function(){return(_Abs=Module[\"_Abs\"]=Module[\"asm\"][\"s\"]).apply(null,arguments
)};var
_Add=Module[\"_Add\"]=function(){return(_Add=Module[\"_Add\"]=Module[\"asm\"][\"t\"]).apply(null,argument
s)};var
_AddN=Module[\"_AddN\"]=function(){return(_AddN=Module[\"_AddN\"]=Module[\"asm\"][\"u\"]).apply(null,ar
guments)};var
_All=Module[\"_All\"]=function(){return(_All=Module[\"_All\"]=Module[\"asm\"][\"v\"]).apply(null,arguments)};
var
_Any=Module[\"_Any\"]=function(){return(_Any=Module[\"_Any\"]=Module[\"asm\"][\"w\"]).apply(null,argumen
ts)};var
_ArgMax=Module[\"_ArgMax\"]=function(){return(_ArgMax=Module[\"_ArgMax\"]=Module[\"asm\"][\"x\"]).app
ly(null,arguments)};var
_AvgPool=Module[\"_AvgPool\"]=function(){return(_AvgPool=Module[\"_AvgPool\"]=Module[\"asm\"][\"y\"]).a
pply(null,arguments)};var
_BatchMatMul=Module[\"_BatchMatMul\"]=function(){return(_BatchMatMul=Module[\"_BatchMatMul\"]=Modu
le[\"asm\"][\"z\"]).apply(null,arguments)};var
_Ceil=Module[\"_Ceil\"]=function(){return(_Ceil=Module[\"_Ceil\"]=Module[\"asm\"][\"A\"]).apply(null,argument
s)};var
_ClipByValue=Module[\"_ClipByValue\"]=function(){return(_ClipByValue=Module[\"_ClipByValue\"]=Module[\
"asm\"][\"B\"]).apply(null,arguments)};var
_Conv2D=Module[\"_Conv2D\"]=function(){return(_Conv2D=Module[\"_Conv2D\"]=Module[\"asm\"][\"C\"]).ap
ply(null,arguments)};var
_Conv2DBackpropInput=Module[\"_Conv2DBackpropInput\"]=function(){return(_Conv2DBackpropInput=Modul
e[\"_Conv2DBackpropInput\"]=Module[\"asm\"][\"D\"]).apply(null,arguments)};var
_Cos=Module[\"_Cos\"]=function(){return(_Cos=Module[\"_Cos\"]=Module[\"asm\"][\"E\"]).apply(null,arguments
)};var
_Cosh=Module[\"_Cosh\"]=function(){return(_Cosh=Module[\"_Cosh\"]=Module[\"asm\"][\"F\"]).apply(null,argu
ments)};var
_CropAndResize=Module[\"_CropAndResize\"]=function(){return(_CropAndResize=Module[\"_CropAndResize\"]
=Module[\"asm\"][\"G\"]).apply(null,arguments)};var
_Cumsum=Module[\"_Cumsum\"]=function(){return(_Cumsum=Module[\"_Cumsum\"]=Module[\"asm\"][\"H\"]).a
pply(null,arguments)};var
_DepthToSpace=Module[\"_DepthToSpace\"]=function(){return(_DepthToSpace=Module[\"_DepthToSpace\"]=M
odule[\"asm\"][\"I\"]).apply(null,arguments)};var
_DepthwiseConv2dNative=Module[\"_DepthwiseConv2dNative\"]=function(){return(_DepthwiseConv2dNative=M
odule[\"_DepthwiseConv2dNative\"]=Module[\"asm\"][\"J\"]).apply(null,arguments)};var

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_Elu=Module[\"_Elu\"]=function(){return(_Elu=Module[\"_Elu\"]=Module[\"asm\"][\"K\"]).apply(null,arguments)}
;var
_Equal=Module[\"_Equal\"]=function(){return(_Equal=Module[\"_Equal\"]=Module[\"asm\"][\"L\"]).apply(null,arg
uments)};var
_Exp=Module[\"_Exp\"]=function(){return(_Exp=Module[\"_Exp\"]=Module[\"asm\"][\"M\"]).apply(null,argument
s)};var
_FlipLeftRight=Module[\"_FlipLeftRight\"]=function(){return(_FlipLeftRight=Module[\"_FlipLeftRight\"]=Modul
e[\"asm\"][\"N\"]).apply(null,arguments)};var
_Floor=Module[\"_Floor\"]=function(){return(_Floor=Module[\"_Floor\"]=Module[\"asm\"][\"O\"]).apply(null,argu
ments)};var
_FloorDiv=Module[\"_FloorDiv\"]=function(){return(_FloorDiv=Module[\"_FloorDiv\"]=Module[\"asm\"][\"P\"]).
apply(null,arguments)};var
_FusedBatchNorm=Module[\"_FusedBatchNorm\"]=function(){return(_FusedBatchNorm=Module[\"_FusedBatchN
orm\"]=Module[\"asm\"][\"Q\"]).apply(null,arguments)};var
_FusedConv2D=Module[\"_FusedConv2D\"]=function(){return(_FusedConv2D=Module[\"_FusedConv2D\"]=Mod
ule[\"asm\"][\"R\"]).apply(null,arguments)};var
_FusedDepthwiseConv2D=Module[\"_FusedDepthwiseConv2D\"]=function(){return(_FusedDepthwiseConv2D=M
odule[\"_FusedDepthwiseConv2D\"]=Module[\"asm\"][\"S\"]).apply(null,arguments)};var
_Gather=Module[\"_Gather\"]=function(){return(_Gather=Module[\"_Gather\"]=Module[\"asm\"][\"T\"]).apply(null
,arguments)};var
_GatherNd=Module[\"_GatherNd\"]=function(){return(_GatherNd=Module[\"_GatherNd\"]=Module[\"asm\"][\"U\"
]).apply(null,arguments)};var
_Greater=Module[\"_Greater\"]=function(){return(_Greater=Module[\"_Greater\"]=Module[\"asm\"][\"V\"]).apply(
null,arguments)};var
_GreaterEqual=Module[\"_GreaterEqual\"]=function(){return(_GreaterEqual=Module[\"_GreaterEqual\"]=Module[\
"asm\"][\"W\"]).apply(null,arguments)};var
_LeakyRelu=Module[\"_LeakyRelu\"]=function(){return(_LeakyRelu=Module[\"_LeakyRelu\"]=Module[\"asm\"][\
"X\"]).apply(null,arguments)};var
_Less=Module[\"_Less\"]=function(){return(_Less=Module[\"_Less\"]=Module[\"asm\"][\"Y\"]).apply(null,argume
nts)};var
_LessEqual=Module[\"_LessEqual\"]=function(){return(_LessEqual=Module[\"_LessEqual\"]=Module[\"asm\"][\"
Z\"]).apply(null,arguments)};var
_Log=Module[\"_Log\"]=function(){return(_Log=Module[\"_Log\"]=Module[\"asm\"][\"_\"]).apply(null,arguments
)};var
_LogicalAnd=Module[\"_LogicalAnd\"]=function(){return(_LogicalAnd=Module[\"_LogicalAnd\"]=Module[\"asm
\"][\"$\"]).apply(null,arguments)};var
_Max=Module[\"_Max\"]=function(){return(_Max=Module[\"_Max\"]=Module[\"asm\"][\"aa\"]).apply(null,argume
nts)};var
_MaxPool=Module[\"_MaxPool\"]=function(){return(_MaxPool=Module[\"_MaxPool\"]=Module[\"asm\"][\"ba\"]).
apply(null,arguments)};var
_Maximum=Module[\"_Maximum\"]=function(){return(_Maximum=Module[\"_Maximum\"]=Module[\"asm\"][\"ca\"]).apply(null,arguments)};var
_Mean=Module[\"_Mean\"]=function(){return(_Mean=Module[\"_Mean\"]=Module[\"asm\"][\"da\"]).apply(null,ar
guments)};var
_Min=Module[\"_Min\"]=function(){return(_Min=Module[\"_Min\"]=Module[\"asm\"][\"ea\"]).apply(null,argumen
ts)};var
_Minimum=Module[\"_Minimum\"]=function(){return(_Minimum=Module[\"_Minimum\"]=Module[\"asm\"][\"fa\
"]).apply(null,arguments)};var
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_MirrorPad=Module[\"_MirrorPad\"]=function(){return(_MirrorPad=Module[\"_MirrorPad\"]=Module[\"asm\"][\"ga\"]).apply(null,arguments)};var
_Multiply=Module[\"_Multiply\"]=function(){return(_Multiply=Module[\"_Multiply\"]=Module[\"asm\"][\"ha\"]).apply(null,arguments)};var
_Neg=Module[\"_Neg\"]=function(){return(_Neg=Module[\"_Neg\"]=Module[\"asm\"][\"ia\"]).apply(null,arguments)};var
_NonMaxSuppressionV3=Module[\"_NonMaxSuppressionV3\"]=function(){return(_NonMaxSuppressionV3=Module[\"_NonMaxSuppressionV3\"]=Module[\"asm\"][\"ja\"]).apply(null,arguments)};var
_NonMaxSuppressionV4=Module[\"_NonMaxSuppressionV4\"]=function(){return(_NonMaxSuppressionV4=Module[\"_NonMaxSuppressionV4\"]=Module[\"asm\"][\"ka\"]).apply(null,arguments)};var
_NonMaxSuppressionV5=Module[\"_NonMaxSuppressionV5\"]=function(){return(_NonMaxSuppressionV5=Module[\"_NonMaxSuppressionV5\"]=Module[\"asm\"][\"la\"]).apply(null,arguments)};var
_NotEqual=Module[\"_NotEqual\"]=function(){return(_NotEqual=Module[\"_NotEqual\"]=Module[\"asm\"][\"ma\"]).apply(null,arguments)};var
_OneHot=Module[\"_OneHot\"]=function(){return(_OneHot=Module[\"_OneHot\"]=Module[\"asm\"][\"na\"]).apply(null,arguments)};var
_PadV2=Module[\"_PadV2\"]=function(){return(_PadV2=Module[\"_PadV2\"]=Module[\"asm\"][\"oa\"]).apply(null,arguments)};var
_Pow=Module[\"_Pow\"]=function(){return(_Pow=Module[\"_Pow\"]=Module[\"asm\"][\"pa\"]).apply(null,arguments)};var
_Prelu=Module[\"_Prelu\"]=function(){return(_Prelu=Module[\"_Prelu\"]=Module[\"asm\"][\"qa\"]).apply(null,arguments)};var
_Prod=Module[\"_Prod\"]=function(){return(_Prod=Module[\"_Prod\"]=Module[\"asm\"][\"ra\"]).apply(null,arguments)};var
_RealDiv=Module[\"_RealDiv\"]=function(){return(_RealDiv=Module[\"_RealDiv\"]=Module[\"asm\"][\"sa\"]).apply(null,arguments)};var
_Relu=Module[\"_Relu\"]=function(){return(_Relu=Module[\"_Relu\"]=Module[\"asm\"][\"ta\"]).apply(null,arguments)};var
_Relu6=Module[\"_Relu6\"]=function(){return(_Relu6=Module[\"_Relu6\"]=Module[\"asm\"][\"ua\"]).apply(null,arguments)};var
_ResizeBilinear=Module[\"_ResizeBilinear\"]=function(){return(_ResizeBilinear=Module[\"_ResizeBilinear\"]=Module[\"asm\"][\"va\"]).apply(null,arguments)};var
_Reverse=Module[\"_Reverse\"]=function(){return(_Reverse=Module[\"_Reverse\"]=Module[\"asm\"][\"wa\"]).apply(null,arguments)};var
_RotateWithOffset=Module[\"_RotateWithOffset\"]=function(){return(_RotateWithOffset=Module[\"_RotateWithOffset\"]=Module[\"asm\"][\"xa\"]).apply(null,arguments)};var
_Round=Module[\"_Round\"]=function(){return(_Round=Module[\"_Round\"]=Module[\"asm\"][\"ya\"]).apply(null,arguments)};var
_Rsqrt=Module[\"_Rsqrt\"]=function(){return(_Rsqrt=Module[\"_Rsqrt\"]=Module[\"asm\"][\"za\"]).apply(null,arguments)};var
_ScatterNd=Module[\"_ScatterNd\"]=function(){return(_ScatterNd=Module[\"_ScatterNd\"]=Module[\"asm\"][\"Aa\"]).apply(null,arguments)};var
_SelectV2=Module[\"_SelectV2\"]=function(){return(_SelectV2=Module[\"_SelectV2\"]=Module[\"asm\"][\"Ba\"]).apply(null,arguments)};var
_Sigmoid=Module[\"_Sigmoid\"]=function(){return(_Sigmoid=Module[\"_Sigmoid\"]=Module[\"asm\"][\"Ca\"]).apply(null,arguments)};var
_Sin=Module[\"_Sin\"]=function(){return(_Sin=Module[\"_Sin\"]=Module[\"asm\"][\"Da\"]).apply(null,arguments)};var
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_Softmax=Module[\"_Softmax\"]=function(){return(_Softmax=Module[\"_Softmax\"]=Module[\"asm\"][\"Ea\"]).apply(null,arguments)};var
_Sqrt=Module[\"_Sqrt\"]=function(){return(_Sqrt=Module[\"_Sqrt\"]=Module[\"asm\"][\"Fa\"]).apply(null,arguments)};var
_Square=Module[\"_Square\"]=function(){return(_Square=Module[\"_Square\"]=Module[\"asm\"][\"Ga\"]).apply(null,arguments)};var
_SquaredDifference=Module[\"_SquaredDifference\"]=function(){return(_SquaredDifference=Module[\"_SquaredDifference\"]=Module[\"asm\"][\"Ha\"]).apply(null,arguments)};var
_Step=Module[\"_Step\"]=function(){return(_Step=Module[\"_Step\"]=Module[\"asm\"][\"Ia\"]).apply(null,arguments)};var
_StridedSlice=Module[\"_StridedSlice\"]=function(){return(_StridedSlice=Module[\"_StridedSlice\"]=Module[\"asm\"][\"Ja\"]).apply(null,arguments)};var
_Sub=Module[\"_Sub\"]=function(){return(_Sub=Module[\"_Sub\"]=Module[\"asm\"][\"Ka\"]).apply(null,arguments)};var
_Sum=Module[\"_Sum\"]=function(){return(_Sum=Module[\"_Sum\"]=Module[\"asm\"][\"La\"]).apply(null,arguments)};var
_Tan=Module[\"_Tan\"]=function(){return(_Tan=Module[\"_Tan\"]=Module[\"asm\"][\"Ma\"]).apply(null,arguments)};var
_Tanh=Module[\"_Tanh\"]=function(){return(_Tanh=Module[\"_Tanh\"]=Module[\"asm\"][\"Na\"]).apply(null,arguments)};var
_Tile=Module[\"_Tile\"]=function(){return(_Tile=Module[\"_Tile\"]=Module[\"asm\"][\"Oa\"]).apply(null,arguments)};var
_TopK=Module[\"_TopK\"]=function(){return(_TopK=Module[\"_TopK\"]=Module[\"asm\"][\"Pa\"]).apply(null,arguments)};var
_Transform=Module[\"_Transform\"]=function(){return(_Transform=Module[\"_Transform\"]=Module[\"asm\"][\"Qa\"]).apply(null,arguments)};var
_Transpose=Module[\"_Transpose\"]=function(){return(_Transpose=Module[\"_Transpose\"]=Module[\"asm\"][\"Ra\"]).apply(null,arguments)};var
__FusedMatMul=Module[\"__FusedMatMul\"]=function(){return(__FusedMatMul=Module[\"__FusedMatMul\"]=Module[\"asm\"][\"Sa\"]).apply(null,arguments)};var
_malloc=Module[\"_malloc\"]=function(){return(_malloc=Module[\"_malloc\"]=Module[\"asm\"][\"Ta\"]).apply(null,arguments)};var
_free=Module[\"_free\"]=function(){return(_free=Module[\"_free\"]=Module[\"asm\"][\"Ua\"]).apply(null,arguments)};var
___errno_location=Module[\"___errno_location\"]=function(){return(___errno_location=Module[\"___errno_location\"]=Module[\"asm\"][\"Va\"]).apply(null,arguments)};var
stackSave=Module[\"stackSave\"]=function(){return(stackSave=Module[\"stackSave\"]=Module[\"asm\"][\"Wa\"]).apply(null,arguments)};var
stackRestore=Module[\"stackRestore\"]=function(){return(stackRestore=Module[\"stackRestore\"]=Module[\"asm\"][\"Xa\"]).apply(null,arguments)};var
stackAlloc=Module[\"stackAlloc\"]=function(){return(stackAlloc=Module[\"stackAlloc\"]=Module[\"asm\"][\"Ya\"]).apply(null,arguments)};Module[\"cwrap\"]=cwrap;var calledRun;function
ExitStatus(status){this.name=\"ExitStatus\";this.message=\"Program terminated with
exit(\"+status+\")\";this.status=status}dependenciesFulfilled=function
runCaller(){if(!calledRun)run();if(!calledRun)dependenciesFulfilled=runCaller};function
run(args){args=args||arguments_;if(runDependencies>0){return}preRun();if(runDependencies>0){return}function
doRun(){if(calledRun)return;calledRun=true;Module[\"calledRun\"]=true;if(ABORT)return;initRuntime();preMain();readyPromiseResolve(Module);if(Module[\"onRuntimeInitialized\"])Module[\"onRuntimeInitialized\"]();postRun(

)}if(Module[\"setStatus\"]){Module[\"setStatus\"](\"Running...\");setTimeout(function(){setTimeout(function(){Module[\"setStatus\"](\"\")},1);doRun()},1)}else{doRun()}}Module[\"run\"]=run;if(Module[\"preInit\"]){if(typeof Module[\"preInit\"]==\"function\")Module[\"preInit\"]=[Module[\"preInit\"]];while(Module[\"preInit\"].length>0){Module[\"preInit\"].pop()()}}run();\n\n\n return WasmBackendModule.ready\n}\n);\n})();\nif (typeof exports === 'object' && typeof module === 'object')\n module.exports = WasmBackendModule;\nelse if (typeof define === 'function' && define['amd'])\n define([], function() { return WasmBackendModule; });\nelse if (typeof exports === 'object')\n exports[\"WasmBackendModule\"] = WasmBackendModule;\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ===\n */\nimport './flags_wasm';\n\nimport {backend_util, BackendTimingInfo, DataStorage, DataType, deprecationWarn, engine, env, KernelBackend, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasmModule, WasmFactoryConfig} from '../wasm-out/tfjs-backend-wasm';\nimport {BackendWasmThreadedSimdModule} from '../wasm-out/tfjs-backend-wasm-threaded-simd';\nimport wasmFactoryThreadedSimd from '../wasm-out/tfjs-backend-wasm-threaded-simd.js';\n// @ts-ignore\nimport {wasmWorkerContents} from '../wasm-out/tfjs-backend-wasm-threaded-simd.worker.js';\nimport wasmFactory from '../wasm-out/tfjs-backend-wasm.js';\n\ninterface TensorData {\n id: number;\n memoryOffset: number;\n shape: number[];\n dtype: DataType;\n refCount: number;\n /** Only used for string tensors, storing encoded bytes. */\n stringBytes?: Uint8Array[];\n}\n\nexport type DataId = object; // object instead of {} to force non-primitive.\n\nexport class BackendWasm extends KernelBackend {\n // 0 is reserved for null data ids.\n private dataIdNextNumber = 1;\n dataIdMap: DataStorage<TensorData>;\n\n constructor(public wasm: BackendWasmModule|BackendWasmThreadedSimdModule) {\n super();\n this.wasm.tfjs.initWithThreadsCount(threadsCount);\n actualThreadsCount = this.wasm.tfjs.getThreadsCount();\n this.dataIdMap = new DataStorage(this, engine());\n }\n\n write(values: backend_util.BackendValues, shape: number[], dtype: DataType):\n DataId {\n const dataId = {id: this.dataIdNextNumber++};\n this.move(dataId, values, shape, dtype, 1);\n return dataId;\n }\n\n numDataIds(): number {\n return this.dataIdMap.numDataIds();\n }\n\n async time(f: () => void): Promise<BackendTimingInfo> {\n const start = util.now();\n f();\n const kernelMs = util.now() - start;\n return {kernelMs};\n }\n\n move(\n dataId: DataId, values: backend_util.BackendValues, shape: number[],\n dtype: DataType, refCount: number): void {\n const id = this.dataIdNextNumber++;\n if (dtype === 'string') {\n const stringBytes = values as Uint8Array[];\n this.dataIdMap.set(\n dataId,\n {id, stringBytes, shape, dtype, memoryOffset: null, refCount});\n return;\n }\n\n const size = util.sizeFromShape(shape);\n const numBytes = size * util.bytesPerElement(dtype);\n const memoryOffset = this.wasm._malloc(numBytes);\n\n this.dataIdMap.set(dataId, {id, memoryOffset, shape, dtype, refCount});\n\n this.wasm.tfjs.registerTensor(id, size, memoryOffset);\n\n if (values != null) {\n this.wasm.HEAPU8.set(\n new Uint8Array(\n (values as backend_util.TypedArray).buffer,\n (values as backend_util.TypedArray).byteOffset, numBytes),\n memoryOffset);\n }\n }\n\n async read(dataId: DataId): Promise<backend_util.BackendValues> {\n return this.readSync(dataId);\n }\n\n readSync(dataId: DataId): backend_util.BackendValues {\n const {memoryOffset, dtype, shape, stringBytes} =\n this.dataIdMap.get(dataId);\n if (dtype === 'string') {\n return stringBytes;\n }\n const bytes = this.wasm.HEAPU8.slice(\n memoryOffset,\n memoryOffset + util.sizeFromShape(shape) * util.bytesPerElement(dtype));\n return typedArrayFromBuffer(bytes.buffer, dtype);\n }\n\n /**\n * Dispose the memory if the dataId has

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 0 refCount. Return true if the memory\n   * is released, false otherwise.\n   * @param dataId\n   * @oaram force
Optional, remove the data regardless of refCount\n   */\n  disposeData(dataId: DataId, force = false): boolean {\n    if
(this.dataIdMap.has(dataId)) {\n      const data = this.dataIdMap.get(dataId);\n      data.refCount--;\n      if (!force
&& data.refCount > 0) {\n        return false;\n      }\n\n      this.wasm._free(data.memoryOffset);\n
this.wasm.tfjs.disposeData(data.id);\n      this.dataIdMap.delete(dataId);\n    }\n    return true;\n  }\n\n  /** Return
refCount of a `TensorData`. */\n  refCount(dataId: DataId): number {\n    if (this.dataIdMap.has(dataId)) {\n
const tensorData = this.dataIdMap.get(dataId);\n      return tensorData.refCount;\n    }\n    return 0;\n  }\n\n
incRef(dataId: DataId) {\n    const data = this.dataIdMap.get(dataId);\n    if (data != null) {\n      data.refCount++;\n
}\n  }\n\n  floatPrecision(): 32 {\n    return 32;\n  }\n\n
  // Returns the memory offset of a tensor. Useful for debugging and unit\n  // testing.\n  getMemoryOffset(dataId:
DataId): number {\n    return this.dataIdMap.get(dataId).memoryOffset;\n  }\n\n  dispose() {\n
this.wasm.tfjs.dispose();\n    if ('PThread' in this.wasm) {\n      this.wasm.PThread.terminateAllThreads();\n    }\n
this.wasm = null;\n  }\n\n  memory() {\n    return {unreliable: false};\n  }\n\n  /**\n   * Make a tensor info for the
output of an op. If `memoryOffset` is not\n   * present, this method allocates memory on the WASM heap. If
`memoryOffset`\n   * is present, the memory was allocated elsewhere (in c++) and we just record\n   * the pointer
where that memory lives.\n   */\n  makeOutput(shape: number[], dtype: DataType, memoryOffset?: number):\n
TensorInfo {\n    let dataId: {};\n    if (memoryOffset == null) {\n      dataId = this.write(null /* values */, shape,
dtype);\n    } else {\n      const id = this.dataIdNextNumber++;\n      dataId = {id};\n      this.dataIdMap.set(dataId,
{id, memoryOffset, shape, dtype, refCount: 1});\n      const size = util.sizeFromShape(shape);\n
this.wasm.tfjs.registerTensor(id, size, memoryOffset);\n    }\n    return {dataId, shape, dtype};\n  }\n\n
typedArrayFromHeap({shape, dtype, dataId}: TensorInfo):\n      backend_util.TypedArray {\n    const buffer =
this.wasm.HEAPU8.buffer;\n    const {memoryOffset} = this.dataIdMap.get(dataId);\n    const size =
util.sizeFromShape(shape);\n    switch (dtype) {\n      case 'float32':\n        return new Float32Array(buffer,
memoryOffset, size);\n      case 'int32':\n        return new Int32Array(buffer, memoryOffset, size);\n      case 'bool':\n
    return new Uint8Array(buffer, memoryOffset, size);\n      default:\n        throw new Error(`Unknown dtype
${dtype}`);\n    }\n  }\n}\n\nfunction createInstantiateWasmFunc(path: string) {\n  // this will be replace by rollup
plugin patchWechatWebAssembly in\n  // minprogram's output.\n  // tslint:disable-next-line:no-any\n
  return (imports: any, callback: any) => {\n    util.fetch(path, {credentials: 'same-origin'}).then((response) => {\n
if (!response['ok']) {\n        imports.env.a(`failed to load wasm binary file at '${path}'`);\n      }\n
response.arrayBuffer().then(binary => {\n        WebAssembly.instantiate(binary, imports).then(output => {\n
callback(output.instance, output.module);\n        });\n      });\n    });\n    return {};\n  };\n}\n\n/**\n * Returns the
path of the WASM binary.\n * @param simdSupported whether SIMD is supported\n * @param threadsSupported
whether multithreading is supported\n * @param wasmModuleFolder the directory containing the WASM
binaries.\n */\nfunction getPathToWasmBinary(\n    simdSupported: boolean, threadsSupported: boolean,\n
wasmModuleFolder: string) {\n  if (wasmPath != null) {\n    // If wasmPath is defined, the user has supplied a full
path to\n    // the vanilla .wasm binary.\n    return wasmPath;\n  }\n\n  let path: WasmBinaryName
 = 'tfjs-backend-wasm.wasm';\n  if (simdSupported && threadsSupported) {\n    path = 'tfjs-backend-wasm-
threaded-simd.wasm';\n  } else if (simdSupported) {\n    path = 'tfjs-backend-wasm-simd.wasm';\n  }\n\n  if
(wasmFileMap != null) {\n    if (wasmFileMap[path] != null) {\n      return wasmFileMap[path];\n    }\n  }\n\n
return wasmModuleFolder + path;\n}\n\n/**\n * Initializes the wasm module and creates the js <--> wasm bridge.\n
*\n * NOTE: We wrap the wasm module in a object with property 'wasm' instead of\n * returning
Promise<BackendWasmModule> to avoid freezing Chrome (last tested\n * in Chrome 76).\n */\nexport async
function init(): Promise<{wasm: BackendWasmModule}> {\n  const [simdSupported, threadsSupported] = await
Promise.all([\n    env().getAsync('WASM_HAS_SIMD_SUPPORT'),\n
env().getAsync('WASM_HAS_MULTITHREAD_SUPPORT')\n  ]);\n\n  return new Promise((resolve, reject) =>
{\n    const factoryConfig: WasmFactoryConfig = {};\n\n    /**\n     * This function overrides
 the Emscripten module locateFile utility.\n     * @param path The relative path to the file that needs to be loaded.\n
  * @param prefix The path to the main JavaScript file's directory.\n     */\n    factoryConfig.locateFile = (path,
```

prefix) => {\n if (path.endsWith('.worker.js')) {\n const response = wasmWorkerContents;\n const blob = new Blob([response], {type: 'application/javascript'});\n return URL.createObjectURL(blob);\n }\n\n if (path.endsWith('.wasm')) {\n return getPathToWasmBinary(\n simdSupported as boolean, threadsSupported as boolean,\n wasmPathPrefix != null ? wasmPathPrefix : prefix);\n }\n return prefix + path;\n };\n\n // Use the instantiateWasm override when system fetch is not available.\n // Reference:\n // https://github.com/emscripten-core/emscripten/blob/2bca083cbbd5a4133db61fbd74d04f7feecfa907/tests/manual_wasm_instantiate.html#L170\n if (customFetch) {\n factoryConfig.instantiateWasm =\n createInstantiateWasmFunc(getPathToWasmBinary(\n simdSupported as boolean, threadsSupported as boolean,\n wasmPathPrefix != null ? wasmPathPrefix : ''));\n }\n\n let initialized = false;\n factoryConfig.onAbort = () => {\n if (initialized) {\n // Emscripten already called console.warn so no need to double log.\n return;\n }\n if (initAborted) {\n // Emscripten calls `onAbort` twice, resulting in double error\n // messages.\n return;\n }\n initAborted = true;\n const rejectMsg =\n 'Make sure the server can serve the `.wasm` file relative to the ' +\n 'bundled js file. For more details see https://github.com/tensorflow/tfjs/blob/master/tfjs-backend-wasm/README.md#using-bundlers';\n reject({message: rejectMsg});\n };\n\n let wasm: Promise<BackendWasmModule>;\n // If `wasmPath` has been defined we must initialize the vanilla module.\n if (threadsSupported && simdSupported && wasmPath == null) {\n factoryConfig.mainScriptUrlOrBlob = new Blob(\n [`var WasmBackendModuleThreadedSimd = ` +\n wasmFactoryThreadedSimd.toString()],\n {type: 'text/javascript'});\n wasm = wasmFactoryThreadedSimd(factoryConfig);\n } else {\n // The wasmFactory works for both vanilla and SIMD binaries.\n wasm = wasmFactory(factoryConfig);\n }\n\n // The WASM module has been successfully created by the factory.\n // Any error will be caught by the onAbort callback defined above.\n wasm.then((module) => {\n initialized = true;\n initAborted = false;\n\n const voidReturnType: string = null;\n // Using the tfjs namespace to avoid conflict with emscripten's API.\n module.tfjs = {\n init: module.cwrap('init', null, []),\n initWithThreadsCount:\n module.cwrap('init_with_threads_count', null, ['number']),\n getThreadsCount:\n module.cwrap('get_threads_count', 'number', []),\n registerTensor: module.cwrap(\n 'register_tensor', null,\n [\n 'number', // id\n 'number', // size\n 'number', // memoryOffset\n]),\n disposeData: module.cwrap('dispose_data', voidReturnType, ['number']),\n dispose: module.cwrap('dispose', voidReturnType, []),\n };\n\n resolve({wasm: module});\n });\n });\n}\n\nfunction typedArrayFromBuffer(\n buffer: ArrayBuffer, dtype: DataType): backend_util.TypedArray {\n switch (dtype) {\n case 'float32':\n return new Float32Array(buffer);\n case 'int32':\n return new Int32Array(buffer);\n case 'bool':\n return new Uint8Array(buffer);\n default:\n throw new Error(`Unknown dtype ${dtype}`);\n }\n}\n\nconst wasmBinaryNames = [\n 'tfjs-backend-wasm.wasm', 'tfjs-backend-wasm-simd.wasm',\n 'tfjs-backend-wasm-threaded-simd.wasm'\n] as const ;\ntype WasmBinaryName = typeof wasmBinaryNames[number];\n\nlet wasmPath: string = null;\nlet wasmPathPrefix: string = null;\nlet wasmFileMap: {[key in WasmBinaryName]?: string} = {};\nlet initAborted = false;\nlet customFetch = false;\n\n/**\n * @deprecated Use `setWasmPaths` instead.\n * Sets the path to the `.wasm` file which will be fetched when the wasm\n * backend is initialized. See\n * https://github.com/tensorflow/tfjs/blob/master/tfjs-backend-wasm/README.md#using-bundlers\n * for more details.\n * @param path wasm file path or url\n * @param usePlatformFetch optional boolean to use platform fetch to download\n * the wasm file, default to false.\n *\n * @doc {heading: 'Environment', namespace: 'wasm'}\n */\nexport function setWasmPath(path: string, usePlatformFetch = false): void {\n deprecationWarn(\n 'setWasmPath has been deprecated in favor of setWasmPaths and' +\n ' will be removed in a future release.');\n if (initAborted) {\n throw new Error(\n 'The WASM backend was already initialized. Make sure you call ' +\n '`setWasmPath()` before you call `tf.setBackend()` or `tf.ready()`');\n }\n wasmPath = path;\n customFetch = usePlatformFetch;\n}\n\n/**\n *

Configures the locations of the WASM binaries.\n *\n * ```js\n * setWasmPaths({\n * 'tfjs-backend-wasm.wasm': 'renamed.wasm',\n * 'tfjs-backend-wasm-simd.wasm': 'renamed-simd.wasm',\n * 'tfjs-backend-wasm-threaded-simd.wasm': 'renamed-threaded-simd.wasm'\n * });\n * tf.setBackend('wasm');\n * ```\n *\n * @param prefixOrFileMap This can be either a string or object:\n * - (string) The path to the directory where the WASM binaries are located.\n * Note that this prefix will be used to load each binary (vanilla,\n * SIMD-enabled, threading-enabled, etc.).\n * - (object) Mapping from names of WASM binaries to custom\n * full paths specifying the locations of those binaries. This is useful if\n * your WASM binaries are not all located in the same directory, or
if your\n * WASM binaries have been renamed.\n * @param usePlatformFetch optional boolean to use platform fetch to download\n * the wasm file, default to false.\n *\n * @doc {heading: 'Environment', namespace: 'wasm'}\n */\nexport function setWasmPaths(\n prefixOrFileMap: string|{[key in WasmBinaryName]?: string},\n usePlatformFetch = false): void {\n if (initAborted) {\n throw new Error(\n 'The WASM backend was already initialized. Make sure you call ' +\n '`setWasmPaths()` before you call `tf.setBackend()` or ' +\n '`tf.ready()`');\n }\n\n if (typeof prefixOrFileMap === 'string') {\n wasmPathPrefix = prefixOrFileMap;\n } else {\n wasmFileMap = prefixOrFileMap;\n const missingPaths =\n wasmBinaryNames.filter(name => wasmFileMap[name] == null);\n if (missingPaths.length > 0) {\n throw new Error(\n `There were no entries found for the following binaries: ` +\n `${missingPaths.join(',')}. Please either call setWasmPaths with a ` +\n `map providing a path for each binary, or with a string indicating ` +\n `the directory where all the binaries can be found.`);\n }\n }\n\n customFetch = usePlatformFetch;\n}\n\n/** Used in unit tests. */\nexport function resetWasmPath(): void {\n wasmPath = null;\n wasmPathPrefix = null;\n wasmFileMap = {};\n customFetch = false;\n initAborted = false;\n}\n\nlet threadsCount = -1;\nlet actualThreadsCount = -1;\n\n/**\n * Sets the number of threads that will be used by XNNPACK to create\n * threadpool (default to the number of logical CPU cores).\n *\n * This must be called before calling `tf.setBackend('wasm')`.\n */\nexport function setThreadsCount(numThreads: number) {\n threadsCount = numThreads;\n}\n\n/**\n * Gets the actual threads count that is used by XNNPACK.\n *\n * It is set after the backend is intialized.\n */\nexport function getThreadsCount(): number {\n if (actualThreadsCount === -1) {\n throw new Error(`WASM backend not initialized.`);\n }\n return actualThreadsCount;\n}\n","export const wasmWorkerContents = 'var Module={};function threadPrintErr(){var text=Array.prototype.slice.call(arguments).join(\" \");console.error(text)}function threadAlert(){var text=Array.prototype.slice.call(arguments).join(\" \");postMessage({cmd:\"alert\",text:text,threadId:Module[\"_pthread_self\"]()})}var err=threadPrintErr;this.alert=threadAlert;Module[\"instantiateWasm\"]=function(info,receiveInstance){var instance=new WebAssembly.Instance(Module[\"wasmModule\"],info);Module[\"wasmModule\"]=null;receiveInstance(instance);return instance.exports};function moduleLoaded(){}this.onmessage=function(e){try{if(e.data.cmd===\"load\"){Module[\"wasmModule\"]=e.data.wasmModule;Module[\"wasmMemory\"]=e.data.wasmMemory;Module[\"buffer\"]=Module[\"wasmMemory\"].buffer;Module[\"ENVIRONMENT_IS_PTHREAD\"]=true;if(typeof e.data.urlOrBlob===\"string\"){importScripts(e.data.urlOrBlob)}else{var objectUrl=URL.createObjectURL(e.data.urlOrBlob);importScripts(objectUrl);URL.revokeObjectURL(objectUrl)}WasmBackendModuleThreadedSimd(Module).then(function(instance){Module=instance;moduleLoaded()})}else if(e.data.cmd===\"objectTransfer\"){Module[\"PThread\"].receiveObjectTransfer(e.data)}else if(e.data.cmd===\"run\"){Module[\"__performance_now_clock_drift\"]=performance.now()-e.data.time;Module[\"__emscripten_thread_init\"](e.data.threadInfoStruct,0,0);var max=e.data.stackBase;var top=e.data.stackBase+e.data.stackSize;Module[\"establishStackSpace\"](top,max);Module[\"_emscripten_tls_init\"]();Module[\"PThread\"].receiveObjectTransfer(e.data);Module[\"PThread\"].setThreadStatus(Module[\"_pthread_self\"](),1);try{var result=Module[\"invokeEntryPoint\"](e.data.start_routine,e.data.arg);if(!Module[\"getNoExitRuntime\"]())Module[\

"PThread\"].threadExit(result)}catch(ex){if(ex===\"Canceled!\"){Module[\"PThread\"].threadCancel()}else if(ex!=\"unwind\"){if(ex instanceof Module[\"ExitStatus\"]){if(Module[\"getNoExitRuntime\"]()){}else{Module[\"PThread\"].threadExit(ex.status)}}else{Module[\"PThread\"].threadExit(-2);throw ex}}}}else if(e.data.cmd===\"cancel\"){if(Module[\"_pthread_self\"]()){Module[\"PThread\"].threadCancel()}}else if(e.data.target===\"setimmediate\"){}else if(e.data.cmd===\"processThreadQueue\"){if(Module[\"_pthread_self\"]()){Module[\"_emscripten_current_thread_process_queued_calls\"]()}}else{err(\"worker.js received unknown command \"+e.data.cmd);err(e.data)}}catch(ex){err(\"worker.js onmessage() captured an uncaught exception: \"+ex);if(ex&&ex.stack)err(ex.stack);throw ex}};if(typeof process===\"object\"&&typeof process.versions===\"object\"&&typeof process.versions.node===\"string\"){self={location:{href:__filename}};var onmessage=this.onmessage;var nodeWorkerThreads=require(\"worker_threads\");global.Worker=nodeWorkerThreads.Worker;var parentPort=nodeWorkerThreads.parentPort;parentPort.on(\"message\",function(data){onmessage({data:data})});var nodeFS=require(\"fs\");var nodeRead=function(filename){return nodeFS.readFileSync(filename,\"utf8\")};function globalEval(x){global.require=require;global.Module=Module;eval.call(null,x)}importScripts=function(f){globalEval(nodeRead(f))};postMessage=function(msg){parentPort.postMessage(msg)};if(typeof performance===\"undefined\"){performance={now:function(){return Date.now()}}}';","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==\n */\n\nimport './flags_wasm';\n\nimport {registerBackend} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm, init} from './backend_wasm';\n\nexport {BackendWasm, getThreadsCount, setThreadsCount, setWasmPath, setWasmPaths} from './backend_wasm';\nexport {version as version_wasm} from './version';\n\nconst WASM_PRIORITY = 2;\nregisterBackend('wasm', async () => {\n const {wasm} = await init();\n return new BackendWasm(wasm);\n}, WASM_PRIORITY);\n","/** @license See the LICENSE file. */\n\n// This code is auto-generated, do not modify this file!\nconst version = '3.11.0';\nexport {version};\n"],"names":["CppDType","FusableActivation","wasmFusedMatMul","fusedMatMulConfig","kernelName","_FusedMatMul","backendName","setupFunc","backend","wasm","cwrap","kernelFunc","args","inputs","attrs","a","b","bias","preluActivationWeights","dtype","Error","transposeA","transposeB","activation","leakyreluAlpha","aId","dataIdMap","get","dataId","id","bId","biasId","biasData","shape","length","preluActivationWeightsId","fusedActivation","leftDim","rightDim","batchDim","out","makeOutput","outId","aShapeBytes","Uint8Array","Int32Array","buffer","bShapeBytes","createUnaryKernelConfig","outType","wasmFunc","x","xId","util","sizeFromShape","absConfig","Abs","createBinaryKernelConfig","supportsFullBroadcast","outputType","newShape","backend_util","assertAndGetBroadcastShape","aBroadcastDims","getBroadcastDims","bBroadcastDims","loopsOverAllOfA","every","v","i","loopsOverAllOfB","addConfig","Add","addNConfig","AddN","inputIds","map","inputIdsBytes","identity","inVals","typedArrayFromHeap","set","wasmTranspose","identityConfig","Identity","transpose","_a","perm","newPerm","push","minValIdx","j","reducedShape","permIsNoOp","outShape","inShape","Array","computeOutShape","cloned","permBytes","xShapeBytes","wasmAll","transposeConfig","Transpose","permuteAxesAndTranspose","axis","xShape","xRank","originalAxes","parseAxisParam","axes","permutedAxes","getAxesPermutation","xTransposed","inputWasTransposed","getInnerMostAxes","transposed","wasmAny","allConfig","All","keepDims","inputId","input","inputRank","assertAxesAreInnerMostDims","_b","reduceShape","reduceSize","disposeData","expandSha

peToKeepDim","anyConfig","Any","wasmAvgPool","argMaxConfig","ArgMax","transposedId","slice","outerSize","innerSize","avgPoolConfig","AvgPool","filterSize","strides","pad","dimRoundingMode","convInfo","computePool2DInfo","filterHeight","filterWidth","padTop","padInfo","top","padRight","right","padBottom","bottom","padLeft","left","strideHeight","strideWidth","channels","inChannels","dataFormat","dilationWidth","dilationHeight","reshape","xSize","$shape","inferFromImplicitShape","assert","incRef","wasmBatchMatMul","reshapeConfig","Reshape","batchMatMulConfig","BatchMatMul","aRank","bRank","innerShapeA","innerShapeB","outerShapeA","outerShapeB","outerDimsA","outerDimsB","batchDimA","batchDimB","batchDimsCompatible","concat","b3dShape","a3d","b3d","a3dId","b3dId","Math","max","sliceImpl","vals","begin","size","isContinous","slice_util","isSliceContinous","xStrides","computeStrides","flatOffset","computeFlatOffset","subarray","decodedData","fromUint8ToStringArray","inBuf","outBuf","outLoc","indexToLoc","inLoc","idx","fromStringArrayToUint8","values","begin_","size_","xVals","readSync","outData","stringBytes","res","sliceImplCPU","outVals","rank","xStride","outOffset","beginI","beginJ","endI","xOffset","slice2d","xStride1","xStride2","beginK","endJ","slice3d","xStride3","endK","beginL","k","slice4d","sliceConfig","Slice","batchToSpaceNDConfig","BatchToSpaceND","blockShape","crops","prod","reduce","reshaped","getReshaped","permuted","getPermuted","reshapedPermuted","getReshapedPermuted","sliceBeginCoords","getSliceBeginCoords","sliceSize","getSliceSize","xReshaped","result","cast","wasmClip","castConfig","Cast","ceilConfig","Ceil","clipByValueConfig","ClipByValue","clipValueMin","clipValueMax","t","$inputs","filter","shapes","assertParamsConsistent","inputs2D","inputsValShapes","simplyConcat","outVals_1","getArrayFromDType","offset","forEach","colOffset","tIdx","row","resIdx","col","concatImplCPU","finalOutShape","sumInnerDims","innerDims","innerDim","inOffset","wasmConv2d","concatConfig","Concat","wasmConv2DBackpropInput","conv2DConfig","Conv2D","filterId","dilations","$dataFormat","convertConv2DDataFormat","computeConv2DInfo","inputChannels","outputChannels","outChannels","isSamePad","type","InterpolationMethod","wasmCropAndResize","conv2DBackpropInputConfig","Conv2DBackpropInput","dy","inputShape","batchSize","inHeight","inWidth","outHeight","outWidth","topPad","leftPad","isChannelsLast","dxStrides","dyStrides","fltS0","fltS1","fltS2","xBatchStride","xRowStride","xColStride","xChannelStride","yBatchStride","yRowStride","yColStride","yChannelStride","dyId","cosConfig","Cos","coshConfig","Cosh","wasmCumsum","cropAndResizeConfig","CropAndResize","castedData","method","extrapolationValue","cropSize","image","boxes","boxInd","numBoxes","cropHeight","cropWidth","imagesData","imagesId","boxesId","boxIndId","imagesShapeBytes","wasmDepthToSpace","cumsumConfig","Cumsum","exclusive","reverse","permutation","permutedX","permutedAxis","permutedOut","finalDim","permutedXId","permutedOutId","getUndoAxesPermutation","wasmDepthwiseConv2d","depthToSpaceConfig","DepthToSpace","blockSize","outputHeight","outputWidth","outputDepth","outputShape","xStridesBytes","outputShapeBytes","outStridesBytes","depthwiseConv2dNativeConfig","DepthwiseConv2dNative","$dilations","eluConfig","Elu","equalConfig","Equal","expConfig","Exp","expandDims","dim","$dim","splice","expandDimsConfig","ExpandDims","fill","value","wasmFlipLeftRight","fillConfig","Fill","wasmBatchNorm","flipLeftRightConfig","FlipLeftRight","imageId","batch","imageHeight","imageWidth","numChannels","floorConfig","Floor","floorDivConfig","FloorDiv","wasmFusedConv2d","fusedBatchNormConfig","FusedBatchNorm","varianceEpsilon","mean","variance","scale","meanId","varianceId","offsetId","scaleId","wasmFusedDepthwiseConv2d","fusedConv2DConfig","FusedConv2D","wasmGatherNd","fusedDepthwiseConv2DConfig","FusedDepthwiseConv2D","wasmGather","gatherNdConfig","GatherNd","params","indices","resultShape","numSlices","indicesShape","sliceRank","indicesId","stridesBytes","gatherV2Config","GatherV2","batchDims","parsedAxis","indicesVals","axisDim","index","shapeInfo","segment_util","collectGatherOpShapeInfo","flattenX","dimSize","indicesSize","flattenIndex","flattenOutputShape","stridesSize","greaterConfig","Greater","greaterEqualConfig","GreaterEqual","wasmMax","leakyReluConfig","LeakyRelu","alpha","lessConfig","Less","lessEqualConfig","LessEqual","logConfig","Log","logicalAndConfig","LogicalAnd","wasmMaxPool","maxConfig","Max","maximumConfig","Maximum","wasmMean","maxPoolConfig","MaxPool","wasmMin","meanConfig","Mean","reductionAxes","castedInput","MirrorPaddingMode","wasmMirrorPad","minConfig","Min","minimumConfig","Minimum","mirrorPadConfig","MirrorPad","paddings","mode","p","prePaddingsFlat","padTuple","postPaddingsFlat","prePaddingsBytes","postPaddingsBytes","multiplyConfig","Multiply","negConfig","Neg","parseResultStruct","resOffset","HEAPU8","pSelectedIndices","selectedSize","pSelectedScores","pValidOutputs","_free","nonMaxSuppressionV3Config","NonMaxSuppressionV3","iouThreshold","maxOutputSize","scoreThreshold","sco

res","scoresId","nonMaxSuppressionV4Config","NonMaxSuppressionV4","padToMaxOutputSize","wasmOneHot","nonMaxSuppressionV5Config","NonMaxSuppressionV5","softNmsSigma","notEqualConfig","NotEqual","oneHotConfig","OneHot","depth","onValue","offValue","onesLikeConfig","OnesLike","wasmPadV2","packConfig","Pack","assertShapesMatch","intermediateTensorInfos","expandedT","wasmPrelu","padV2Config","PadV2","constantValue","powConfig","Pow","wasmProd","preluConfig","Prelu","weightsId","wasmResizeBilinear","prodConfig","Prod","rangeConfig","Range","start","stop","step","makeZerosTypedArray","numElements","abs","ceil","rangeImplCPU","realDivConfig","RealDiv","reluConfig","Relu","relu6Config","Relu6","wasmReverse","resizeBilinearConfig","ResizeBilinear","images","alignCorners","halfPixelCenters","newHeight","newWidth","oldHeight","oldWidth","xData","wasmRotate","reverseConfig","Reverse","dims","axesBytes","outShapeBytes","wasmScatterNd","rotateWithOffsetConfig","RotateWithOffset","radians","fillValue","center","centerX","centerY","fillValues","fillBytes","roundConfig","Round","rsqrtConfig","Rsqrt","wasmSelect","scatterNdConfig","ScatterNd","updates","numUpdates","outputSize","updatesId","selectConfig","Select","condition","e","conditionId","tId","eId","cRank","tRank","sigmoidConfig","Sigmoid","sinConfig","Sin","softmaxConfig","Softmax","logits","spaceToBatchNDConfig","SpaceToBatchND","completePaddings","paddedX","reshapedPaddedShape","permutedReshapedPaddedPermutation","flattenShape","paddedXReshaped","paddedXT","wasmStep","splitVConfig","SplitV","numOrSizeSplits","$axis","splitSizes","prepareSplitSize","s","xSliceSize","xSlice","sqrtConfig","Sqrt","squareConfig","Square","squaredDifferenceConfig","SquaredDifference","wasmStridedSlice","stepConfig","Step","wasmSum","stridedSliceConfig","StridedSlice","end","beginMask","endMask","ellipsisMask","newAxisMask","shrinkAxisMask","finalShapeSparse","finalShape","isIdentity","sliceDim0","isSimpleSlice","$begin","$end","$strides","sliced","beginBytes","endBytes","subConfig","Sub","wasmTile","sumConfig","Sum","tanConfig","Tan","tanhConfig","Tanh","wasmTopK","tileConfig","Tile","reps","newShapeBytes","wasmTransform","topKConfig","TopK","sorted","outValues","outValuesId","outIndices","outIndicesId","transformConfig","Transform","fillModeId","transforms","interpolation","fillMode","transformsId","interpolationModeId","unpackConfig","Unpack","numOutputs","outIndex","outs","zerosLikeConfig","ZerosLike","kernelConfigs_1","_i","kernelConfig","registerKernel","ENV","env","registerFlag","WebAssembly","validate","MessageChannel","port1","postMessage","SharedArrayBuffer","_scriptDir","WasmBackendModuleThreadedSimd","document","currentScript","src","undefined","__filename","GROWABLE_HEAP_I8","wasmMemory","updateGlobalBufferAndViews","HEAP8","GROWABLE_HEAP_U8","GROWABLE_HEAP_I32","HEAP32","GROWABLE_HEAP_U32","HEAPU32","GROWABLE_HEAP_F64","HEAPF64","readyPromiseResolve","readyPromiseReject","Module","Promise","resolve","reject","key","moduleOverrides","hasOwnProperty","quit_","status","toThrow","ENVIRONMENT_IS_WEB","ENVIRONMENT_IS_WORKER","ENVIRONMENT_IS_NODE","ENVIRONMENT_IS_SHELL","window","importScripts","process","versions","node","ENVIRONMENT_IS_PTHREAD","read_","readAsync","readBinary","nodeFS","nodePath","scriptDirectory","locateFile","path","nodeWorkerThreads","require$$0","dirname","__dirname","filename","binary","require$$1","ret","replace","ex","ExitStatus","abort","require$$2","console","error","global","Worker","read","f","data","readbuffer","scriptArgs","quit","print","log","warn","printErr","self","location","href","indexOf","substr","lastIndexOf","url","xhr","XMLHttpRequest","open","send","responseText","responseType","response","onload","onerror","performance","require$$3","wasmBinary","bind","err","warnOnce","text","shown","wasmModule","noExitRuntime","ABORT","getCFunc","ident","func","ccall","returnType","argTypes","opts","toC","string","str","len","stringToUTF8","stackAlloc","array","arr","writeArrayToMemory","cArgs","stack","converter","stackSave","apply","UTF8ToString","Boolean","convertReturnValue","stackRestore","numericArgs","arguments","UTF8ArrayToString","heap","maxBytesToRead","endIdx","u0","u1","u2","String","fromCharCode","ch","ptr","stringToUTF8Array","outIdx","maxBytesToWrite","startIdx","u","charCodeAt","outPtr","lengthBytesUTF8","alignUp","multiple","buf","Int8Array","Int16Array","Uint16Array","Uint32Array","Float32Array","Float64Array","wasmTable","INITIAL_MEMORY","Memory","initial","maximum","shared","byteLength","__ATPRERUN__","__ATINIT__","__ATMAIN__","__ATPOSTRUN__","preRun","addOnPreRun","shift","callRuntimeCallbacks","initRuntime","preMain","postRun","addOnPostRun","cb","unshift","___wasm_call_ctors","runDependencies","dependenciesFulfilled","addRunDependency","removeRunDependency","callback","what","RuntimeError","hasPrefix","prefix","prototype","startsWith","dataURIPrefix","isDataURI","fileURIPrefix","isFileURI","wasmBinaryFile","getBinary","file","getBinaryPromise","fetch","credentials","then","catch","createWasm","info","asmLi

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,OAAOE,EAAMF,EAAMG,EAAWC,EAASqB,YAAiB,SAASC,EAAkBC,EAAKtoB,EAAIuoB,GAAyD,IAAzC,IAAIC,EAAOxoB,EAAIuoB,EAAImBpB,EAAI,KAAWnnB,GAAKwoB,IAAQ,CAAC,IAAIC,EAAGH

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No license file was found, but licenses were detected in source scan.

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* @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {FlipLeftRight, FlipLeftRightInputs, KernelConfig, KernelFunc, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmFlipLeftRight: (\n xId: number, batch: number, imageHeight: number, imageWidth: number,\n numChannels: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmFlipLeftRight = backend.wasm.cwrap(FlipLeftRight, null /* void */, [\n 'number', // xId\n 'number', // batch\n 'number', // imageHeight\n 'number', // imageWidth\n 'number', // numChannels\n 'number', // outId\n]);\n}\n\nexport function flipLeftRight(\n args: {inputs: FlipLeftRightInputs, backend: BackendWasm}): TensorInfo {\n const {inputs, backend} = args;\n const {image} = inputs;\n\n const out = backend.makeOutput(image.shape, image.dtype);\n const imageId = backend.dataIdMap.get(image.dataId).id;\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n const [batch, imageHeight, imageWidth, numChannels] = image.shape;\n\n wasmFlipLeftRight(\n imageId, batch,\n imageHeight, imageWidth, numChannels, outId);\n return out;\n}\n\nexport const flipLeftRightConfig: KernelConfig = {\n kernelName: FlipLeftRight,\n backendName: 'wasm',\n kernelFunc: flipLeftRight as {} as KernelFunc,\n setupFunc: setup\n};\n"]}

Found in path(s):
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernels/FlipLeftRight.js.map
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BackendWasm extends KernelBackend {\n  // 0 is reserved for null data ids.\n  private dataIdNextNumber = 1;\n
dataIdMap: DataStorage<TensorData>;\n\n  constructor(public wasm:
BackendWasmModule|BackendWasmThreadedSimdModule) {\n    super();\n
this.wasm.tfjs.initWithThreadsCount(threadsCount);\n    actualThreadsCount = this.wasm.tfjs.getThreadsCount();\n
 this.dataIdMap = new DataStorage(this, engine());\n  }\n\n  write(values: backend_util.BackendValues, shape:
number[], dtype: DataType):\n      DataId {\n    const dataId = {id: this.dataIdNextNumber++};\n
this.move(dataId, values, shape, dtype, 1);\n    return dataId;\n  }\n\n  numDataIds(): number {\n    return
this.dataIdMap.numDataIds();\n  }\n\n  async time(f: () => void): Promise<BackendTimingInfo>
 {\n    const start = util.now();\n    f();\n    const kernelMs = util.now() - start;\n    return {kernelMs};\n  }\n\n
move(\n      dataId: DataId, values: backend_util.BackendValues, shape: number[],\n      dtype: DataType, refCount:
number): void {\n    const id = this.dataIdNextNumber++;\n    if (dtype === 'string') {\n      const stringBytes =
values as Uint8Array[];\n      this.dataIdMap.set(\n          dataId,\n          {id, stringBytes, shape, dtype,
memoryOffset: null, refCount});\n      return;\n    }\n\n    const size = util.sizeFromShape(shape);\n    const
numBytes = size * util.bytesPerElement(dtype);\n    const memoryOffset = this.wasm._malloc(numBytes);\n\n
this.dataIdMap.set(dataId, {id, memoryOffset, shape, dtype, refCount});\n\n    this.wasm.tfjs.registerTensor(id, size,
memoryOffset);\n\n    if (values != null) {\n      this.wasm.HEAPU8.set(\n          new Uint8Array(\n              (values
as backend_util.TypedArray).buffer,\n              (values as backend_util.TypedArray).byteOffset,
 numBytes),\n          memoryOffset);\n    }\n  }\n\n  async read(dataId: DataId):
Promise<backend_util.BackendValues> {\n    return this.readSync(dataId);\n  }\n\n  readSync(dataId: DataId):
backend_util.BackendValues {\n    const {memoryOffset, dtype, shape, stringBytes} =\n
this.dataIdMap.get(dataId);\n    if (dtype === 'string') {\n      return stringBytes;\n    }\n    const bytes =
this.wasm.HEAPU8.slice(\n        memoryOffset,\n        memoryOffset + util.sizeFromShape(shape) *
util.bytesPerElement(dtype));\n    return typedArrayFromBuffer(bytes.buffer, dtype);\n  }\n\n  /**\n   * Dispose the
memory if the dataId has 0 refCount. Return true if the memory\n   * is released, false otherwise.\n   * @param
dataId\n   * @oaram force Optional, remove the data regardless of refCount\n   */\n  disposeData(dataId: DataId,
force = false): boolean {\n    if (this.dataIdMap.has(dataId)) {\n      const data = this.dataIdMap.get(dataId);\n
data.refCount--;\n
    if (!force && data.refCount > 0) {\n        return false;\n      }\n\n      this.wasm._free(data.memoryOffset);\n
this.wasm.tfjs.disposeData(data.id);\n      this.dataIdMap.delete(dataId);\n    }\n    return true;\n  }\n\n  /** Return
refCount of a `TensorData`. */\n  refCount(dataId: DataId): number {\n    if (this.dataIdMap.has(dataId)) {\n
const tensorData = this.dataIdMap.get(dataId);\n      return tensorData.refCount;\n    }\n    return 0;\n  }\n\n
incRef(dataId: DataId) {\n    const data = this.dataIdMap.get(dataId);\n    if (data != null) {\n      data.refCount++;\n
}\n  }\n\n  floatPrecision(): 32 {\n    return 32;\n  }\n\n  // Returns the memory offset of a tensor. Useful for
debugging and unit\n  // testing.\n  getMemoryOffset(dataId: DataId): number {\n    return
this.dataIdMap.get(dataId).memoryOffset;\n  }\n\n  dispose() {\n    this.wasm.tfjs.dispose();\n    if ('PThread' in
this.wasm) {\n      this.wasm.PThread.terminateAllThreads();\n    }\n    this.wasm
 = null;\n  }\n\n  memory() {\n    return {unreliable: false};\n  }\n\n  /**\n   * Make a tensor info for the output of an
op. If `memoryOffset` is not\n   * present, this method allocates memory on the WASM heap. If `memoryOffset`\n
* is present, the memory was allocated elsewhere (in c++) and we just record\n   * the pointer where that memory
lives.\n   */\n  makeOutput(shape: number[], dtype: DataType, memoryOffset?: number):\n      TensorInfo {\n    let
dataId: {};\n    if (memoryOffset == null) {\n      dataId = this.write(null /* values */, shape, dtype);\n    } else {\n
const id = this.dataIdNextNumber++;\n      dataId = {id};\n      this.dataIdMap.set(dataId, {id, memoryOffset, shape,
dtype, refCount: 1});\n      const size = util.sizeFromShape(shape);\n      this.wasm.tfjs.registerTensor(id, size,
memoryOffset);\n    }\n    return {dataId, shape, dtype};\n  }\n\n  typedArrayFromHeap({shape, dtype, dataId}:
TensorInfo):\n      backend_util.TypedArray {\n    const buffer
 = this.wasm.HEAPU8.buffer;\n    const {memoryOffset} = this.dataIdMap.get(dataId);\n    const size =
util.sizeFromShape(shape);\n    switch (dtype) {\n      case 'float32':\n        return new Float32Array(buffer,
memoryOffset, size);\n      case 'int32':\n        return new Int32Array(buffer, memoryOffset, size);\n      case 'bool':\n
```

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    return new Uint8Array(buffer, memoryOffset, size);\n      default:\n        throw new Error(`Unknown dtype ${dtype}`);\n    }\n  }\n}\n\nfunction createInstantiateWasmFunc(path: string) {\n  // this will be replace by rollup plugin patchWechatWebAssembly in\n  // minprogram's output.\n  // tslint:disable-next-line:no-any\n  return (imports: any, callback: any) => {\n    util.fetch(path, {credentials: 'same-origin'}).then((response) => {\n      if (!response['ok']) {\n        imports.env.a(`failed to load wasm binary file at '${path}'`);\n      }\n      response.arrayBuffer().then(binary => {\n        WebAssembly.instantiate(binary, imports).then(output => {\n          callback(output.instance, output.module);\n        });\n      });\n    });\n    return {};\n  };\n}\n\n/**\n * Returns the path of the WASM binary.\n * @param simdSupported whether SIMD is supported\n * @param threadsSupported whether multithreading is supported\n * @param wasmModuleFolder the directory containing the WASM binaries.\n */\nfunction getPathToWasmBinary(\n    simdSupported: boolean, threadsSupported: boolean,\n    wasmModuleFolder: string) {\n  if (wasmPath != null) {\n    // If wasmPath is defined, the user has supplied a full path to\n    // the vanilla .wasm binary.\n    return wasmPath;\n  }\n\n  let path: WasmBinaryName = 'tfjs-backend-wasm.wasm';\n  if (simdSupported && threadsSupported) {\n    path = 'tfjs-backend-wasm-threaded-simd.wasm';\n  } else if (simdSupported) {\n    path = 'tfjs-backend-wasm-simd.wasm';\n  }\n\n  if (wasmFileMap != null) {\n    if (wasmFileMap[path] != null) {\n      return wasmFileMap[path];\n    }\n  }\n\n  return wasmModuleFolder + path;\n}\n\n/**\n * Initializes the wasm module and creates the js <--> wasm bridge.\n *\n * NOTE: We wrap the wasm module in a object with property 'wasm' instead of\n * returning Promise<BackendWasmModule> to avoid freezing Chrome (last tested\n * in Chrome 76).\n */\nexport async function init(): Promise<{wasm: BackendWasmModule}> {\n  const [simdSupported, threadsSupported] = await Promise.all([\n    env().getAsync('WASM_HAS_SIMD_SUPPORT'),\n    env().getAsync('WASM_HAS_MULTITHREAD_SUPPORT')\n  ]);\n\n  return new Promise((resolve, reject) => {\n    const factoryConfig: WasmFactoryConfig = {};\n\n    /**\n     * This function overrides the Emscripten module locateFile utility.\n     * @param path The relative path to the file that needs to be loaded.\n     * @param prefix The path to the main JavaScript file's directory.\n     */\n    factoryConfig.locateFile = (path, prefix) => {\n      if (path.endsWith('.worker.js')) {\n        const response = wasmWorkerContents;\n        const blob = new Blob([response], {type: 'application/javascript'});\n        return URL.createObjectURL(blob);\n      }\n      if (path.endsWith('.wasm')) {\n        return getPathToWasmBinary(\n            simdSupported as boolean, threadsSupported as boolean,\n            wasmPathPrefix != null ? wasmPathPrefix : prefix);\n      }\n      return prefix + path;\n    };\n\n    // Use the instantiateWasm override when system fetch is not available.\n    // Reference:\n    // https://github.com/emscripten-core/emscripten/blob/2bca083cbbd5a4133db61fbd74d04f7feecfa907/tests/manual_wasm_instantiate.html#L170\n    if (customFetch) {\n      factoryConfig.instantiateWasm =\n          createInstantiateWasmFunc(getPathToWasmBinary(\n              simdSupported as boolean, threadsSupported as boolean,\n              wasmPathPrefix != null ? wasmPathPrefix : ''));\n    }\n\n    let initialized = false;\n    factoryConfig.onAbort = () => {\n      if (initialized) {\n        // Emscripten already called console.warn so no need to double log.\n        return;\n      }\n      if (initAborted) {\n        // Emscripten calls `onAbort` twice, resulting in double error\n        // messages.\n        return;\n      }\n      initAborted = true;\n      const rejectMsg =\n          'Make sure the server can serve the `.wasm` file relative to the ' +\n          'bundled js file. For more details see https://github.com/tensorflow/tfjs/blob/master/tfjs-backend-wasm/README.md#using-bundlers';\n      reject({message: rejectMsg});\n    };\n\n    let wasm: Promise<BackendWasmModule>;\n    // If `wasmPath` has been defined we must initialize the vanilla module.\n    if (threadsSupported && simdSupported && wasmPath == null) {\n      factoryConfig.mainScriptUrlOrBlob = new Blob(\n          [`var WasmBackendModuleThreadedSimd = ` +\n              wasmFactoryThreadedSimd.toString()],\n          {type: 'text/javascript'});\n      wasm = wasmFactoryThreadedSimd(factoryConfig);\n    } else {\n      // The wasmFactory works for both vanilla and SIMD binaries.\n      wasm = wasmFactory(factoryConfig);\n    }\n\n    // The WASM module has been successfully created by the factory.\n    // Any error will be caught by the onAbort callback defined above.\n    wasm.then((module) => {\n      initialized = true;\n      initAborted = false;\n\n      const voidReturnType: string = null;\n      // Using the tfjs namespace to avoid conflict with emscripten's API.\n
```

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module.tfjs = {\n  init: module.cwrap('init', null, []),\n  initWithThreadsCount:\n module.cwrap('init_with_threads_count', null, ['number']),\n  getThreadsCount:
module.cwrap('get_threads_count', 'number', []),\n  registerTensor: module.cwrap(\n  'register_tensor',
null,\n  [\n  'number',  // id\n  'number',  // size\n  'number',  // memoryOffset\n
]),\n  disposeData: module.cwrap('dispose_data', voidReturnType,
 ['number']),\n  dispose: module.cwrap('dispose', voidReturnType, []),\n  };\n\n  resolve({wasm:
module});\n  });\n  });\n}\n\nfunction typedArrayFromBuffer(\n  buffer: ArrayBuffer, dtype: DataType):
backend_util.TypedArray {\n  switch (dtype) {\n  case 'float32':\n  return new Float32Array(buffer);\n  case
'int32':\n  return new Int32Array(buffer);\n  case 'bool':\n  return new Uint8Array(buffer);\n  default:\n
throw new Error(`Unknown dtype ${dtype}`);\n  }\n}\n\nconst wasmBinaryNames = [\n  'tfjs-backend-
wasm.wasm', 'tfjs-backend-wasm-simd.wasm',\n  'tfjs-backend-wasm-threaded-simd.wasm'\n] as const ;\ntype
WasmBinaryName = typeof wasmBinaryNames[number];\n\nlet wasmPath: string = null;\nlet wasmPathPrefix:
string = null;\nlet wasmFileMap: {[key in WasmBinaryName]?: string} = {};\nlet initAborted = false;\nlet
customFetch = false;\n\n/**\n * @deprecated Use `setWasmPaths` instead.\n * Sets the path to the `.wasm` file
which will be fetched
 when the wasm\n * backend is initialized. See\n * https://github.com/tensorflow/tfjs/blob/master/tfjs-backend-
wasm/README.md#using-bundlers\n * for more details.\n * @param path wasm file path or url\n * @param
usePlatformFetch optional boolean to use platform fetch to download\n *  the wasm file, default to false.\n *\n *
@doc {heading: 'Environment', namespace: 'wasm'}\n */\nexport function setWasmPath(path: string,
usePlatformFetch = false): void {\n  deprecationWarn(\n  'setWasmPath has been deprecated in favor of
setWasmPaths and' +\n  ' will be removed in a future release.');\n  if (initAborted) {\n  throw new Error(\n
'The WASM backend was already initialized. Make sure you call ' +\n  '`setWasmPath()` before you call
`tf.setBackend()` or `tf.ready()`');\n  }\n  wasmPath = path;\n  customFetch = usePlatformFetch;\n}\n\n/**\n *
Configures the locations of the WASM binaries.\n *\n * ```js\n * setWasmPaths({\n *  'tfjs-backend-wasm.wasm':
'renamed.wasm',\n
 *  'tfjs-backend-wasm-simd.wasm': 'renamed-simd.wasm',\n *  'tfjs-backend-wasm-threaded-simd.wasm': 'renamed-
threaded-simd.wasm'\n * });\n * tf.setBackend('wasm');\n * ```\n *\n * @param prefixOrFileMap This can be either
a string or object:\n *  - (string) The path to the directory where the WASM binaries are located.\n *  Note that this
prefix will be used to load each binary (vanilla,\n *  SIMD-enabled, threading-enabled, etc.).\n *  - (object)
Mapping from names of WASM binaries to custom\n *  full paths specifying the locations of those binaries. This
is useful if\n *  your WASM binaries are not all located in the same directory, or if your\n *  WASM binaries
have been renamed.\n * @param usePlatformFetch optional boolean to use platform fetch to download\n *  the
wasm file, default to false.\n *\n * @doc {heading: 'Environment', namespace: 'wasm'}\n */\nexport function
setWasmPaths(\n  prefixOrFileMap: string|{[key in WasmBinaryName]?: string},\n  usePlatformFetch
 = false): void {\n  if (initAborted) {\n  throw new Error(\n  'The WASM backend was already initialized. Make
sure you call ' +\n  '`setWasmPaths()` before you call `tf.setBackend()` or ' +\n  '`tf.ready()`');\n  }\n\n  if
(typeof prefixOrFileMap === 'string') {\n  wasmPathPrefix = prefixOrFileMap;\n  } else {\n  wasmFileMap =
prefixOrFileMap;\n  const missingPaths =\n  wasmBinaryNames.filter(name => wasmFileMap[name] ==
null);\n  if (missingPaths.length > 0) {\n  throw new Error(\n  `There were no entries found for the
following binaries: ` +\n  `${missingPaths.join(',')}. Please either call setWasmPaths with a ` +\n  `map
providing a path for each binary, or with a string indicating ` +\n  `the directory where all the binaries can be
found.`);\n  }\n  }\n\n  customFetch = usePlatformFetch;\n}\n\n/** Used in unit tests. */\nexport function
resetWasmPath(): void {\n  wasmPath = null;\n  wasmPathPrefix = null;\n
 wasmFileMap = {};\n  customFetch = false;\n  initAborted = false;\n}\n\nlet threadsCount = -1;\nlet
actualThreadsCount = -1;\n\n/**\n * Sets the number of threads that will be used by XNNPACK to create\n *
threadpool (default to the number of logical CPU cores).\n *\n * This must be called before calling
`tf.setBackend('wasm')`.\n */\nexport function setThreadsCount(numThreads: number) {\n  threadsCount =
numThreads;\n}\n\n/**\n * Gets the actual threads count that is used by XNNPACK.\n *\n * It is set after the
```

backend is intialized.\n */\nexport function getThreadsCount(): number {\n if (actualThreadsCount === -1) {\n throw new Error(`WASM backend not initialized.`);\n }\n return actualThreadsCount;\n}\n"]}

Found in path(s):
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/backend_wasm.js.map
No license file was found, but licenses were detected in source scan.

{"version":3,"file":"SquaredDifference.js","sourceRoot":"","sources":["../../src/kernels/SquaredDifference.ts"],"names":[],"mappings":"AAAA;;;;;;;;;;;;;;GAeG;AACH,OAAO,EAAE,iBAAiB,EAAC,MAAM,uBAAuB,CAAC;AACtE,OAAO,EAAC,wBAAwB,EAAC,MAAM,iBAAiB,CAAC;AACzD,MAAM,qBAAqB,GAAG,IAAI,CAAC;AACnC,MAAM,CAAC,MAAM,uBAAuB,GAAG,iBAAiB,CAAC,qBAAqB,EAAE,CAAC","sourcesContent":["/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the
 specific language governing permissions and\n * limitations under the License.\n *
==\n
*/\nimport {KernelConfig, SquaredDifference} from '@tensorflow/tfjs-core';\nimport {createBinaryKernelConfig} from './binary_kernel';\nconst supportsFullBroadcast = true;\nexport const squaredDifferenceConfig: KernelConfig =\n   createBinaryKernelConfig(SquaredDifference, supportsFullBroadcast);\n"]}

Found in path(s):
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernels/SquaredDifference.js.map
No license file was found, but licenses were detected in source scan.

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ReshapeInputs, attrs: ReshapeAttrs, backend: BackendWasm})
{\n const {inputs, attrs} = args;\n const {x} = inputs;\n const {shape} = attrs;\n\n const xSize = util.sizeFromShape(x.shape);\n const $shape = util.inferFromImplicitShape(shape, xSize);\n\n util.assert(\n xSize === util.sizeFromShape($shape),\n   () => `new shape: ${$shape}, old shape: ${x.shape}. New shape and old ` +\n   `shape must have the same number of elements.`);\n\n // Backend needs to track refCount for the dataId for reshape op\n args.backend.incRef(x.dataId);\n return {dataId: x.dataId, shape: $shape, dtype: x.dtype};\n}\n\nexport const reshapeConfig: KernelConfig = {\n kernelName: Reshape,\n backendName: 'wasm',\n kernelFunc: reshape as {} as KernelFunc\n};\n"]}

Found in path(s):
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernels/Reshape.js.map
No license file was found, but licenses were detected in source scan.

{"version":3,"file":"Slice.js","sourceRoot":"","sources":["../../src/kernels/Slice.ts"],"names":[],"mappings":"AAAA;;;;;;;;;;;;;GAeG;AAEH,OAAO,EAAyC,KAAK,EAAE,UAAU,EAAuC,IAAI,EAAC,MAAM,uBAAuB,CAAC;AAG3I,OAAO,EAAC,YAAY,EAAC,MAAM,wBAAwB,CAAC;AAEpD,MAAM,UAAU,KAAK,CAAC,jB,IAAoE;IACtE,MAAM,EAAC,MAAM,EAAC,MAAM,EAAE,EAAC,CAAC,EAAC,EAAE,KAAK,EAAE,EAAC,KAAK,EAAE,IAAI,EAAC,EAAE,OAAO,EAAC,GAAG,IAAI,CAAC;IAE1D,IAAI,CAAC,gBAAgB,CAAC,CAAC,EAAE,KAAK,EAAE,IAAI,EAAC,CAAC,CAAC;IAEvC,OAAO,EAAC,MAAM,EAAE,CAAC,CAAC,MAAM,EAAE,KAAK,EAAE,IAAI,EAAC,CAAC;AAC3C,CAAC;AAED,MAAM,CAAC,MAAM,WAAW,GAAiB,EAAC,UAAU,EAAE,OAAO,EAAE,WAAW,EAAE,MAAM,EAAE,KAAK,EAAE,KAAK,EAAC,CAAC","sourcesContent":["/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ===\n */\n\nimport {backend_util, KernelConfig, KernelFunc, Slice, SliceAttrs, SliceInputs, TypedArray, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nexport function slice(args: {inputs: SliceInputs, attrs: SliceAttrs, backend: BackendWasm}) {\n const {inputs, attrs, backend} = args;\n const {x} = inputs;\n const {begin, size} = attrs;\n\n const [$begin, $size] = backend_util.parseSliceParams(x, begin, size);\n\n backend_util.assertParamsValid(x, $begin, $size);\n\n const out = backend.makeOutput($size, x.dtype);\n\n const xVals = backend.typedArrayFromHeap(x);\n const outVals = backend.typedArrayFromHeap(out);\n const xStrides = util.computeStrides(x.shape);\n\n const kernelFunc = backend.wasm.cwrap(Slice, null /*void*/, [\n   'number', // xId\n   'array',   // begin\n   'array',   // xStrides\n   'array',   // size\n   'number', // xRank\n   'array',   // outVals\n]);\n\n kernelFunc(\n   x.id, new Uint8Array(new Int32Array($begin).buffer),\n   new Uint8Array(new Int32Array(xStrides).buffer),\n   new Uint8Array(new Int32Array($size).buffer), x.shape.length,\n   new Uint8Array(outVals.buffer));\n\n return out;\n}\n\nexport const sliceConfig: KernelConfig = {kernelName: Slice, backendName: 'wasm', kernelFunc: slice as {} as KernelFunc};\n"]}

E,SAAS,IAAI,IAAI,CAAC,CAAC,CAAC,CAAC;KACtB;AACH,CAAC;AAED,SAAS,OAAO,CACZ,KAA8B,EAAE,QAAAgB,EAAE,QAAAgB,EAAE,EAClE,OAAAgC,EAAE,KAA+B,EACjE,IAA8B;IAChC,IAAI,SAAS,GAAG,CAAC,CAAC;IAClB,MAAM,MAAM,GAAG,KAAK,CAAC,CAAC,CAAC,CAAC;IACxB,MAAM,MAAM,GAAG,KAAK,CAAC,CAAC,CAAC,CAAC;IACxB,MAAM,MAAM,GAAG,KAAK,CAAC,CAAC,CAAC,CAAC;IACxB,MAAM,IAAI,GAAG,MAAM,GAAG,GAAG,CAAC,CAAC,CAAC,CAAC;IAC9B

{\n slice2d(\n
xVals as TypedArray, xStrides[0], outVals, begin_ as [number, number],\n size_ as [number, number]);\n } else if (rank === 3) {\n slice3d(\n xVals as TypedArray, xStrides[0], xStrides[1], outVals,\n begin_ as [number, number, number], size_ as [number, number, number]);\n } else if (rank === 4) {\n slice4d(\n xVals as TypedArray, xStrides[0], xStrides[1], xStrides[2], outVals,\n begin_ as [number, number, number, number],\n size_ as [number, number, number, number]);\n } else {\n const res =\n sliceImplCPU(xVals, begin_, size_, x.shape, x.dtype) as TypedArray;\n outVals.set(res);\n }\n\n return out;\n}\n\nfunction slice2d(\n xVals: backend_util.TypedArray, xStride: number,\n outVals: backend_util.TypedArray, begin: [number, number],\n size: [number, number]): void {\n let outOffset = 0;\n const beginI = begin[0];\n const beginJ = begin[1];\n const endI = beginI + size[0];\n for (let i = beginI; i < endI;
i++) {\n const xOffset = i * xStride + beginJ;\n outVals.set(xVals.subarray(xOffset, xOffset + size[1]), outOffset);\n outOffset += size[1];\n }\n}\n\nfunction slice3d(\n xVals: backend_util.TypedArray, xStride1: number, xStride2: number,\n outVals: backend_util.TypedArray, begin: [number, number, number],\n size: [number, number, number]): void {\n let outOffset = 0;\n const beginI = begin[0];\n const beginJ = begin[1];\n const beginK = begin[2];\n const endI = beginI + size[0];\n const endJ = beginJ + size[1];\n for (let i = beginI; i < endI; i++) {\n for (let j = beginJ; j < endJ; j++) {\n const xOffset = i * xStride1 + j * xStride2 + beginK;\n outVals.set(xVals.subarray(xOffset, xOffset + size[2]), outOffset);\n outOffset += size[2];\n }\n }\n}\n\nfunction slice4d(\n xVals: backend_util.TypedArray, xStride1: number, xStride2: number,\n xStride3: number, outVals: backend_util.TypedArray,\n begin: [number, number, number, number],\n
size: [number, number, number, number]): void {\n let outOffset = 0;\n const beginI = begin[0];\n const beginJ = begin[1];\n const beginK = begin[2];\n const endI = beginI + size[0];\n const endJ = beginJ + size[1];\n const endK = beginK + size[2];\n const beginL = begin[3];\n\n for (let i = beginI; i < endI; i++) {\n for (let j = beginJ; j < endJ; j++) {\n for (let k = beginK; k < endK; k++) {\n const xOffset = i * xStride1 + j * xStride2 + k * xStride3 + beginL;\n outVals.set(xVals.subarray(xOffset, xOffset + size[3]), outOffset);\n outOffset += size[3];\n }\n }\n }\n}\n\nexport const sliceConfig: KernelConfig = {\n kernelName: Slice,\n backendName: 'wasm',\n kernelFunc: slice as {} as KernelFunc,\n};\n"]}

Found in path(s):
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernels/Slice.js.map
No license file was found, but licenses were detected in source scan.

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C;AAC3E,CAAC","sourcesContent":["/**\n
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implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n
*/\n\nimport {backend_util, TensorInfo, util} from '@tensorflow/tfjs-core';\nimport {BackendWasm} from '../backend_wasm';\nimport {transpose} from './Transpose';\n\n/**\n * Compute permutation axes and do a transpose if necessary.\n *\n * Used by reduction ops.\n * @param x input TensorInfo\n * @param axis reduction axes\n * @param backend wasm backend instance\n */\nexport function permuteAxesAndTranspose(\n x: TensorInfo, axis: number|number[], backend: BackendWasm): {\n transposed: TensorInfo|null,\n axes: number[],\n originalAxes: number[],\n inputWasTransposed: boolean\n} {\n const xShape = x.shape;\n const xRank = x.shape.length;\n\n const originalAxes = util.parseAxisParam(axis, xShape);\n let axes = originalAxes;\n const permutedAxes = backend_util.getAxesPermutation(axes,
xRank);\n let xTransposed = null;\n let inputWasTransposed = false;\n if (permutedAxes != null) {\n const newShape: number[] = new Array(xRank);\n for (let i = 0; i < newShape.length; i++) {\n newShape[i] = xShape[permutedAxes[i]];\n }\n\n axes = backend_util.getInnerMostAxes(axes.length, xRank);\n xTransposed =\n transpose({inputs: {x}, attrs: {perm: permutedAxes}, backend});\n\n const xId = backend.dataIdMap.get(x.dataId).id;\n const transposedId = backend.dataIdMap.get(xTransposed.dataId).id;\n if (transposedId !== xId) {\n inputWasTransposed = true;\n }\n }\n\n return {transposed: xTransposed, originalAxes, axes, inputWasTransposed};\n}\n"]}

Found in path(s):
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernels/kernel_utils.js.map
No license file was found, but licenses were detected in source scan.

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EAAE,MAAM;IACnB,SAAS,EAAE,KAAK;IAChB,UAAU,EAAE,IAAwB;CACrC,CAAC","sourcesContent":["/*\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n * ==\n */\n\nimport {KernelConfig, KernelFunc, TensorInfo, TopK, TopKAttrs, TopKInputs} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\nimport {CppDType} from './types';\n\nlet wasmTopK: (\n   xId: number, xShapeBytes: Uint8Array, xShapeLength: number,\n   xDtype: CppDType, k: number, sorted: boolean, outValuesId: number,\n   outIndicesId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmTopK = backend.wasm.cwrap(TopK, null /* void */, [\n   'number', // xId\n   'array',   // x.shape\n   'number', // x.shape.length\n   'number', // x.dtype\n   'number', // k\n   'bool',\n   // sorted\n   'number', // outValuesId\n   'number', // outIndicesId\n]);\n}\n\nexport const topk:\n   (args: {inputs: TopKInputs, backend: BackendWasm, attrs: TopKAttrs}) =>\n   TensorInfo[] | TensorInfo = ({inputs, backend, attrs}) => {\n   const {x} = inputs;\n   const {k, sorted} = attrs;\n\n   const xId = backend.dataIdMap.get(x.dataId).id;\n   const xShapeBytes = new Uint8Array(new Int32Array(x.shape).buffer);\n   const outputShape = x.shape.slice();\n   outputShape[outputShape.length - 1] = k;\n   const outValues = backend.makeOutput(outputShape, x.dtype);\n   const outValuesId = backend.dataIdMap.get(outValues.dataId).id;\n   const outIndices = backend.makeOutput(outputShape, 'int32');\n   const outIndicesId = backend.dataIdMap.get(outIndices.dataId).id;\n\n   wasmTopK(\n   xId, xShapeBytes, x.shape.length, CppDType[x.dtype], k, sorted,\n   outValuesId, outIndicesId);\n\n   return [outValues, outIndices];\n   };\n\nexport const topKConfig: KernelConfig = {\n kernelName: TopK,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: topk as {} as KernelFunc,\n};\n"]}

Found in path(s):
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernels/TopK.js.map
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* /tfjs-backend-wasm-zip/tfjs-backend-wasm/starter/parcel/index.html

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{"version":3,"file":"_FusedMatMul.js","sourceRoot":"","sources":["../../src/kernels/_FusedMatMul.ts"],"names":[],"mappings":"AAAA;;;;;;;;;;;;;;;GAeG;AAEH,OAAO,EAAC,YAAY,EAAkE,MAAM,uBAAuB,CAAC;AAIpH,OAAO,EAAC,iBAAiB,EAAC,MAAM,SAAS,CAAC;AAE1C,IAAI,eAAKQ,CAAC;AAEb,SAAS,KAAK,CAAC,OAAOoB,CAAC;IACjC,eAAe,GAAG,OAAO,CAAC,IAAI,CAAC,KAAK,CAAC,YAAY,EAAE,IAAI,CAAC,UAAU,EAAE;QAClE,QAAQ;QACR,OAAO;QACP,QAAQ;QACR,QAAQ;QACR,OAAO;QACP,QAAQ;QACR,QAAQ;QACR,QAAQ;QACR

biasId: number,\n preluActivationWeightsId: number, leakyreluAlpha:
number, outId: number) =>\n void;\n\nfunction setup(backend: BackendWasm) {\n wasmFusedMatMul =
backend.wasm.cwrap(_FusedMatMul, null /* void */, [\n 'number', // a_id\n 'array', // a_shape\n 'number', //
a_shape.length\n 'number', // b_id\n 'array', // b_shape\n 'number', // b_shape.length\n 'number', //
transpose_a\n 'number', // transpose_b\n 'number', // activation\n 'number', // biasId\n 'number', //
preluActivationWeightsId\n 'number', // leakyreluAlpha\n 'number' // out_id\n]);\n}\n\nfunction
fusedBatchMatMul(args: {\n inputs: _FusedMatMulInputs,\n backend: BackendWasm,\n attrs:
_FusedMatMulAttrs\n}) {\n const {inputs, backend, attrs} = args;\n const {a, b, bias, preluActivationWeights} =
inputs;\n\n if (a.dtype !== 'float32' || b.dtype !== 'float32') {\n throw new Error(\n `_FusedMatMul for non
non-float32 tensors not yet supported.`);\n }\n\n const {transposeA, transposeB, activation, leakyreluAlpha}
= attrs;\n const aId = backend.dataIdMap.get(a.dataId).id;\n const bId = backend.dataIdMap.get(b.dataId).id;\n\n
let biasId = 0;\n if (bias != null) {\n const biasData = backend.dataIdMap.get(bias.dataId);\n if
(biasData.shape.length !== 1) {\n throw new Error(\n `_FusedMatMul only supports rank-1 bias but got ` +\n
`rank ${biasData.shape.length}.`);\n }\n biasId = biasData.id;\n }\n const preluActivationWeightsId =
preluActivationWeights == null ?\n 0 :\n backend.dataIdMap.get(preluActivationWeights.dataId).id;\n const
fusedActivation =\n FusableActivation[activation as {} as keyof typeof FusableActivation];\n if
(fusedActivation == null) {\n throw new Error(\n `${activation} activation not yet supported for
FusedConv2D ` +\n `in the wasm backend.`);\n }\n\n const leftDim = transposeA ? a.shape[2] : a.shape[1];\n
const rightDim = transposeB ? b.shape[1] : b.shape[2];\n const batchDim = a.shape[0];\n\n
const out = backend.makeOutput([batchDim, leftDim, rightDim], a.dtype);\n const outId =
backend.dataIdMap.get(out.dataId).id;\n\n const aShapeBytes = new Uint8Array(new
Int32Array(a.shape).buffer);\n const bShapeBytes = new Uint8Array(new Int32Array(b.shape).buffer);\n\n
wasmFusedMatMul(\n aId, aShapeBytes, a.shape.length, bId, bShapeBytes, b.shape.length,\n transposeA,
transposeB, fusedActivation, biasId, preluActivationWeightsId,\n leakyreluAlpha || 0, outId);\n\n return
out;\n}\n\nexport const fusedMatMulConfig: KernelConfig = {\n kernelName: _FusedMatMul,\n backendName:
'wasm',\n setupFunc: setup,\n kernelFunc: fusedBatchMatMul as {} as KernelFunc\n};\n"]}

Found in path(s):
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernels/_FusedMatMul.js.map
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* ===
*/

Found in path(s):
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/src/test_node.ts
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/test_node.d.ts
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/test_node.js
No license file was found, but licenses were detected in source scan.

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 * ==\n
*/\nimport {KernelConfig, Relu} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\nexport const reluConfig: KernelConfig = createUnaryKernelConfig(Relu);\n"]}

Found in path(s):
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernels/Relu.js.map
No license file was found, but licenses were detected in source scan.

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 and\n * limitations under the License.\n *
 ==\n
*/\n\nimport {Add, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from './binary_kernel';\n\nconst supportsFullBroadcast = true;\n\nexport const addConfig: KernelConfig =\n createBinaryKernelConfig(Add, supportsFullBroadcast);\n"]}

Found in path(s):
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernels/Add.js.map
No license file was found, but licenses were detected in source scan.

{"version":3,"file":"MirrorPad.js","sourceRoot":"","sources":["../../src/kernels/MirrorPad.ts"],"names":[],"mappings":"AAAA;;;;;;;;;;;;;;;;GAgBG;AAEH,OAAO,EAAC,YAAY,EAAC,MAAM,uBAAuB,CAAC;AAEnD,OAAO,EAAC,uBAAuB,EAAC,MAAM,gBAAgB,CAAC;AACvD,MAAM,CAAC,MAAM,eAAe,GAAiB,uBAAuB,CAAC,YAAY,CAAC,CAAC

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Found in path(s):
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernels/MirrorPad.js.map
No license file was found, but licenses were detected in source scan.

{"version":3,"file":"OnesLike.js","sourceRoot":"","sources":["../../src/kernels/OnesLike.ts"],"names":[],"mappings":"AAAA;;;;;;;;;;;;;;;GAeG;AAEH,OAAO,EAA2B,QAAQ,EAAiB,MAAM,uBAAuB,CAAC;AAIzF,SAAS,QAAQ,CAAC,IAAoD;IACpE,MAAM,EAAC,MAAM,EAAE,OAAO,EAAC,GAAG,IAAI,CAAC;IAC/B,MAAM,GAAG,GAAG,OAAO,CAAC,UAAU,CAAC,CAAC,CAAC,KAAK,EAAE,CAAC,CAAC,KAAK,CAAC,CAAC;IACjD,MAAM,OAAO,GAAG,OAAO,CAAC,qBAAqB,CAAC,GAAG,CAAC,CAAC;IACnD,OAAO,CAAC,IAAI,CAAC,CAAC,CAAC,CAAC;IAChB,OAAO,GAAG,CAAC;AACb,CAAC;AAED,MAAM,CAAC,MAAM,eAAe,GAAiB;IAC3C,UAAU,EAAE,QAAQ;IACpB,WAAW,EAAE,MAAM;IACnB,UAAU,EAAE,QAAQ;CACrB,CAAC","sourcesContent":["/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n * ==\n */\n\nimport {KernelConfig, KernelFunc, OnesLike, OnesLikeInputs} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nfunction onesLike(args: {inputs: OnesLikeInputs, backend: BackendWasm}) {\n const {inputs: {x}, backend} = args;\n const out = backend.makeOutput(x.shape, x.dtype);\n const outVals = backend.typedArrayFromHeap(out);\n outVals.fill(1);\n return out;\n}\n\nexport const onesLikeConfig: KernelConfig = {\n kernelName: OnesLike,\n backendName: 'wasm',\n kernelFunc: onesLike as {} as KernelFunc,\n};\n"]}

Found in path(s):
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernels/OnesLike.js.map
No license file was found, but licenses were detected in source scan.

{"version":3,"file":"ClipByValue.js","sourceRoot":"","sources":["../../src/kernels/ClipByValue.ts"],"names":[],"mappings":"AAAA;;;;;;;;;;;;;;;GAeG;AAEH,OAAO,EAAC,QAAQ,EAAiB,MAAM,uBAAuB,CAAC;AAI/D,SAAS,WAAW,CAAC,IAAuD;IAC1E,MAAM,EAAC,MAAM,EAAE,OAAO,EAAC,GAAG,IAAI,CAAC;IAC/B,MAAM,GAAG,GAAG,OAAO,CAAC,UAAU,CAAC,CAAC,CAAC,KAAK,EAAE,CAAC,CAAC,KAAK,CAAC,CAAC;IACjD,MAAM,OAAO,GAAG,OAAO,CAAC,qBAAqB,CAAC,GAAG,CAAC,CAAC;IACnD,OAAO,CAAC,IAAI,CAAC,CAAC,CAAC,CAAC;IAChB,OAAO,GAAG,CAAC;AACb,CAAC;AAED,MAAM,CAAC,MAAM,kBAAkB,GAAiB;IAC9C,UAAU,EAAE,WAAW;IACvB,WAAW,EAAE,MAAM;IACnB,UAAU,EAAE,WAAW;CACxB,CAAC","sourcesContent":["/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a

copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n
*/\n\nimport {ClipByValue, ClipByValueAttrs, ClipByValueInputs, KernelConfig, KernelFunc} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm}
from '../backend_wasm';\n\nlet wasmClip: (xId: number, min: number, max: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmClip = backend.wasm.cwrap(ClipByValue, null /* void */, [\n   'number', // x_id\n   'number', // min\n   'number', // max\n   'number'   // out_id\n]);\n}\n\nfunction clip(args: {\n inputs: ClipByValueInputs,\n backend: BackendWasm,\n attrs: ClipByValueAttrs\n}) {\n const {inputs, backend, attrs} = args;\n const {x} = inputs;\n const {clipValueMin, clipValueMax} = attrs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n const out = backend.makeOutput(x.shape, x.dtype);\n const outId = backend.dataIdMap.get(out.dataId).id;\n wasmClip(xId, clipValueMin, clipValueMax, outId);\n return out;\n}\n\nexport const clipByValueConfig: KernelConfig = {\n kernelName: ClipByValue,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: clip as {} as KernelFunc\n};\n"]}

Found in path(s):
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernels/ClipByValue.js.map
No license file was found, but licenses were detected in source scan.

{"version":3,"file":"Sigmoid.js","sourceRoot":"","sources":["../../src/kernels/Sigmoid.ts"],"names":[],"mappings":"AAAA;;;;;;;;;;;;;;;GAeG;AAEH,OAAO,EAA2B,OAAO,EAA6B,IAAI,EAAC,MAAM,uBAAuB,CAAC;AAIzG,IAAI,QAAA8C,CAAC;AAEnD,SAAS,KAAK,CAAC,OAAoB;IACjC,QAAQ,GAAG,OAAO,CAAC,IAAI,CAAC,KAAK,CAAC,IAAI,EAAE,IAAI,EAAE,IAAI,EAAE

=== 0) {\n return out;\n }\n\n wasmFunc(xId, outId);\n return out;\n}\n\nexport const sigmoidConfig: KernelConfig = {\n kernelName: 'Sigmoid',\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: sigmoid as {} as KernelFunc\n};\n"]}

Found in path(s):
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernels/Sigmoid.js.map
No license file was found, but licenses were detected in source scan.

{"version":3,"file":"OneHot.js","sourceRoot":"","sources":["../../src/kernels/OneHot.ts"],"names":[],"mappings":"AAAA;;;;;;;;;;;;;;GAeG;AAEH,OAAO,EAA2B,MAAM,EAA4B,MAAM,uBAAuB,CAAC;AAIlG,IAAI,UAEsB,CAAC;AAE3B,SAAS,KAAK,CAAC,OAAoB;IACjC,UAAU,GAAG,OAAO,CAAC,IAAI,CAAC,KAAK,CAAC,MAAM,EAAE

{"version":3,"file":"Greater.js","sourceRoot":"","sources":["../../src/kernels/Greater.ts"],"names":[],"mappings":"AAAA;;;;;;;;;;;;;;;GAeG;AACH,OAAO,EAAC,OAAO,EAAE,MAAM,uBAAuB,CAAC;AAE5D,OAAO,EAAC,wBAAwB,EAAC,MAAM,iBAAiB,CAAC;AAEzD,MAAM,qBAAqB,GAAG,KAAK,CAAC;AACpC,MAAM,CAAC,MAAM,aAAa,GAAe,wBAAwB,CAC/D,OAAO,EAAE,qBAAqB,EAAE,MAAM,CAAC,CAAC","sourcesContent":["/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==\n */\nimport {Greater, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from './binary_kernel';\n\nconst supportsFullBroadcast = false;\nexport const greaterConfig: KernelConfig =\n createBinaryKernelConfig(Greater, supportsFullBroadcast, 'bool');\n"]}

Found in path(s):
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernels/Greater.js.map
No license file was found, but licenses were detected in source scan.

{"version":3,"file":"FusedBatchNorm.js","sourceRoot":"","sources":["../../src/kernels/FusedBatchNorm.ts"],"names":[],"mappings":"AAAA;;;;;;;;;;;;;;;GAeG;AAEH,OAAO,EAAC,OAAO,EAAE,YAAY,EAAC,MAAM,uBAAuB,CAAC;AAC5D,OAAO,EAAC,wBAAwB,EAAC,MAAM,iBAAiB,CAAC;AAEzD,MAAM,CAAC,MAAM,gBAAgB,GAAe,wBAAwB,CAAC,YAAY,EAAE,KAAK,EAAE,MAAM,CAAC,CAAC","sourcesContent":["/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *

==========\n*/\n\nimport {FusedBatchNorm, FusedBatchNormAttrs, FusedBatchNormInputs, KernelConfig, KernelFunc, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmBatchNorm: (\n xId: number, meanId: number, varianceId: number, offsetId: number,\n scaleId: number, varianceEpsilon: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n wasmBatchNorm = backend.wasm.cwrap(\n FusedBatchNorm, null /* void */,\n ['number', 'number', 'number', 'number', 'number', 'number', 'number']);\n}\n\nfunction fusedBatchNorm(args: {\n backend: BackendWasm,\n inputs: FusedBatchNormInputs,\n attrs: FusedBatchNormAttrs\n}): TensorInfo {\n const {backend, inputs, attrs} = args;\n const {varianceEpsilon} = attrs;\n const {x, mean, variance, offset, scale} = inputs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n const meanId = backend.dataIdMap.get(mean.dataId).id;\n const varianceId = backend.dataIdMap.get(variance.dataId).id;\n const offsetId = offset != null ? backend.dataIdMap.get(offset.dataId).id : 0;\n const scaleId = scale != null ? backend.dataIdMap.get(scale.dataId).id : 0;\n\n const out = backend.makeOutput(x.shape, x.dtype);\n // Short-circuit zero-sized tensors.\n if (util.sizeFromShape(x.shape) === 0) {\n return out;\n }\n\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n wasmBatchNorm(\n xId, meanId, varianceId, offsetId, scaleId, varianceEpsilon, outId);\n return out;\n}\n\nexport const fusedBatchNormConfig: KernelConfig = {\n kernelName: FusedBatchNorm,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: fusedBatchNorm as {} as KernelFunc\n};\n"]}

Found in path(s):
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernels/FusedBatchNorm.js.map
No license file was found, but licenses were detected in source scan.

{"version":3,"file":"LogicalAnd.js","sourceRoot":"","sources":["../../src/kernels/LogicalAnd.ts"],"names":[],"mappings":"AAAA;;;;;;;;;;;;;;;GAeG;AACH,OAAO,EAAe,UAAU,EAAC,MAAM,uBAAuB,CAAC;AAE/D,OAAO,EAAC,wBAAwB,EAAC,MAAM,iBAAiB,CAAC;AAEzD,OAAO,EAAC,qBAAqB,EAAC,MAAM,cAAc,CAAC;AAEnD,OAAO,EAAC,gBAAgB,EAAC,MAAM,yBAAyB,CAAC;AAEzD,MAAM,CAAC,MAAM,qBAAqB,GAAe;IAC/C,UAAU,EAAE,UAAU;IACtB,WAAW,EAAE,MAAM;IACnB,SAAS,EAAE,gBAAgB;IAC3B,UAAU,EAAE,wBAAwB;CACrC,CAAC","sourcesContent":["/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n * ==========\n */\nimport {KernelConfig, LogicalAnd} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from './binary_kernel';\nconst supportsFullBroadcast = false;\nexport const logicalAndConfig: KernelConfig =\n createBinaryKernelConfig(LogicalAnd, supportsFullBroadcast, 'bool');\n"]}

Found in path(s):
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernels/LogicalAnd.js.map
No license file was found, but licenses were detected in source scan.

{"version":3,"file":"Minimum.js","sourceRoot":"","sources":["../../src/kernels/Minimum.ts"],"names":[],"mappings":"AAAA;;;;;;;;;;;;;;;GAeG;AACH,OAAO,EAAe,UAAU,EAAC,MAAM,uBAAuB,CAAC;AAE/D,OAAO,EAAC,wBAAwB,EAAC,MAAM,iBAAiB,CAAC;AAEzD,OAAO,EAAC,qBAAqB,EAAC,MAAM,cAAc,CAAC;AAEnD,OAAO,EAAC,gBAAgB,EAAC,MAAM,yBAAyB,CAAC;AAEzD,MAAM,CAAC,MAAM,iBAAiB,GAAe;IAC3C,UAAU,EAAE,UAAU;IACtB,WAAW,EAAE,MAAM;IACnB,SAAS,EAAE,gBAAgB;IAC3B,UAAU,EAAE,wBAAwB;CACrC,CAAC","sourcesContent":["/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version

2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing
permissions and\n * limitations under the License.\n *
==========\n
*/\nimport {KernelConfig, Minimum} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from './binary_kernel';\nconst supportsFullBroadcast = false;\nexport const minimumConfig: KernelConfig =\n createBinaryKernelConfig(Minimum, supportsFullBroadcast);\n"]}

Found in path(s):
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernels/Minimum.js.map
No license file was found, but licenses were detected in source scan.

{"version":3,"file":"Step.js","sourceRoot":"","sources":["../../src/kernels/Step.ts"],"names":[],"mappings":"AAAA;;;;;;;;;;;;;GAeG;AAEH,OAAO,EAA2B,IAAI,EAAoC,MAAM,uBAAuB,CAAC;AAIxG,OAAO,EAAC,QAAQ,EAAC,MAAM,SAAS,CAAC;AAEjC,OAAO,EAAC,QAAQ,EAAC,MAAM,SAAS,CAAC;AAET,SAAS,CAAC;AAElC,OAAO,EAAC,QAAQ,EAAC,MAAM,SAAS,CAAC;AAEj

Found in path(s):
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernels/Step.js.map
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{"version":3,"file":"FusedConv2D.js","sourceRoot":"","sources":["../../src/kernels/FusedConv2D.ts"],"names":[],"mappings":"AAAA;;;;;;;;;;;;;;GAeG;AAEH,OAAO,EAAC,YAAY,EAAE,WAAW,EAA0E,MAAM,uBAAuB,CAAC;AAIzI,OAAO,EAAC,iBAAiB,EAAC,MAAM,SAAS,CAAC;AAE1C,IAAI,eAAQ,CAAC;AAEb,SAAS,CAAC,KAAK,CAAC,OAAO,CAAC,CAAC,IAAI,CAAC,CAAC,KAAK,CAAC,CAAC,WAAW,CAAC,CAAC,UAAU,CAAC,CAAC,QAAQ,CAAC,CAAC,QAAQ,CAAC,CAAC,QAAQ

```
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 implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
 ==========================================================================\n
 */\n\nimport {backend_util, FusedConv2D, FusedConv2DAttrs, FusedConv2DInputs, KernelConfig, KernelFunc, Tensor4D} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {FusableActivation} from './types';\n\nlet wasmFusedConv2d:\n    (xId: number, batchSize: number, inputHeight: number, inputWidth: number,\n     filterId: number, filterHeight: number, filterWidth: number,\n     biasId: number, padTop: number, padRight: number, padBottom: number,\n     padLeft: number, isSamePad: number, dilationHeight: number,\n     dilationWidth: number, strideHeight: number, strideWidth: number,\n     inputChannels: number, outputChannels: number, activation: number,\n     preluActivationWeightsId: number, leakyreluAlpha: number, outId: number) =>\n         void;\n\nfunction
 setup(backend: BackendWasm) {\n  wasmFusedConv2d = backend.wasm.cwrap(FusedConv2D, null /* void */, [\n
 'number',  // xId\n    'number',  // batchSize\n    'number',  // inputHeight\n    'number',  // inputWidth\n    'number',  // filterId\n    'number',  // filterHeight\n    'number',  // filterWidth\n    'number',  // biasId\n    'number',  // padTop\n    'number',  // padRight\n    'number',  // padBottom\n    'number',  // padLeft\n    'number',  // isSamePad\n    'number',  // dilationHeight\n    'number',  // dilationWidth\n    'number',  // strideHeight\n    'number',  // strideWidth\n    'number',  // inputChannels\n    'number',  // outputChannels\n    'number',  // activation\n    'number',  // preluActivationWeightsId\n    'number',  // leakyreluAlpha\n    'number',  // outId\n  ]);\n}\n\nfunction fusedConv2d(args: {\n  inputs: FusedConv2DInputs,\n  backend: BackendWasm,\n  attrs: FusedConv2DAttrs\n}) {\n  const {inputs, attrs, backend} = args;\n  const {x, filter, bias,
 preluActivationWeights} = inputs;\n  const {\n    strides,\n    pad,\n    dilations,\n    dataFormat,\n    dimRoundingMode,\n    activation,\n    leakyreluAlpha\n  } = attrs;\n\n  const convInfo = backend_util.computeConv2DInfo(\n      (x as Tensor4D).shape, (filter as Tensor4D).shape, strides, dilations,\n      pad, dimRoundingMode);\n\n  const fusedActivation =\n      FusableActivation[activation as {} as keyof typeof FusableActivation];\n  if (fusedActivation == null) {\n    throw new Error(\n        `${activation} activation not yet supported for FusedConv2D ` +\n        `in the wasm backend.`);\n  }\n\n  const xId = backend.dataIdMap.get(x.dataId).id;\n  const filterId = backend.dataIdMap.get(filter.dataId).id;\n\n  const outputChannels = convInfo.outChannels;\n\n  let biasId = 0;\n  if (bias != null) {\n    const biasData = backend.dataIdMap.get(bias.dataId);\n    if (biasData.shape.length !== 1) {\n      throw new Error(\n`FusedConv2D only supports rank-1 bias but
 got ` +\n          `rank ${biasData.shape.length}.`);\n    }\n    if (biasData.shape[0] !== outputChannels) {\n      throw new Error(\n          `FusedConv2D bias shape (${biasData.shape}) does not ` +\n          `match the number of output channels (${outputChannels})`);\n    }\n    biasId = biasData.id;\n  }\n\n  const filterHeight = convInfo.filterHeight;\n  const filterWidth = convInfo.filterWidth;\n  const padTop = convInfo.padInfo.top;\n  const padRight = convInfo.padInfo.right;\n  const padBottom = convInfo.padInfo.bottom;\n  const padLeft = convInfo.padInfo.left;\n  const dilationHeight = convInfo.dilationHeight;\n  const dilationWidth = convInfo.dilationWidth;\n  const strideHeight = convInfo.strideHeight;\n  const strideWidth = convInfo.strideWidth;\n  const inputChannels = convInfo.inChannels;\n  const isSamePad = convInfo.padInfo.type === 'SAME' ? 1 : 0;\n  const batchSize = convInfo.batchSize;\n  const inHeight = convInfo.inHeight;\n  const inWidth = convInfo.inWidth;\n\n
  if (dataFormat !== 'NHWC') {\n    throw new Error(\n        `wasm backend FusedConv2D does not support dataFormat:` +\n        `${dataFormat}'. Please use 'NHWC'.`);\n  }\n\n  const out = backend.makeOutput(convInfo.outShape, 'float32');\n  const outId = backend.dataIdMap.get(out.dataId).id;\n  const
```

preluActivationWeightsId = preluActivationWeights == null ?\n 0 :\n backend.dataIdMap.get(preluActivationWeights.dataId).id;\n\n wasmFusedConv2d(\n xId, batchSize, inHeight, inWidth, filterId, filterHeight, filterWidth,\n biasId, padTop, padRight, padBottom, padLeft, isSamePad, dilationHeight,\n dilationWidth, strideHeight, strideWidth, inputChannels, outputChannels,\n fusedActivation, preluActivationWeightsId, leakyreluAlpha || 0, outId);\n\n return out;\n}\n\nexport const fusedConv2DConfig: KernelConfig = {\n kernelName: FusedConv2D,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: fusedConv2d as {} as KernelFunc\n};\n"]}

Found in path(s):
*
/tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernels/FusedConv2D.js.map
No license file was found, but licenses were detected in source scan.

{"version":3,"file":"Range.js","sourceRoot":"","sources":["../../src/kernels/Range.ts"],"names":[],"mappings":"AAAA;;;;;;;;;;;;;;GAeG;AAEH,OAAO,EAA2B,KAAK,EAAyB,MAAM,uBAAuB,CAAC;AAG9F,OAAO,EAAC,YAAY,EAAC,MAAM,wBAAwB,CAAC;AAEpD,MAAM,CAAC,MAAM,KAAK,GACd,CAAC,IAA+D,EAAe,EAAE;IAC/E,MAAM,EAAC,OAAO,EAAE,KAAK,EAAC,GAAG,IAAI,CAAC;IAC9B,MAAM,EAAC,KAAK,EAAE,IAAI,EAAE,IAAI,EAAE,KAAK,EAAC,GAAG,KAAK,CAAC;IAEzC,MAAM,MAAM,GAAG,YAAY,CAAC,KAAK,EAAE,IAAI,EAAE,IAAI,EAAE,KAAK,CAAC,CAAC;IAEtD,MAAM,GAAG,GAAG,OAAO,CAAC,YAAY,CAAC,CAAC,MAAM,CAAC,MAAM,CAAC,EAAE,KAAK,CAAC,CAAC;IACzD,MAAM,OAAO,GAAG,OAAO,CAAC,mBAAmB,CAAC,GAAG,CAAC,CAAC;IACjD,OAAO,CAAC,GAAG,CAAC,MAAM,CAAC,CAAC;IACpB,OAAO,GAAG,CAAC;AACb,CAAC,CAAC;AAEN,MAAM,CAAC,MAAM,WAAW,GAAiB,EAAC,UAAU,EAAE,KAAK,EAAE,UAAU,EAAE,MAAM,EAAE,IAAI,EAAE,KAAK,EAAC,CAAC","sourcesContent":["/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version
2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n */\n\nimport {KernelConfig, KernelFunc, Range, RangeAttrs, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\nimport {rangeImplCPU} from '../kernel_utils/shared';\n\nexport const range =\n (args: {backend: BackendWasm, attrs: RangeAttrs}): TensorInfo => {\n const {backend, attrs} = args;\n const {start, stop, step, dtype} = attrs;\n
const values = rangeImplCPU(start, stop, step, dtype);\n\n const out = backend.makeOutput([values.length], dtype);\n const outVals = backend.typedArrayFromHeap(out);\n outVals.set(values);\n return out;\n};\n\nexport const rangeConfig: KernelConfig = {\n kernelName: Range,\n backendName: 'wasm',\n kernelFunc: range as {} as KernelFunc\n};\n"]}

Found in path(s):
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernels/Range.js.map
No license file was found, but licenses were detected in source scan.

{"version":3,"file":"CropAndResize.js","sourceRoot":"","sources":["../../src/kernels/CropAndResize.ts"],"names":[],"mappings":"AAAA;;;;;;;;;;;;;;;GAeG;AAEH,OAAO,EAAC,YAAY,EAAE,KAAK,EAAE,eAAe,EAAE,eAAe,EAAE,WAAW,EAAC,MAAM,uBAAuB,CAAC;AAEzG,OAAO,EAAC,YAAY,EAAC,MAAM,wBAAwB,CAAC;AAEpD,MAAM,CAAC,MAAM,cAAc,GACvB,CAAC,IAAwE,EAAe,EAAE;IACxF,MAAM,EAAC,OAAO,EAAE,MAAM,EAAE,MAAM,EAAC,GAAG,IAAI,CAAC;IACvC,MAAM,EAAC,SAAS,EAAE,UAAU,EAAE,SAAS,EAAE,UAAU,EAAC,GAAG,MAAM,CAAC;IAE9D,MAAM,MAAM,GAAG,YAAY,CAAC,MAAM,EAAE,MAAM,EAAE,MAAM,EAAE,MAAM,CAAC,CAAC;IAE5D,MAAM,GAAG,GAAG,OAAO,CAAC,YAAY,CAAC,CAAC,MAAM,CAAC,MAAM,CAAC,EAAE,MAAM,CAAC,CAAC;IAC1D,MAAM,OAAO,GAAG,OAAO,CAAC,mBAAmB,CAAC,GAAG,CAAC,CAAC;IACjD,OAAO,CAAC,GAAG,CAAC,MAAM,CAAC,CAAC;IACpB,OAAO,GAAG,CAAC;AACb,CAAC,CAAC;AAEN,MAAM,CAAC,MAAM,gBAAgB,GAAsB,EAAC,UAAU,EAAE,eAAe,EAAE,UAAU,EAAE,MAAM,EAAE,IAAI,EAAE,cAAc,EAAC,CAAC","sourcesContent":["/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version
2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n */\n\nimport {KernelConfig, KernelFunc, CropAndResize, CropAndResizeAttrs, CropAndResizeMethod, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\nimport {cropAndResizeImplCPU} from '../kernel_utils/shared';\n\nexport const cropAndResize =\n (args: {backend: BackendWasm, attrs: CropAndResizeAttrs}): TensorInfo => {\n const {backend, attrs} = args;\n const {cropSize, method, extrapolationValue} = attrs;\n\n const out = backend.makeOutput([cropSize], dtype);\n const outVals = backend.typedArrayFromHeap(out);\n return out;\n};\n\nexport const cropAndResizeConfig: KernelConfig = {\n kernelName: CropAndResize,\n backendName: 'wasm',\n kernelFunc: cropAndResize as {} as KernelFunc\n};\n"]}

,IAAI,iBAGkE,CAAC;AAEvE,SAAS,KAAK,CAAC,OAAoB;IACjC,iBAAiB,GAAG,OAAO,CAAC,IAAI,CAAC,KAAK,CAAC,aAAa,EAAE,IAAI,CAAC,QAAQ,EAAE;QACnE,QAAQ;QACR,QAAQ;QACR,QAAQ;QACR,QAAQ;QACR,OAAO;QACP,QAAQ;QACR,QAAQ;QACR,QAAQ;QACR,QAAQ;QACR,QAAQ,CAAG,SAAS;KACrB,CAAC,CAAC;AACL,CAAC;AAED,SAAS,aAAa,CAAC,IAAItB;IACC,MAAM,EAAC,OAAO,EAAE,EAAE,MAAM,EAAE,EAAE,KAAK,EAAC,EAAE,GAAG,IAAI,CAAC;IACtD,IAAI,CAAC,MAAM,EAAC,EAAE,MAAM,EAAE,EAAE,MAAM,EAAE,kBAAkB,EAAE,EAAE,QAAQ,EAAE,CAAC,GAAG,KAAK,CAAC;IAC1E,IAAI,CAAC,MAAM,EAAC,EAAE,MAAM,EAAE,KAAK,EAAE,EAAE,KAAK,EAAE,EAAE,MAAM,EAAE,CAAC,GAAG,KAAK,CAAC;IAC1D,IAAI,CAAC,MAAM,EAAC,QAAQ,EAAE,KAAK,EAAE,KAAK,EAAE,KAAK,EAAE,KAAK,EAAE,KAAK,CAAC;IAChE,IAAI,CAAC,MAAM,EAAC,KAAK,EAAE,KAAK,EAAE,KAAK,EAAE,KAAK,EAAE,KAAK,EAAE,KAAK,CAAC;IACrD

backend.dataIdMap.get(castedData.dataId);\n }\n\n const imagesId = imagesData.id;\n const boxesId = backend.dataIdMap.get(boxes.dataId).id;\n const boxIndId = backend.dataIdMap.get(boxInd.dataId).id;\n\n const out = backend.makeOutput(outShape, 'float32');\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n const imagesShapeBytes = new Uint8Array(new Int32Array(image.shape).buffer);\n\n wasmCropAndResize(\n imagesId, boxesId, boxIndId, numBoxes, imagesShapeBytes, cropHeight,\n cropWidth,\n InterpolationMethod[method as {} as keyof typeof InterpolationMethod],\n extrapolationValue, outId);\n\n if (castedData != null) {\n backend.disposeData(castedData.dataId);\n }\n\n return out;\n}\n\nexport const cropAndResizeConfig: KernelConfig = {\n kernelName: CropAndResize,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: cropAndResize as {} as KernelFunc\n};\n"]}

Found in path(s):
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernels/CropAndResize.js.map
No license file was found, but licenses were detected in source scan.

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Found in path(s):
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernels/Round.js.map
No license file was found, but licenses were detected in source scan.

{"version":3,"file":"flags_wasm.js","sourceRoot":"","sources":["../src/flags_wasm.ts"],"names":[],"mappings":"AAAA;;;;;;;;;;;;;;;GAeG;AAEH,OAAO,EAAC,KAAK,EAAC,MAAM,uBAAuB,CAAC;AAC5C,MAAM,CAAC,MAAM,WAAW,GAAG,KAAK,CAAC,KAAK,CAAC,KAAK,CAAC

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 the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {env} from '@tensorflow/tfjs-core';\n\nconst ENV = env();\n\n/**\n * True if SIMD is supported.\n */\n// From: https://github.com/GoogleChromeLabs/wasm-feature-detect\nENV.registerFlag(\n   // This typed array passed in to WebAssembly.validate is WebAssembly binary\n   // code. In this case it is a small program that contains SIMD\n   // instructions.\n   'WASM_HAS_SIMD_SUPPORT', async () => WebAssembly.validate(new Uint8Array([\n   0, 97, 115, 109, 1, 0, 0, 0, 1, 4, 1,   96, 0, 0, 3,\n   2, 1, 0,   10, 9, 1, 7, 0, 65, 0, 253, 15, 26, 11\n   ])));\n\n/**\n * True if threads are supported.\n */\n// From: https://github.com/GoogleChromeLabs/wasm-feature-detect\nENV.registerFlag('WASM_HAS_MULTITHREAD_SUPPORT',
 async () => {\n // TODO(annxingyuan): Enable node support once this is resolved:\n // https://github.com/tensorflow/tfjs/issues/3830\n if (ENV.get('IS_NODE')) {\n   return false;\n }\n\n try {\n   // Test for transferability of SABs (needed for Firefox)\n   // https://groups.google.com/forum/#!msg/mozilla.dev.platform/IHkBZlHETpA/dwsMNchWEQAJ\n   new MessageChannel().port1.postMessage(new SharedArrayBuffer(1));\n   // This typed array is a WebAssembly program containing threaded\n   // instructions.\n   return WebAssembly.validate(new Uint8Array([\n   0, 97, 115, 109, 1, 0, 0, 0, 1, 4, 1, 96, 0,   0, 3, 2, 1, 0, 5,\n   4, 1, 3,   1,   1, 10, 11, 1, 9, 0, 65, 0, 254, 16, 2, 0, 26, 11\n   ]));\n } catch (e) {\n   return false;\n }\n});\n"]}

Found in path(s):
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/flags_wasm.js.map
No license file was found, but licenses were detected in source scan.

{"version":3,"file":"index.js","sourceRoot":"","sources":["../src/index.ts"],"names":[],"mappings":"AAAA;;;;;;;;;;;;;;;;GAeG;AAEH,OAAO,wBAAwB,CAAC;AAChC,cAAc,QAAQ,CAAC","sourcesContent":["/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport './register_all_kernels';\nexport
 * from './base';\n"]}

Found in path(s):
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/index.js.map
No license file was found, but licenses were detected in source scan.

{"version":3,"file":"Less.js","sourceRoot":"","sources":["../../src/kernels/Less.ts"],"names":[],"mappings":"AAAA;;;

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permissions and\n * limitations under the License.\n *
==\n */\nimport {KernelConfig, Less} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from './binary_kernel';\nconst supportsFullBroadcast = false;\nexport const lessConfig: KernelConfig =\n createBinaryKernelConfig(Less, supportsFullBroadcast, 'bool');\n"]}

Found in path(s):
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernels/Less.js.map
No license file was found, but licenses were detected in source scan.

{"version":3,"file":"Concat.js","sourceRoot":"","sources":["../../src/kernels/Concat.ts"],"names":[],"mappings":"AAAA;;;;;;;;;;;;;;;GAeG;AAEH,OAAO,EAAC,YAAY,EAAE,MAAM,EAAuD,IAAI,EAAC,MAAM,uBAAuB,CAAC;AAGtH,OAAO,EAAC,aAAa,EAAC,MAAM,wBAAwB,CAAC;AACrD,OAAO,EAAC,QAAQ,EAAC,MAAM,WAAW,CAAC;AACpC,OAAO,EAAC,MAAM,EAAC,MAAM,UAAU,CAAC;AAElC,OAAO,EAAC,MAAM,EAAE,MAAM,EAAC,MAAM,cAAc,CAAC;AAE5C,OAAO,EAAC,IAAI,EAAE,IAAI,EAAC,MAAM,SAAS,CAAC;AAEnC,MAAM,UAAU,MAAM,CAAC,EAAC,MAAM,EAAE,MAAM,EAAC;IACrC,MAAM,CAAC,MAAM,CAAC,GAAG,MAAM,CAAC,MAAM,CAAC,CAAC;IAChC,MAAM,CAAC,MAAM,CAAC,GAAG,MAAM,CAAC,MAAM,CAAC,CAAC;IAEh

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inputs[0].dtype,\n   simplyConcat) as string[];\n\n   const finalOutShape =\n backend_util.computeOutShape($inputs.map(t => t.shape),
 axis);\n\n   out.shape = finalOutShape;\n   const outData = backend.dataIdMap.get(out.dataId);\n outData.stringBytes = backend_util.fromStringArrayToUint8(outVals);\n\n   inputs2D.forEach(t => backend.disposeData(t.dataId));\n\n   return out;\n }\n\n const batchDim = util.sizeFromShape($inputs[0].shape.slice(0, axis));\n let sumInnerDims = 0;\n const innerDims = $inputs.map(input => {\n   const innerDim = util.sizeFromShape(input.shape.slice(axis));\n   sumInnerDims += innerDim;\n   return innerDim;\n });\n const inVals = $inputs.map(input => backend.typedArrayFromHeap(input));\n const outVals = backend.typedArrayFromHeap(out);\n for (let b = 0; b < batchDim; b++) {\n   let outOffset = b * sumInnerDims;\n   for (let i = 0; i < inVals.length; i++) {\n   const innerDim = innerDims[i];\n   const inOffset = b * innerDim;\n   const vals = inVals[i].subarray(inOffset, inOffset + innerDim);\n   outVals.set(vals, outOffset);\n   outOffset += innerDim;\n   }\n }\n return out;\n}\n\nexport const concatConfig: KernelConfig = {\n kernelName: Concat,\n backendName: 'wasm',\n kernelFunc: concat as {} as KernelFunc,\n};\n"]}

Found in path(s):
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernels/Concat.js.map
No license file was found, but licenses were detected in source scan.

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* distributed under the License is distributed on an "AS IS" BASIS,
* WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.
* See the License for the specific language governing permissions and
* limitations under the License.
* ===
*/

Found in path(s):
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernels/kernel_utils.js
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernels/kernel_utils.d.ts
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/src/kernels/kernel_utils.ts
No license file was found, but licenses were detected in source scan.

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KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\n// Import shared functionality from tfjs-backend-cpu without triggering\n// side effects.\n// tslint:disable-next-line: no-imports-from-dist\nimport {concatImpl as concatImplCPU} from '@tensorflow/tfjs-backend-cpu/dist/shared';\n\n// tslint:disable-next-line: no-imports-from-dist\nimport {sliceImpl as sliceImplCPU} from '@tensorflow/tfjs-backend-cpu/dist/shared';\n\n// tslint:disable-next-line: no-imports-from-dist\nimport {rangeImpl as rangeImplCPU} from '@tensorflow/tfjs-backend-cpu/dist/shared';\n\nexport {concatImplCPU, rangeImplCPU, sliceImplCPU};\n"]}

Found in path(s):
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernel_utils/shared.js.map
No license file was found, but licenses were detected in source scan.

{"version":3,"file":"Max.js","sourceRoot":"","sources":["../../src/kernels/Max.ts"],"names":[],"mappings":"AAAA;;;;;;;;;;;;;GAeG;AAEH,OAAO,EAAC,YAAY,EAA4B,GAAG,EAAmC,IAAI,EAAC,MAAM,uBAAuB,CAAC;AAIzH,OAAO,EAAC,YAAY,EAAE,uBAAuB,EAAC,MAAM,gBAAgB,CAAC;AACrE,OAAO,EAAC,QAAQ,EAAC,MAAM,SAAS,CAAC;AAEjC,OAAO,EAAC,SAAS,EAAE,OAAO,EAAC,MAAM,YAAY,CAAC;AAE9C

ACpC,CAAC","sourcesContent":["/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {backend_util, KernelConfig, KernelFunc, Max, MaxAttrs, MaxInputs, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {permuteAxesAndTranspose} from './kernel_utils';\nimport {CppDType} from './types';\n\nlet wasmMax: (xId: number, dtype: number, reduceSize: number, outId: number) =>\n void;\n\nfunction setup(backend: BackendWasm): void {\n wasmMax = backend.wasm.cwrap(Max, null /*void*/, [\n 'number', // x_id\n 'number', // dtype\n 'number', // reduce_size\n 'number', // out_id\n]);\n}\n\nfunction max(args: {backend: BackendWasm, inputs: MaxInputs, attrs: MaxAttrs}):\n TensorInfo {\n const {backend, inputs, attrs} = args;\n const {reductionIndices: axis, keepDims} = attrs;\n const {x} = inputs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n let inputId = xId;\n let input = x;\n\n const {transposed, axes, originalAxes, inputWasTransposed} =\n permuteAxesAndTranspose(x, axis, backend);\n\n if (inputWasTransposed) {\n const transposedId = backend.dataIdMap.get(transposed.dataId).id;\n input = transposed;\n inputId = transposedId;\n }\n\n const inputRank = input.shape.length;\n backend_util.assertAxesAreInnerMostDims('max', axes, inputRank);\n const [outShape, reduceShape] =\n backend_util.computeOutAndReduceShapes(input.shape, axes);\n const reduceSize = util.sizeFromShape(reduceShape);\n\n const out = backend.makeOutput(outShape, x.dtype);\n if (util.sizeFromShape(input.shape) !== 0) {\n const outId = backend.dataIdMap.get(out.dataId).id;\n wasmMax(inputId, CppDType[x.dtype], reduceSize, outId);\n }\n\n if (inputWasTransposed) {\n // dispose of the transposed tensor.\n backend.disposeData(transposed.dataId);\n }\n\n if (keepDims) {\n // reshape\n const newShape = backend_util.expandShapeToKeepDim(out.shape, originalAxes);\n out.shape = newShape;\n }\n\n return out;\n}\n\nexport const maxConfig: KernelConfig = {\n kernelName: Max,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: max as {} as KernelFunc\n};\n"]}

Found
in path(s):
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernels/Max.js.map
No license file was found, but licenses were detected in source scan.

{"version":3,"file":"tf-backend-wasm.es2017.js","sources":["../src/kernels/types.ts","../src/kernels/_FusedMatMul.ts","../src/kernels/unary_kernel.ts","../src/kernels/Abs.ts","../src/kernels/binary_kernel.ts","../src/kernels/Add.ts","../src/kernels/AddN.ts","../src/kernels/Identity.ts","../src/kernels/Transpose.ts","../src/kernels/kernel_utils.ts","../src/kernels/All.ts","../src/kernels/Any.ts","../src/kernels/ArgMax.ts","../src/kernels/AvgPool.ts","../src/kernels/Reshape.ts","../src/kernels/BatchMatMul.ts","../node_modules/@tensorflow/tfjs-backend-cpu/dist/kernels/Concat_impl.js","../node_modules/@tensorflow/tfjs-backend-cpu/dist/kernels/Range_impl.js","../node_modules/@tensorflow/tfjs-backend-cpu/dist/kernels/Slice.js","../src/kernels/Slice.ts","../src/kernels/BatchToSpaceND.ts","../src/kernels/Cast.ts","../src/kernels/Ceil.ts","../src/kernels/ClipByValue.ts","../src/kernels/Concat.ts","../src/kernels/Conv2D.ts","../src/kernels/Conv2DBackpropInput.ts","../src/kernels/Cos.ts","../src/kernels/Cosh.ts","../src/kernels/CropAndResize.ts","../src/kernels/Cumsum.ts","../src/kernels/DepthToSpace.ts","../src/kernels/DepthwiseConv2dNative.ts","../src/kernels/Elu.ts","../src/kernels/Equal.ts","../src/kernels/Exp.ts","../src/kernels/ExpandDims.ts","../src/kernels/Fill.ts","../src/kernels/FlipLeftRight.ts","../src/kernels/Floor.ts","../src/kernels/FloorDiv.ts","../src/kernels/FusedBatchNorm.ts","../src/kernels/

FusedConv2D.ts","../src/kernels/FusedDepthwiseConv2D.ts","../src/kernels/GatherNd.ts","../src/kernels/GatherV2.ts","../src/kernels/Greater.ts","../src/kernels/GreaterEqual.ts","../src/kernels/LeakyRelu.ts","../src/kernels/Less.ts","../src/kernels/LessEqual.ts","../src/kernels/Log.ts","../src/kernels/LogicalAnd.ts","../src/kernels/Max.ts","../src/kernels/Maximum.ts","../src/kernels/MaxPool.ts","../src/kernels/Mean.ts","../src/kernels/Min.ts","../src/kernels/Minimum.ts","../src/kernels/MirrorPad.ts","../src/kernels/Multiply.ts","../src/kernels/Neg.ts","../src/kernels/NonMaxSuppression_util.ts","../src/kernels/NonMaxSuppressionV3.ts","../src/kernels/NonMaxSuppressionV4.ts","../src/kernels/NonMaxSuppressionV5.ts","../src/kernels/NotEqual.ts","../src/kernels/OneHot.ts","../src/kernels/OnesLike.ts","../src/kernels/Pack.ts","../src/kernels/PadV2.ts","../src/kernels/Pow.ts","../src/kernels/Prelu.ts","../src/kernels/Prod.ts","../src/kernels/Range.ts","../src/kernels/RealDiv.ts","../src/kernels/Relu.ts","../src/kernels/Relu6.ts","../src/kernels/ResizeBilinear.ts","../src/kernels/Reverse.ts","../src/kernels/RotateWithOffset.ts","../src/kernels/Round.ts","../src/kernels/Rsqrt.ts","../src/kernels/ScatterNd.ts","../src/kernels/Select.ts","../src/kernels/Sigmoid.ts","../src/kernels/Sin.ts","../src/kernels/Softmax.ts","../src/kernels/SpaceToBatchND.ts","../src/kernels/SplitV.ts","../src/kernels/Sqrt.ts","../src/kernels/Square.ts","../src/kernels/SquaredDifference.ts","../src/kernels/Step.ts","../src/kernels/StridedSlice.ts","../src/kernels/Sub.ts","../src/kernels/Sum.ts","../src/kernels/Tan.ts","../src/kernels/Tanh.ts","../src/kernels/Tile.ts","../src/kernels/TopK.ts","../src/kernels/Transform.ts","../src/kernels/Unpack.ts","../src/kernels/ZerosLike.ts","../src/register_all_kernels.ts","../src/flags_wasm.ts","../wasm-out/tfjs-backend-wasm-threaded-simd.js","../wasm-out/tfjs-backend-wasm-threaded-simd.worker.js","../wasm-out/tfjs-backend-wasm.js","../src/backend_wasm.ts","../src/version.ts","../src/base.ts"],"sourcesContent":["/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT
 WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\n// This enum must align with the enum defined in cc/backend.h.\nexport enum CppDType {\n float32 = 0,\n int32 = 1,\n bool = 2,\n string = 3,\n complex64 = 4\n}\n\n// Must match enum in cc/fusable_activations.h.\nexport enum FusableActivation {\n linear = 0,\n relu = 1,\n relu6 = 2,\n prelu = 3,\n leakyrelu = 4,\n sigmoid = 5,\n elu = 6\n}\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n
 * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {_FusedMatMul, _FusedMatMulAttrs, _FusedMatMulInputs, KernelConfig, KernelFunc} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {FusableActivation} from './types';\n\nlet wasmFusedMatMul:\n   (aId: number, aShape: Uint8Array, aShapeSize: number, bId: number,\n bShape: Uint8Array, bShapeSize: number, transposeA: boolean,\n   transposeB: boolean, activation: number, biasId: number,\n   preluActivationWeightsId: number, leakyreluAlpha: number, outId: number) =>\n void;\n\nfunction setup(backend: BackendWasm) {\n wasmFusedMatMul = backend.wasm.cwrap(_FusedMatMul, null /* void */, [\n
 'number', // a_id\n   'array',   // a_shape\n   'number', // a_shape.length\n   'number', // b_id\n   'array',   // b_shape\n   'number', // b_shape.length\n   'number', // transpose_a\n   'number', // transpose_b\n   'number', // activation\n   'number', // biasId\n   'number', // preluActivationWeightsId\n   'number', // leakyreluAlpha\n   'number'   // out_id\n]);\n}\n\nfunction fusedBatchMatMul(args: {\n inputs: _FusedMatMulInputs,\n backend:

```
BackendWasm,\n  attrs: _FusedMatMulAttrs\n}) {\n  const {inputs, backend, attrs} = args;\n  const {a, b, bias,
preluActivationWeights} = inputs;\n\n  if (a.dtype !== 'float32' || b.dtype !== 'float32') {\n    throw new Error(\n
`_FusedMatMul for non non-float32 tensors not yet supported.`);\n  }\n\n  const {transposeA, transposeB,
activation, leakyreluAlpha} = attrs;\n  const aId = backend.dataIdMap.get(a.dataId).id;\n  const bId =
backend.dataIdMap.get(b.dataId).id;\n\n  let biasId = 0;\n  if (bias != null) {\n
    const biasData = backend.dataIdMap.get(bias.dataId);\n    if (biasData.shape.length !== 1) {\n      throw new
Error(\n          `_FusedMatMul only supports rank-1 bias but got ` +\n          `rank ${biasData.shape.length}.`);\n
}\n    biasId = biasData.id;\n  }\n  const preluActivationWeightsId = preluActivationWeights == null ?\n      0 :\n
backend.dataIdMap.get(preluActivationWeights.dataId).id;\n  const fusedActivation =\n
FusableActivation[activation as {} as keyof typeof FusableActivation];\n  if (fusedActivation == null) {\n    throw
new Error(\n        `${activation} activation not yet supported for FusedConv2D ` +\n        `in the wasm backend.`);\n
}\n\n  const leftDim = transposeA ? a.shape[2] : a.shape[1];\n  const rightDim = transposeB ? b.shape[1] :
b.shape[2];\n  const batchDim = a.shape[0];\n\n  const out = backend.makeOutput([batchDim, leftDim, rightDim],
a.dtype);\n  const outId = backend.dataIdMap.get(out.dataId).id;\n\n  const aShapeBytes = new Uint8Array(new
 Int32Array(a.shape).buffer);\n  const bShapeBytes = new Uint8Array(new Int32Array(b.shape).buffer);\n\n
wasmFusedMatMul(\n      aId, aShapeBytes, a.shape.length, bId, bShapeBytes, b.shape.length,\n      transposeA,
transposeB, fusedActivation, biasId, preluActivationWeightsId,\n      leakyreluAlpha || 0, outId);\n\n  return
out;\n}\n\nexport const fusedMatMulConfig: KernelConfig = {\n  kernelName: _FusedMatMul,\n  backendName:
'wasm',\n  setupFunc: setup,\n  kernelFunc: fusedBatchMatMul as {} as KernelFunc\n};\n","/**\n * @license\n *
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 OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language
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==========================================================================\n
*/\n\nimport {DataType, KernelConfig, TensorInfo, UnaryInputs, util} from '@tensorflow/tfjs-core';\n\nimport
{BackendWasm} from '../backend_wasm';\n\nimport {CppDType} from './types';\n\nexport function
createUnaryKernelConfig(\n    kernelName: string, outType?: DataType): KernelConfig {\n  let wasmFunc: (xId:
number, dtype: number, outId: number) => void;\n\n  function setupFunc(backend: BackendWasm): void {\n
wasmFunc = backend.wasm.cwrap(kernelName, null /* void */, [\n      'number',  // x_id\n      'number',  // dtype\n
'number',  // out_id\n    ]);\n  }\n\n  function kernelFunc(args: {backend: BackendWasm, inputs: UnaryInputs}):\n
TensorInfo {\n    const {backend, inputs: {x}} = args;\n    const xId = backend.dataIdMap.get(x.dataId).id;\n
    const out = backend.makeOutput(x.shape, outType || x.dtype);\n    const outId =
backend.dataIdMap.get(out.dataId).id;\n\n    // Short-circuit zero-sized tensors.\n    if (util.sizeFromShape(out.shape)
=== 0) {\n      return out;\n    }\n\n    wasmFunc(xId, CppDType[x.dtype], outId);\n    return out;\n  }\n\n  return
{kernelName, backendName: 'wasm', setupFunc, kernelFunc};\n}\n","/**\n * @license\n * Copyright 2019 Google
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OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language
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==========================================================================\n
*/\nimport {Abs, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from
'./unary_kernel';\n\nexport const absConfig: KernelConfig = createUnaryKernelConfig(Abs);\n","/**\n * @license\n
```

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==========\n*/\n\nimport {AddN, KernelConfig, KernelFunc, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {CppDType} from './types';\n\nlet wasmFunc:\n (inputIds: Uint8Array, inputIdsLen: number, dtype: number, outId: number) =>\n void;\n\nfunction setupFunc(backend: BackendWasm): void {\n wasmFunc = backend.wasm.cwrap(AddN, null /* void */, [\n 'array', // input_ids\n 'number', // input_ids.length\n 'number', // dtype\n 'number', // out_id\n]);\n}\n\nfunction addn(args: {inputs: TensorInfo[], backend: BackendWasm}) {\n const {inputs,
backend} = args;\n const out = backend.makeOutput(inputs[0].shape, inputs[0].dtype);\n\n // Short-circuit zero-sized tensors.\n if (util.sizeFromShape(out.shape) === 0) {\n return out;\n }\n\n const inputIds = inputs.map(x => backend.dataIdMap.get(x.dataId).id);\n const inputIdsBytes = new Uint8Array(new Int32Array(inputIds).buffer);\n const outId = backend.dataIdMap.get(out.dataId).id;\n wasmFunc(inputIdsBytes, inputIds.length, CppDType[out.dtype], outId);\n\n return out;\n}\n\nexport const addNConfig: KernelConfig = {\n kernelName: AddN,\n backendName: 'wasm',\n setupFunc,\n kernelFunc: addn as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or
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==========\n*/\n\nimport {Identity, IdentityInputs, KernelConfig, KernelFunc} from '@tensorflow/tfjs-core';\nimport {TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nexport function identity(args: {inputs: IdentityInputs, backend: BackendWasm}):\n TensorInfo {\n const {inputs: {x}, backend} = args;\n const out = backend.makeOutput(x.shape, x.dtype);\n const inVals = backend.typedArrayFromHeap(x);\n const outVals = backend.typedArrayFromHeap(out);\n outVals.set(inVals);\n return out;\n}\n\nexport const identityConfig: KernelConfig = {\n kernelName: Identity,\n backendName: 'wasm',\n
kernelFunc: identity as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n*/\n\nimport {KernelConfig, KernelFunc, TensorInfo, Transpose, TransposeAttrs, TransposeInputs} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {identity} from './Identity';\nimport {CppDType}
from './types';\n\nlet wasmTranspose: (\n xId: number, xShape: Uint8Array, xShapeLength: number, dtype: CppDType,\n outId: number, perm: Uint8Array, permLength: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmTranspose = backend.wasm.cwrap(Transpose, null /* void */, [\n 'number', // xId\n 'array', // x.shape\n 'number', // x.shape.length\n 'number', // dtype\n 'number', // outId\n 'array', // perm\n 'number', // perm.length\n]);\n}\n\nexport function transpose(\n args:\n {inputs: TransposeInputs, backend: BackendWasm, attrs: TransposeAttrs}):\n TensorInfo {\n const {inputs, backend, attrs} = args;\n // Reduce any dimensions with size one. Lower-rank transpose kernel performs\n // better due to simpler memory access pattern.\n const [reducedShape, perm] = removeOneSizeDims(inputs.x.shape, attrs.perm);\n\n let permIsNoOp = true;\n for (let i = 0; i < perm.length; i++) {\n if (perm[i] !== i) {\n permIsNoOp

= false;\n }\n }\n const outShape = computeOutShape(inputs.x.shape, attrs.perm);\n const x = {\n dataId: inputs.x.dataId,\n shape: reducedShape,\n dtype: inputs.x.dtype\n };\n\n if (permIsNoOp) {\n const cloned = identity({inputs, backend});\n cloned.shape = outShape;\n return cloned;\n }\n\n const out = backend.makeOutput(outShape, x.dtype);\n const xId = backend.dataIdMap.get(x.dataId).id;\n const outId = backend.dataIdMap.get(out.dataId).id;\n const permBytes = new Uint8Array(new Int32Array(perm).buffer);\n const xShapeBytes = new Uint8Array(new Int32Array(x.shape).buffer);\n\n wasmTranspose(\n xId, xShapeBytes, x.shape.length, CppDType[x.dtype], outId, permBytes,\n perm.length);\n return out;\n}\n\nfunction computeOutShape(inShape: number[], perm: number[]): number[] {\n const outShape = new Array(inShape.length);\n for (let i = 0; i < outShape.length; i++) {\n outShape[i] = inShape[perm[i]];\n }\n return outShape;\n}\n\nfunction
removeOneSizeDims(\n shape: number[], perm: number[]): [number[], number[]] {\n const newShape: number[] = [];\n const newPerm: number[] = [];\n for (let i = 0; i < shape.length; ++i) {\n if (shape[i] !== 1) {\n newShape.push(shape[i]);\n }\n if (shape[perm[i]] !== 1) {\n newPerm.push(perm[i]);\n }\n }\n for (let i = 0; i < newPerm.length; ++i) {\n let minValIdx = -1;\n for (let j = 0; j < newPerm.length; ++j) {\n if (newPerm[j] >= i &&\n (minValIdx === -1 || newPerm[minValIdx] > newPerm[j])) {\n minValIdx = j;\n }\n }\n newPerm[minValIdx] = i;\n }\n return [newShape, newPerm];\n}\n\nexport const transposeConfig: KernelConfig = {\n kernelName: Transpose,\n backendName: 'wasm',\n kernelFunc: transpose as {} as KernelFunc,\n setupFunc: setup,\n};\n","/**\n * @license\n * Copyright 2020 Google Inc. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this
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==\n */\n\nimport {backend_util, TensorInfo, util} from '@tensorflow/tfjs-core';\nimport {BackendWasm} from '../backend_wasm';\nimport {transpose} from './Transpose';\n\n/**\n * Compute permutation axes and do a transpose if necessary.\n *\n * Used by reduction ops.\n * @param x input TensorInfo\n * @param axis reduction axes\n * @param backend wasm backend instance\n */\nexport function permuteAxesAndTranspose(\n x: TensorInfo, axis: number|number[],
backend: BackendWasm): {\n transposed: TensorInfo|null,\n axes: number[],\n originalAxes: number[],\n inputWasTransposed: boolean\n} {\n const xShape = x.shape;\n const xRank = x.shape.length;\n\n const originalAxes = util.parseAxisParam(axis, xShape);\n let axes = originalAxes;\n const permutedAxes = backend_util.getAxesPermutation(axes, xRank);\n let xTransposed = null;\n let inputWasTransposed = false;\n if (permutedAxes != null) {\n const newShape: number[] = new Array(xRank);\n for (let i = 0; i < newShape.length; i++) {\n newShape[i] = xShape[permutedAxes[i]];\n }\n\n axes = backend_util.getInnerMostAxes(axes.length, xRank);\n xTransposed =\n transpose({inputs: {x}, attrs: {perm: permutedAxes}, backend});\n\n const xId = backend.dataIdMap.get(x.dataId).id;\n const transposedId = backend.dataIdMap.get(xTransposed.dataId).id;\n if (transposedId !== xId) {\n inputWasTransposed = true;\n }\n }\n\n return {transposed:
xTransposed, originalAxes, axes, inputWasTransposed};\n}\n","/**\n * @license\n * Copyright 2021 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n

*/\n\nimport {All, AllAttrs, AllInputs, backend_util, KernelConfig, KernelFunc, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {permuteAxesAndTranspose} from './kernel_utils';\n\nlet wasmAll: (xId: number, reduceSize: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n wasmAll = backend.wasm.cwrap(All, null /*void*/, ['number, number, number']);\n}\n\nfunction all(args: {backend: BackendWasm, inputs: AllInputs, attrs: AllAttrs}):\n   TensorInfo {\n const {backend, inputs, attrs} = args;\n const {axis, keepDims} = attrs;\n const {x} = inputs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n let inputId = xId;\n let input = x;\n\n const {transposed, axes, originalAxes, inputWasTransposed} =\n   permuteAxesAndTranspose(x, axis, backend);\n\n if (inputWasTransposed) {\n   const transposedId = backend.dataIdMap.get(transposed.dataId).id;\n   input = transposed;\n   inputId = transposedId;\n }\n\n const inputRank = input.shape.length;\n backend_util.assertAxesAreInnerMostDims('all', axes, inputRank);\n const [outShape, reduceShape] =\n   backend_util.computeOutAndReduceShapes(input.shape, axes);\n const reduceSize = util.sizeFromShape(reduceShape);\n\n const out = backend.makeOutput(outShape, x.dtype);\n if (util.sizeFromShape(input.shape) !== 0) {\n   const outId = backend.dataIdMap.get(out.dataId).id;\n   wasmAll(inputId, reduceSize, outId);\n }\n\n if (inputWasTransposed) {\n   // dispose of the transposed tensor.\n   backend.disposeData(transposed.dataId);\n }\n\n if (keepDims) {\n   // reshape\n   const newShape = backend_util.expandShapeToKeepDim(out.shape, originalAxes);\n   out.shape = newShape;\n }\n\n return out;\n}\n\nexport const allConfig: KernelConfig = {\n kernelName: All,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: all as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2021 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==*/\n\nimport {Any, AnyAttrs, AnyInputs, backend_util, KernelConfig, KernelFunc, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {permuteAxesAndTranspose} from './kernel_utils';\n\nlet wasmAny: (xId: number, reduceSize: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n wasmAny = backend.wasm.cwrap(Any, null /*void*/, ['number, number, number']);\n}\n\nfunction any(args: {backend: BackendWasm, inputs: AnyInputs, attrs: AnyAttrs}):\n   TensorInfo {\n const {backend, inputs, attrs} = args;\n const {axis, keepDims} = attrs;\n const {x} = inputs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n let inputId = xId;\n let input = x;\n\n const {transposed, axes, originalAxes, inputWasTransposed} =\n   permuteAxesAndTranspose(x, axis, backend);\n\n if (inputWasTransposed) {\n   const transposedId = backend.dataIdMap.get(transposed.dataId).id;\n   input = transposed;\n   inputId = transposedId;\n }\n\n const inputRank = input.shape.length;\n backend_util.assertAxesAreInnerMostDims('any', axes, inputRank);\n const [outShape, reduceShape] =\n   backend_util.computeOutAndReduceShapes(input.shape, axes);\n const reduceSize = util.sizeFromShape(reduceShape);\n\n const out = backend.makeOutput(outShape, x.dtype);\n if (util.sizeFromShape(input.shape) !== 0) {\n   const outId = backend.dataIdMap.get(out.dataId).id;\n   wasmAny(inputId, reduceSize, outId);\n }\n\n if (inputWasTransposed) {\n   // dispose of the transposed tensor.\n   backend.disposeData(transposed.dataId);\n }\n\n if (keepDims) {\n   // reshape\n   const newShape = backend_util.expandShapeToKeepDim(out.shape, originalAxes);\n   out.shape = newShape;\n }\n\n return out;\n}\n\nexport const anyConfig: KernelConfig = {\n kernelName: Any,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: any as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights

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 * ==\n */\n\nimport {ArgMax, ArgMaxAttrs, ArgMaxInputs, KernelConfig, KernelFunc, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {permuteAxesAndTranspose} from './kernel_utils';\nimport {CppDType} from './types';\n\nlet wasmFunc: (\n xId: number, dtype: number, outerSize: number, innerSize: number,\n outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmFunc = backend.wasm.cwrap(ArgMax, null /* void */, [\n 'number', // x_id\n 'number', // dtype\n 'number', // outer_size\n 'number', // inner_size\n 'number'   // out_id\n]);\n}\n\nfunction argmax(\n args: {inputs: ArgMaxInputs, backend: BackendWasm, attrs: ArgMaxAttrs}) {\n const {backend, inputs, attrs} = args;\n const {axis} = attrs as {} as ArgMaxAttrs;\n const {x} = inputs as {} as ArgMaxInputs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n let
 inputId = xId;\n let input = x;\n\n const {transposed, axes, inputWasTransposed} =\n permuteAxesAndTranspose(x, axis, backend);\n\n if (inputWasTransposed) {\n const transposedId = backend.dataIdMap.get(transposed.dataId).id;\n if (transposedId !== xId) {\n // transpose was not a no-op. We will need to dispose of this\n // once we are done.\n input = transposed;\n inputId = transposedId;\n }\n }\n\n const outShape = input.shape.slice(0, -1);\n const out = backend.makeOutput(outShape, 'int32');\n const outId = backend.dataIdMap.get(out.dataId).id;\n const outerSize = util.sizeFromShape(out.shape);\n const innerSize = input.shape[axes[0]];\n wasmFunc(inputId, CppDType[input.dtype], outerSize, innerSize, outId);\n\n if (inputWasTransposed) {\n // dispose of the transposed tensor.\n backend.disposeData(transposed.dataId);\n }\n\n return out;\n}\n\nexport const argMaxConfig: KernelConfig = {\n kernelName: ArgMax,\n backendName: 'wasm',\n
  kernelFunc: argmax as {} as KernelFunc,\n setupFunc: setup\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
 * ==\n */\n\nimport {AvgPool, AvgPoolAttrs, AvgPoolInputs, backend_util, KernelConfig, KernelFunc, Tensor4D} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmAvgPool: (\n xId: number, batchSize: number, inputHeight: number, inputWidth: number,\n filterHeight: number, filterWidth: number, padTop: number, padRight: number,\n padBottom: number, padLeft: number, strideHeight: number,\n stride Width: number, channels: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmAvgPool = backend.wasm.cwrap(AvgPool, null /* void */, [\n 'number', // xId\n 'number', // batchSize\n 'number', // inputHeight\n 'number', // inputWidth\n 'number', // filterHeight\n 'number', // filterWidth\n 'number', // padTop\n 'number', // padRight\n 'number', // padBottom\n 'number', // padLeft\n 'number', // strideHeight\n 'number', // strideWidth\n 'number', // channels\n 'number', // outId\n]);\n}\n\nfunction avgPool(\n args: {inputs: AvgPoolInputs, backend: BackendWasm, attrs: AvgPoolAttrs}) {\n const {inputs, attrs, backend} = args;\n\n const x = inputs.x as Tensor4D;\n const xId = backend.dataIdMap.get(x.dataId).id;\n\n
  const {filterSize, strides, pad, dimRoundingMode} = attrs;\n const convInfo =
backend_util.computePool2DInfo(\n x.shape, filterSize, strides, 1 /* dilations */, pad, dimRoundingMode);\n\n const filterHeight = convInfo.filterHeight;\n const filterWidth = convInfo.filterWidth;\n const padTop =

convInfo.padInfo.top;\n const padRight = convInfo.padInfo.right;\n const padBottom = convInfo.padInfo.bottom;\n const padLeft = convInfo.padInfo.left;\n const strideHeight = convInfo.strideHeight;\n const strideWidth = convInfo.strideWidth;\n const channels = convInfo.inChannels;\n\n if (convInfo.dataFormat !== 'channelsLast') {\n throw new Error(\n `wasm backend does not support dataFormat:'` +\n `${convInfo.dataFormat}'. Please use 'channelsLast'.`);\n }\n\n if (convInfo.dilationWidth !== 1 || convInfo.dilationHeight !== 1) {\n throw new Error(\n `was backend only supports average pooling with dilation = [1, 1], `
+\n `got [${convInfo.dilationHeight}, ${convInfo.dilationWidth}].`);\n }\n\n const out = backend.makeOutput(convInfo.outShape, 'float32');\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n wasmAvgPool(\n xId, x.shape[0], x.shape[1], x.shape[2], filterHeight, filterWidth,\n padTop, padRight, padBottom, padLeft, strideHeight, strideWidth, channels,\n outId);\n return out;\n}\n\nexport const avgPoolConfig: KernelConfig = {\n kernelName: AvgPool,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: avgPool as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed
on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n */\n\nimport {KernelConfig, KernelFunc, Reshape, ReshapeAttrs, ReshapeInputs, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nexport function reshape(\n args: {inputs: ReshapeInputs, attrs: ReshapeAttrs, backend: BackendWasm}) {\n const {inputs, attrs} = args;\n const {x} = inputs;\n const {shape} = attrs;\n\n const xSize = util.sizeFromShape(x.shape);\n const $shape = util.inferFromImplicitShape(shape, xSize);\n\n util.assert(\n xSize === util.sizeFromShape($shape),\n () => `new shape: ${$shape}, old shape: ${x.shape}. New shape and old ` +\n `shape must have the same number of elements.`);\n\n // Backend needs to track refCount
for the dataId for reshape op\n args.backend.incRef(x.dataId);\n return {dataId: x.dataId, shape: $shape, dtype: x.dtype};\n}\n\nexport const reshapeConfig: KernelConfig = {\n kernelName: Reshape,\n backendName: 'wasm',\n kernelFunc: reshape as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n */\n\nimport
{BatchMatMul, BatchMatMulAttrs, BatchMatMulInputs, KernelConfig, KernelFunc, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {reshape} from './Reshape';\n\nlet wasmBatchMatMul: (\n aId: number, aShape: Uint8Array, aShapeSize: number, bId: number,\n bShape: Uint8Array, bShapeSize: number, transposeA: boolean,\n transposeB: boolean, outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmBatchMatMul = backend.wasm.cwrap(BatchMatMul, null /* void */, [\n 'number', // a_id\n 'array', // a_shape\n 'number', // a_shape.length\n 'number', // b_id\n 'array', // b_shape\n 'number', // b_shape.length\n 'number', // transpose_a\n 'number', // transpose_b\n 'number' // out_id\n]);\n}\n\nfunction batchMatMul(args: {\n inputs: BatchMatMulInputs,\n backend: BackendWasm,\n attrs: BatchMatMulAttrs\n}) {\n const {inputs, backend, attrs} = args;\n const {a, b} = inputs;\n const

{transposeA, transposeB} = attrs;\n\n if (a.dtype !== 'float32' || b.dtype !== 'float32') {\n   throw new Error(\n`BatchMatMul for non non-float32 tensors not yet supported.`);\n }\n\n const aRank = a.shape.length;\n const bRank = b.shape.length;\n\n const innerShapeA = transposeA ? a.shape[aRank - 2] : a.shape[aRank - 1];\n const innerShapeB = transposeB ? b.shape[bRank - 1] : b.shape[bRank - 2];\n\n const outerShapeA = transposeA ? a.shape[aRank - 1] : a.shape[aRank - 2];\n const outerShapeB = transposeB ? b.shape[bRank - 2] : b.shape[bRank - 1];\n\n const outerDimsA = a.shape.slice(0, -2);\n const outerDimsB = b.shape.slice(0, -2);\n\n const batchDimA = util.sizeFromShape(outerDimsA);\n const batchDimB = util.sizeFromShape(outerDimsB);\n\n const batchDimsCompatible =\n   batchDimA === batchDimB || batchDimA === 1 || batchDimB === 1;\n\n util.assert(\n   aRank >= 2 && bRank >= 2 && batchDimsCompatible,\n   () => `Error in matMul: the input batch dimensions
must either be the ` +\n          `same or at least one input batch dimension must be 1. Got input ` +\n          `batch dimensions of (${outerDimsA}) and (${outerDimsB}).`);\n\n const outShapeOuterDims =\n   batchDimA > batchDimB ? a.shape.slice(0, -2) : b.shape.slice(0, -2);\n const outShape =
outShapeOuterDims.concat([outerShapeA, outerShapeB]);\n\n util.assert(\n   innerShapeA === innerShapeB,\n() => `Error in matMul: inner shapes (${innerShapeA}) and (` +\n   `${innerShapeB}) of Tensors with shapes ${a.shape} and ` +\n   `${b.shape} and transposeA=${transposeA}` +\n   ` and transposeB=${transposeB} must match.`);\n\n const a3dShape = transposeA ? [batchDimA, innerShapeA, outerShapeA] :\n[batchDimA, outerShapeA, innerShapeA];\n const b3dShape = transposeB ? [batchDimB, outerShapeB, innerShapeB] :\n   [batchDimB, innerShapeB, outerShapeB];\n\n // The rest of the implementation
is designed to operate on rank-3 tensors\n const a3d = reshape({inputs: {x: a}, backend, attrs: {shape: a3dShape}});\n const b3d = reshape({inputs: {x: b}, backend, attrs: {shape: b3dShape}});\n\n const a3dId = backend.dataIdMap.get(a3d.dataId).id;\n const b3dId = backend.dataIdMap.get(b3d.dataId).id;\n\n const leftDim = transposeA ? a3d.shape[2] : a3d.shape[1];\n const rightDim = transposeB ? b3d.shape[1] : b3d.shape[2];\n const batchDim = Math.max(batchDimA, batchDimB);\n\n const out = backend.makeOutput([batchDim, leftDim, rightDim], a3d.dtype);\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n const aShapeBytes = new Uint8Array(new Int32Array(a3d.shape).buffer);\n const bShapeBytes = new Uint8Array(new Int32Array(b3d.shape).buffer);\n\n wasmBatchMatMul(\n   a3dId, aShapeBytes, a3d.shape.length, b3dId, bShapeBytes,\n   b3d.shape.length, transposeA, transposeB, outId);\n\n backend.disposeData(a3d.dataId);\n backend.disposeData(b3d.dataId);\n\n out.shape
= outShape;\n return out;\n}\n\nexport const batchMatMulConfig: KernelConfig = {\n kernelName: BatchMatMul,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: batchMatMul as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n */\nimport { backend_util, util } from '@tensorflow/tfjs-core';\nexport
function concatImpl(inputs, outShape, dtype, simplyConcat) {\n   const outVals = util.getArrayFromDType(dtype, util.sizeFromShape(outShape));\n   if (simplyConcat && dtype !== 'string') {\n   // Use built-in TypedArray.set() method for speed.\n   let offset = 0;\n   inputs.forEach(input => {\n   const size = util.sizeFromShape(input.shape);\n   outVals.set(input.vals, offset);\n   offset += size;\n   });\n   }\n   else {\n   let colOffset = 0;\n   inputs.forEach(input => {\n   const decodedData = dtype === 'string' ?\n   backend_util.fromUint8ToStringArray(input.vals) :\n   input.vals;\n   let tIdx = 0;\n   for (let row = 0; row < input.shape[0]; ++row) {\n   const resIdx = row * outShape[1] + colOffset;\n

for (let col = 0; col < input.shape[1]; ++col) {\n outVals[resIdx + col] = decodedData[tIdx++];\n }\n
}\n colOffset += input.shape[1];\n });\n }\n return outVals;\n}\n//#
sourceMappingURL=data:application/json; base64,eyJ2ZXJzaW9uIjozLCJmaWxlIjoiQ29uY2F0X2ltcGwuanMiLC
Jzb3VyY2VSb290IjoiIiwic291cmNlcyI6WyIuLi8uLi8uLi8uLi8uLi8uLi90ZmpzLWJhY2tlbmQtY3B1L3NyYy9rZ
XJuZWxzL0NvbmNhdF9pbXBsLnRzIl0sIm5hbWVzIjpbXSwibWFwcGluZ3MiOiJBQUFBOzs7Ozs7Ozs7Oz
s7R0FlRztBQUVILE9BQU8sRUFBQyxZQUFZLEVBQXVDLE1BQU0sRUFBQyxNQUFNLEVBQUMsTUFBTSxFQUFDLE1BQU0sRU
FDO0FBRTlELE9BQU8sRUFBQyxlQUFlLEVBQUMsTUFBTSxFQUFDLE1BQU0sRUFBQyxNQUFNLEVBQUMsTUFBTSxFQUFDLE
xFQUFFLFlBQXFCO0lBQ3hDLE1BQU0sT0FBTyxxHQUFHLElBQUksQ0FBQyxpQkFBaUIsQ0FBQyxxLQUFLLL
EVBQUUsSUFBSSxDQUFDLGFBQWEsQ0FBQyxxRQUFRLENBQUMsQ0FBQyxxDQUFDO0lBRTVFLElBQUk
sWUFBWSxJQUFJLEtBQUssS0FBSyxqRQUFRLEVBQUU7UUFDdEMsMsa0RBQWtEO1FBQ2xELEtUFB
TSxHQUFHLENBQUMsQ0FBQztRQUNmLE1BQU0sQ0FBQyxxPQUFPLENBQUMsS0FBSyxqDQUFDLEVBQU
U7WUFDckIsTUFBTSxJQUFJLEdBQUcsSUFBSSxCQUFBQ0FBQyxxLQUFLLENBQUMsS0FBSyxqDQUFDLEVBQU
QUU7WUFDckIsTUFBTSxJQUFJLEdBQUcsSUFBSSxCQUFBQ0FBQyxxLQUFLLENBQUMsS0FBSyxqDQUFDLEVBQU
ENBQUMsSUFBb0IsQ0FBQyxxDQUFDLENBQUM7Z0JBQ3BFLEtBQUssQ0FBQyxxQjQUFrQixqDQUFDO1lBRTd
CLElBQUksSUFBSSxHLENBQUMsQ0FBQztZQUVViLEtBQUssSUFBSSxHLEdBQUcsQ0FBQyxxFQUFFLEVBQUUsR0F
QUFFLEdBQUcsR0FBRyxxLQUFLLLENBQUMsS0FBSyxqDQUFDLENBQUMsQ0FBQyxqFQUFFLEVBQUUsR0F
BRyxxFQUFFO2dCQUM3QyxqxNQUFNLE1BQU0sR0FBRyxxHQUFHLHLEdBQUcsUUFBUSxDQUFDLENBQUMsQ
0FBQyxxHQUFHLHLFNBQVMsQ0FBQztnQkFDN0MsQkFDN0MsS0FBSyxjQUFBQyxqR0FBRyxqRQUFFLEdBQUcsR0FBRyxxLQUFLLENBQUMsQ0FBQyxqDQUFDLEVBQUUsR0
FBRyxxHQUFHLHLEtBQUssLQUFLLLENBQUMsQ0FBQyxqDQUFDLEVBQUUsRUFBRSxxHQUFHLHLEVB
QUU7b0JBQzdDLE1BQU0sQ0FBQyxxNQUFNLE1LEdBQUcsR0FBRyxxDQUFDLEdBQUcsV0FBVyxxDQUFDLEtBQ
UksRUFBRSxxDQUFDLENBQUM7aUJBQzdDO2FBQUMsTQUFTLElBQUksS0FBSyxqDQUFDLEtBQ
QUssQ0FBQyxqDQUFDLENBQUMsQ0FBQztRQUM5QyxNQUFNLENBQUMsQ0FBQyxxTQUFTLElBQUksS0FBSyxqDQUFDLENBQUMsQ0FBQztRQUNoRC

UZyb21TaGFwZShpbnB1dC5zaGFwZSk7XG5cbiAgICAgIChvdXRWYWxzIGFzIFR5cGVkQXJyYXkpLnNldChpbnB1dC52YWxzIGFzIFR5cGVkQXJyYXksIG9mZnNldCk7XG4gICAgICBvZmZzZXQgKz0gc2l6ZTtcbiAgICB9KTtcbiAgfSBlbHNlIHtcbiAgICBsZXQgY29sT2Zmc2V0ID0gMDtcblxuICAgIGlucHV0cy5mb3JFYWNoKGluc HV0ID0+IHtcbiAgICAgIGNvbnN0IGRlY29kZWREYXRhID0gZHR5cGUgPT09ICdzdHJpbmcnID9cbiAgICAgICAgIC

EMuIEFsbCBSaWdodHMgUmVzZXJ2ZWQuXG4gKiBMaWNlbnNlZCB1bmRlciB0aGUgQXBhY2hlIExpY2Vuc2UsIFZlcnNpb24gMi4wICh0aGUgXCJMaWNlbnNlXCIpO1xuICogeW91IG1heSBub3QgdXNlIHRoaXMgZmlsZSBleGNlcHQgaW4gY29tcGxpYW5jZSB3aXRoIHRoZSBMaWNlbnNlLlxuICogWW91IG1heSBvYnRhaW4gYSBjb3B5IG9mIHRoZSBMaWNlbnNlIGF0XG4gKlxuICogaHR0cDovL3d3dy5hcGFjaGUub3JnL2xpY2Vuc2VzL0xJQ0VOU0UtMi4wXG4gKlxuICogVW5sZXNzIHJlcXVpcmVkIGJ5IGFwcGxpY2FibGUgbGF3IG9yIGFncmVlZCB0byBpbiB3cml0aW5nLCBzb2Z0d2FyZVxuICogZGlzdHJpYnV0ZWQgdW5kZXIgdGhlIExpY2Vuc2UgaXMgZGlzdHJpYnV0ZWQgb24gYW4gXCJBUyBJUyIgQkFTSVMsXG4gKiBXSVRIT1VUIFdBUlJBTlRJRVMgT1IgQ09ORElUSU9OUyBPRiBBTlkgS0lORCwgZWl0aGVyIGV4cHJlc3Mgb3IgaW1wbGllZC5cbiAqIFNlZSB0aGUgTGljZW5zZSBmb3IgdGhlIHNwZWNpZmljIGxhbmd1YWdlIGdvdmVybmluZyBwZXJtaXNzaW9uc1xuICogYW5kIGxpbWl0YXRpb25zIHVuZGVyIHRoZSBMaWNlbnNlLlxuICogPT09PT09PT09P

{ x } = inputs;\n const { begin, size } = attrs;\n assertNotComplex(x, 'slice');\n const [$begin, $size] = slice_util.parseSliceParams(x, begin, size);\n slice_util.assertParamsValid(x, $begin, $size);\n const vals = backend.data.get(x.dataId).values;\n const outVals = sliceImpl(vals, $begin, $size, x.shape, x.dtype);\n return backend.makeTensorInfo($size, x.dtype, outVals);\n}\nexport const sliceConfig = {\n kernelName: Slice,\n backendName: 'cpu',\n kernelFunc: slice\n};\n//#
sourceMappingURL=data:application/json; base64,eyJ2ZXJzaW9uIjozLCJmaWxlIjoiU2xpY2UuanMiLCJzb3VyY2VSb290IjoiIiwic291cmNlcyI6WyIuLi8uLi8uLi8uLi8uLi8uLi90ZmpzLWJhY2tlbmQtY3B1L3NyYy9rZXJuZWxzL1NsaWNlLnRzIl0sIm5hbWVzIjpbXSwibWFwcGluZ3MiOiJBQUFBOzs7Ozs7Ozs7Ozs7R0FlRztBQUU9sRUFBQyxZQUFZLEVBQUMsWlCLE1BQU0sRUFBc0MsMsS0FBSyxFQUFDLE1BQU0sRUFBQyxNQUFNLEVBQUMsTUFBTSxFQUFDLE1BQU0sRUAsRUFBQyxNQUFNLEVBQUMsTUAsRUFBQyxNQUFNLEVBQUMsTUAsRUFBQyxNQUFNLEVBQUMsT

GUgXCJMaWNlbnNlXCIpO1xuICogeW91IG1heSBub3QgdXNlIHRoaXMgZmlsZSBleGNlcHQgaW4gY29tcGxpYW5jZSB3aXRoIHRoZSBMaWNlbnNlLlxuICogWW91IG1heSBvYnRhaW4gYSBjb3B5IG9mIHRoZSBMaWNlbnNlIGF0XG4gKlxuICogaHR0cDovL3d3dy5hcGFjaGUub3JnL2xpY2Vuc2VzL0xJQ0VOU0UtMi4wXG4gKlxuICogVW5sZXNzIHJlcXVpcmVkIGJ5IGFwcGxpY2FibGUgbGF3IG9yIGFncmVlZCB0byBpbiB3cml0aW5nLCBzb2Z0d2FyZVxuICogZGlzdHJpYnV0ZWQgdW5kZXIgdGhlIExpY2Vuc2UgaXMgZGlzdHJpYnV0ZWQgb24gYW4gXCJBUyBJUyIgQkFTSVMsXG4gKiBXSVRIT1VUIFdBUlJBTlRJRVMgT1IgQ09ORElUSU9OUyBPRiBBTlkgS0lORCwgZWl0aGVyIGV4cHJlc3MgT3IgaW1wbGllZC5cbiAqIFNlZSB0aGUgTGljZW5zZSBmb3IgdGhlIHNwZWNpZmljIGxhbmd1YWdlIGdvdmVybmluZyBwZXJtaXNzaW9uc1xuICogYW5kIGxpbWl0YXRpb25zIHVuZGVyIHRoZSBMaWNlbnNlLlxuICovXG5cbmltcG9ydCB7IGRlZXBDbG9uZSB9IGZyb20gJy4uL3V0aWxzL2RlZXBDbG9uZSc7XG5cbmNvbnN0IGRlZmF1bHRPcHRpb25zID0gT2JqZWN0LmZyZWV6ZSh7XG4gIGFsbG93Qm9vbGVhbkF0dHJpYnV0ZXM6IGZhbHNlLFxuICBhbGxvd051bWVyaWNBdHRyaWJ1dGVzOiBmYWxzZSxcbiAgYWxsb3dVbmtub3duQXR0cmlidXRlczogZmFsc2UsXG4gIGFsbG93RGF0YUF0dHJpYnV0ZXM6IGZhbHNlLFxuICBvbkludmFsaWRBdHRyaWJ1dGU6IG51bGwsXG4gIG9uSW52YWxpZEF0dHJpYnV0ZU5hbWU6IG51bGwsXG4gIHNraXBJbnZhbGlkQXR0cmlidXRlczogZmFsc2UsXG4gIGZvcmNlOiBmYWxzZSxcbiAgc2FuaXRpemU6IHRydWUsXG4gIGRyb3BUYWdzOiBbXSxcbiAgYWxsb3dlZFRhZ3M6IFtdLFxuICBmb3JiaWRUYWdzOiBbXSxcbiAgYWxsb3dlZEF0dHJpYnV0ZXM6IFtdLFxuICBmb3JiaWRBdHRyaWJ1dGVzOiBbXSxcbiAgZXh0cmFEZWZhdWx0czogZmFsc2UsXG4gIGZvcmJpZEF0dHJpYnV0ZUd1YXJkOiBudWxsLFxuICBhbGxvd2VkQXR0cmlidXRlR3VhcmQ6IG51bGwsXG4gIGFsbG93U2VsZkNsb3Npbmc6IGZhbHNlLFxuICBhbGxvd0FyaWFBdHRyaWJ1dGVzOiBmYWxzZSxcbiAgYWxsb3dEYXRhQXR0cmlidXRlczogZmFsc2UsXG4gIGFsbG93SXNBbGxvd2VkOiBmYWxzZSxcbiAgYWxsb3dVbmtub3duUHJvdG9jb2xzOiBmYWxzZSxcbiAgYWxsb3dQcm9jZXNzSW5zdHJ1Y3Rpb25zOiBmYWxzZSxcbiAgYWRkVXJpU2NoZW1lQ2hlY2s6IGZhbHNlLFxuICBwYXJzZUJvZHlJbnRvRWxlbWVudHM6IHRydWUsXG4gIHNhbml0aXplRG9tOiB0cnVlLFxuICBzYW5pdGl6ZUtpbmRzOiBmYWxzZSxcbiAgc2FuaXRpemVOYW1lZFByb3BzOiBmYWxzZSxcbiAgc2FuaXRpemVOYW1lZFByb3BzUHJlZml4OiAnc2FuaXRpemUtbmFtZWQtcHJvcHMtJyxcbiAgcmV0dXJuRE9NOiBmYWxzZSxcbiAgcmV0dXJuRE9NRnJhZ21lbnQ6IGZhbHNlLFxuICByZXR1cm5Eb21JbXBvcnQ6IGZhbHNlLFxuICBmb3JjZUJvZHlJbnRvRWxlbWVudHM6IGZhbHNlLFxuICBzYW5pdGl6ZURvbTogdHJ1ZSxcbiAgc2FuaXRpemVLaW5kczogZmFsc2UsXG4gIHNhbml0aXplTmFtZWRQcm9wczogZmFsc2UsXG4gIHNhbml0aXplTmFtZWRQcm9wc1ByZWZpeDogJ3Nhbml0aXplLW5hbWVkLXByb3BzLScsXG4gIHJldHVybkRPTTogZmFsc2UsXG4gIHJldHVybkRPTUZyYWdtZW50OiBmYWxzZSxcbiAgcmV0dXJuRG9tSW1wb3J0OiBmYWxzZSxcbiAgZm9yY2VCb2R5SW50b0RvbTogZmFsc2U

law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {backend_util, KernelConfig, KernelFunc, Slice, slice_util, SliceAttrs, SliceInputs, TypedArray, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\nimport {sliceImplCPU} from '../kernel_utils/shared';\n\nexport function slice(\n args: {inputs: SliceInputs, attrs: SliceAttrs, backend: BackendWasm}) {\n const {inputs: {x}, attrs: {begin, size}, backend} = args;\n\n const [begin_, size_] = slice_util.parseSliceParams(x, begin, size);\n\n const isContinous = slice_util.isSliceContinous(x.shape, begin_, size_);\n const xVals = backend.readSync(x.dataId);\n const out = backend.makeOutput(size_, x.dtype);\n const xStrides = util.computeStrides(x.shape);\n const outData = backend.dataIdMap.get(out.dataId);\n\n if (isContinous) {\n const flatOffset = slice_util.computeFlatOffset(begin_, xStrides);\n\n if (x.dtype === 'string') {\n outData.stringBytes =\n (xVals as Uint8Array[])\n .slice(flatOffset, flatOffset + util.sizeFromShape(size_));\n } else {\n const outVals = backend.typedArrayFromHeap(out);\n outVals.set(\n (xVals as TypedArray)\n .subarray(flatOffset, flatOffset + util.sizeFromShape(size_)));\n }\n\n return out;\n }\n\n if (x.dtype === 'string') {\n const res = sliceImplCPU(xVals, begin_, size_, x.shape, x.dtype);\n outData.stringBytes = res as Uint8Array[];\n return out;\n }\n\n const outVals = backend.typedArrayFromHeap(out);\n const rank = x.shape.length;\n if (rank === 2) {\n slice2d(\n xVals as TypedArray, xStrides[0], outVals, begin_ as [number, number],\n size_ as [number, number]);\n } else if (rank === 3) {\n slice3d(\n xVals as TypedArray, xStrides[0], xStrides[1], outVals,\n begin_ as [number, number, number], size_ as [number, number, number]);\n } else if (rank === 4) {\n slice4d(\n xVals as TypedArray, xStrides[0], xStrides[1], xStrides[2], outVals,\n begin_ as [number, number, number, number],\n size_ as [number, number, number, number]);\n } else {\n const res =\n sliceImplCPU(xVals, begin_, size_, x.shape, x.dtype) as TypedArray;\n outVals.set(res);\n }\n\n return out;\n}\n\nfunction slice2d(\n xVals: backend_util.TypedArray, xStride: number,\n outVals: backend_util.TypedArray, begin: [number, number],\n size: [number, number]): void {\n let outOffset = 0;\n const beginI = begin[0];\n const beginJ = begin[1];\n const endI = beginI + size[0];\n for (let i = beginI; i < endI; i++) {\n const xOffset = i * xStride + beginJ;\n outVals.set(xVals.subarray(xOffset, xOffset + size[1]), outOffset);\n outOffset += size[1];\n }\n}\n\nfunction slice3d(\n xVals: backend_util.TypedArray, xStride1: number, xStride2: number,\n outVals: backend_util.TypedArray, begin: [number, number, number],\n size: [number, number, number]): void {\n let outOffset = 0;\n const beginI = begin[0];\n const beginJ = begin[1];\n const beginK = begin[2];\n const endI = beginI + size[0];\n const endJ = beginJ + size[1];\n for (let i = beginI; i < endI; i++) {\n for (let j = beginJ; j < endJ; j++) {\n const xOffset = i * xStride1 + j * xStride2 + beginK;\n outVals.set(xVals.subarray(xOffset, xOffset + size[2]), outOffset);\n outOffset += size[2];\n }\n }\n}\n\nfunction slice4d(\n xVals: backend_util.TypedArray, xStride1: number, xStride2: number,\n xStride3: number, outVals: backend_util.TypedArray,\n begin: [number, number, number, number],\n size: [number, number, number, number]): void {\n let outOffset = 0;\n const beginI = begin[0];\n const beginJ = begin[1];\n const beginK = begin[2];\n\n const endI = beginI + size[0];\n const endJ = beginJ + size[1];\n const endK = beginK + size[2];\n const beginL = begin[3];\n\n for (let i = beginI; i < endI; i++) {\n for (let j = beginJ; j < endJ; j++) {\n for (let k = beginK; k < endK; k++) {\n const xOffset = i * xStride1 + j * xStride2 + k * xStride3 + beginL;\n outVals.set(xVals.subarray(xOffset, xOffset + size[3]), outOffset);\n outOffset += size[3];\n }\n }\n }\n}\n\nexport const sliceConfig: KernelConfig = {\n kernelName: Slice,\n backendName: 'wasm',\n kernelFunc: slice as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2021 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing,

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==========\n
*/\n\nimport {backend_util, BatchToSpaceND, BatchToSpaceNDAttrs, BatchToSpaceNDInputs, KernelConfig, KernelFunc} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {reshape} from './Reshape';\nimport {slice} from './Slice';\nimport {transpose} from './Transpose';\n\nfunction batchToSpaceND(args: {\n inputs: BatchToSpaceNDInputs,\n backend: BackendWasm,\n attrs: BatchToSpaceNDAttrs\n}) {\n const {inputs, backend, attrs} = args;\n const {x} = inputs;\n const {blockShape, crops} = attrs;\n\n const prod = blockShape.reduce((a, b) => a * b);\n\n const reshaped = backend_util.getReshaped(x.shape, blockShape, prod);\n const
permuted = backend_util.getPermuted(reshaped.length, blockShape.length);\n const reshapedPermuted =\n backend_util.getReshapedPermuted(x.shape, blockShape, prod);\n const sliceBeginCoords =\n backend_util.getSliceBeginCoords(crops, blockShape.length);\n const sliceSize =\n backend_util.getSliceSize(reshapedPermuted, crops, blockShape.length);\n\n const xReshaped = reshape({inputs: {x}, backend, attrs: {shape: reshaped}});\n const xTransposed =\n   transpose({inputs: {x: xReshaped}, backend, attrs: {perm: permuted}});\n const xTransposedReshaped = reshape(\n   {inputs: {x: xTransposed}, backend, attrs: {shape: reshapedPermuted}});\n const result = slice({\n   inputs: {x: xTransposedReshaped},\n   backend,\n attrs: {begin: sliceBeginCoords, size: sliceSize}\n });\n\n backend.disposeData(xReshaped.dataId);\n backend.disposeData(xTransposed.dataId);\n backend.disposeData(xReshaped.dataId);\n\n return result;\n}\n\nexport const batchToSpaceNDConfig:
KernelConfig = {\n kernelName: BatchToSpaceND,\n backendName: 'wasm',\n kernelFunc: batchToSpaceND as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n
*/\n\nimport {Cast, CastAttrs, CastInputs, KernelConfig, KernelFunc} from '@tensorflow/tfjs-core';\nimport {TensorInfo} from '@tensorflow/tfjs-core';\n\nimport
{BackendWasm} from '../backend_wasm';\n\nexport function cast(\n   args: {inputs: CastInputs, attrs: CastAttrs, backend: BackendWasm}):\n   TensorInfo {\n const {inputs: {x}, attrs: {dtype}, backend} = args;\n const out = backend.makeOutput(x.shape, dtype);\n const inVals = backend.typedArrayFromHeap(x);\n const outVals = backend.typedArrayFromHeap(out);\n outVals.set(inVals);\n return out;\n}\n\nexport const castConfig:
KernelConfig = {\n kernelName: Cast,\n backendName: 'wasm',\n kernelFunc: cast as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2021 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n
* WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n
*/\nimport {KernelConfig, Ceil} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\n\nexport const ceilConfig: KernelConfig = createUnaryKernelConfig(Ceil);\n","/**\n *

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* See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {ClipByValue, ClipByValueAttrs, ClipByValueInputs, KernelConfig, KernelFunc} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmClip: (xId: number, min: number, max: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmClip = backend.wasm.cwrap(ClipByValue, null /* void */, [\n 'number', // x_id\n 'number', // min\n 'number', // max\n 'number' // out_id\n]);\n}\n\nfunction clip(args: {\n inputs: ClipByValueInputs,\n backend: BackendWasm,\n attrs: ClipByValueAttrs\n}) {\n const {inputs, backend, attrs} = args;\n const {x} = inputs;\n const {clipValueMin, clipValueMax} = attrs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n const out = backend.makeOutput(x.shape, x.dtype);\n const outId = backend.dataIdMap.get(out.dataId).id;\n
wasmClip(xId, clipValueMin, clipValueMax, outId);\n return out;\n}\n\nexport const clipByValueConfig: KernelConfig = {\n kernelName: ClipByValue,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: clip as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {backend_util, Concat, ConcatAttrs, ConcatInputs, KernelConfig, KernelFunc, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\nimport {concatImplCPU} from '../kernel_utils/shared';\nimport {identity} from './Identity';\nimport {reshape} from './Reshape';\n\nexport function concat(\n args: {inputs: ConcatInputs, backend: BackendWasm, attrs: ConcatAttrs}) {\n const {inputs, backend} = args;\n\n const axis = util.parseAxisParam(args.attrs.axis, inputs[0].shape)[0];\n\n let outShape = backend_util.computeOutShape(inputs.map(t => t.shape), axis);\n\n // Keep only non-empty tensors (ignore tensors with 0 in their shape).\n const $inputs = inputs.filter(t => util.sizeFromShape(t.shape) > 0);\n if ($inputs.length === 1) {\n return identity({inputs: {x: $inputs[0]}, backend});\n }\n\n const out = backend.makeOutput(outShape, inputs[0].dtype);\n\n if (util.sizeFromShape(outShape) === 0) {\n return out;\n }\n\n const shapes = $inputs.map(t
=> t.shape);\n backend_util.assertParamsConsistent(shapes, axis);\n\n if ($inputs[0].dtype === 'string') {\n // Any concat of n-dimensional tensors across any axis can be reduced to\n // a concatenation of two-dimensional tensors across the axis 1 by first\n // partitioning the axes of the original tensors into those less than the\n // axis to be concatenated and the rest. Then reshape the tensors\n // into a two-dimensional tensor by collapsing these two sets of axes and\n // concatenate the resulting matrices across the axis 1, finally reshaping\n // the result to have the proper shape.\n const inputs2D = $inputs.map(t => {\n const innerSize = util.sizeFromShape(t.shape.slice(axis));\n const shape = [-1, innerSize];\n return reshape({inputs: {x: t}, backend, attrs: {shape}});\n });\n\n const inputsValShapes = inputs2D.map(t => {\n return {vals: backend.readSync(t.dataId), shape: t.shape};\n });\n\n // Concats 2d tensors
along axis=1.\n const outShape =\n backend_util.computeOutShape(inputs2D.map(t => t.shape), 1 /* axis */);\n const simplyConcat = inputs2D[0].shape[0] === 1;\n const outVals = concatImplCPU(\n inputsValShapes, outShape, inputs[0].dtype,\n simplyConcat) as string[];\n\n const finalOutShape =\n backend_util.computeOutShape($inputs.map(t => t.shape), axis);\n\n out.shape = finalOutShape;\n

```
const outData = backend.dataIdMap.get(out.dataId);\n    outData.stringBytes =
backend_util.fromStringArrayToUint8(outVals);\n\n    inputs2D.forEach(t => backend.disposeData(t.dataId));\n\n
return out;\n  }\n\n  const batchDim = util.sizeFromShape($inputs[0].shape.slice(0, axis));\n  let sumInnerDims =
0;\n  const innerDims = $inputs.map(input => {\n    const innerDim = util.sizeFromShape(input.shape.slice(axis));\n
  sumInnerDims += innerDim;\n    return innerDim;\n  });\n  const inVals = $inputs.map(input =>
backend.typedArrayFromHeap(input));\n
  const outVals = backend.typedArrayFromHeap(out);\n  for (let b = 0; b < batchDim; b++) {\n    let outOffset = b *
sumInnerDims;\n    for (let i = 0; i < inVals.length; i++) {\n      const innerDim = innerDims[i];\n      const inOffset =
b * innerDim;\n      const vals = inVals[i].subarray(inOffset, inOffset + innerDim);\n      outVals.set(vals,
outOffset);\n      outOffset += innerDim;\n    }\n  }\n  return out;\n}\n\nexport const concatConfig: KernelConfig =
{\n  kernelName: Concat,\n  backendName: 'wasm',\n  kernelFunc: concat as {} as KernelFunc,\n};\n","/**\n *
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express or implied.\n * See the License for the specific language governing permissions and\n * limitations under
the License.\n *
==========================================================================\n
*/\n\nimport {backend_util, Conv2D, Conv2DAttrs, Conv2DInputs, KernelConfig, KernelFunc, Tensor4D} from
'@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmConv2d: (\n    xId:
number, batchSize: number, inputHeight: number, inputWidth: number,\n    filterId: number, filterHeight: number,
filterWidth: number, padTop: number,\n    padRight: number, padBottom: number, padLeft: number, isSamePad:
number,\n    dilationHeight: number, dilationWidth: number, strideHeight: number,\n    strideWidth: number,
inputChannels: number, outputChannels: number,\n    outId: number) => void;\n\nfunction setup(backend:
BackendWasm) {\n  wasmConv2d = backend.wasm.cwrap(Conv2D,
 null /* void */, [\n    'number',  // xId\n    'number',  // batchSize\n    'number',  // inputHeight\n    'number',  //
inputWidth\n    'number',  // filterId\n    'number',  // filterHeight\n    'number',  // filterWidth\n    'number',  //
padTop\n    'number',  // padRight\n    'number',  // padBottom\n    'number',  // padLeft\n    'number',  // isSamePad\n
 'number',  // dilationHeight\n    'number',  // dilationWidth\n    'number',  // strideHeight\n    'number',  //
strideWidth\n    'number',  // inputChannels\n    'number',  // outputChannels\n    'number',  // outId\n
]);\n}\n\nfunction conv2d(\n    args: {inputs: Conv2DInputs, backend: BackendWasm, attrs: Conv2DAttrs}) {\n
const {inputs, attrs, backend} = args;\n\n  const {x, filter} = inputs;\n  const xId =
backend.dataIdMap.get(x.dataId).id;\n  const filterId = backend.dataIdMap.get(filter.dataId).id;\n\n  const {strides,
dilations, pad, dimRoundingMode, dataFormat} = attrs;\n  const $dataFormat =
backend_util.convertConv2DDataFormat(dataFormat);\n
  const convInfo = backend_util.computeConv2DInfo(\n      (x as Tensor4D).shape, (filter as Tensor4D).shape,
strides, dilations,\n      pad, dimRoundingMode, false, $dataFormat);\n\n  const filterHeight =
convInfo.filterHeight;\n  const filterWidth = convInfo.filterWidth;\n  const padTop = convInfo.padInfo.top;\n  const
padRight = convInfo.padInfo.right;\n  const padBottom = convInfo.padInfo.bottom;\n  const padLeft =
convInfo.padInfo.left;\n  const dilationHeight = convInfo.dilationHeight;\n  const dilationWidth =
convInfo.dilationWidth;\n  const strideHeight = convInfo.strideHeight;\n  const strideWidth =
convInfo.strideWidth;\n  const inputChannels = convInfo.inChannels;\n  const outputChannels =
convInfo.outChannels;\n  const isSamePad = convInfo.padInfo.type === 'SAME' ? 1 : 0;\n\n  if
(convInfo.dataFormat !== 'channelsLast') {\n    throw new Error(\n        `wasm backend Conv2D does not support
dataFormat:'` +\n        `${convInfo.dataFormat}'. Please
 use 'channelsLast'.`);\n  }\n\n  const out = backend.makeOutput(convInfo.outShape, 'float32');\n  const outId =
backend.dataIdMap.get(out.dataId).id;\n  wasmConv2d(\n      xId, x.shape[0], x.shape[1], x.shape[2], filterId,
```

filterHeight,\n filterWidth, padTop, padRight, padBottom, padLeft, isSamePad,\n dilationHeight, dilationWidth, strideHeight, strideWidth, inputChannels,\n outputChannels, outId);\n return out;\n}\n\nexport const conv2DConfig: KernelConfig = {\n kernelName: Conv2D,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: conv2d as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed
under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n */\n\nimport {backend_util, Conv2DBackpropInput, Conv2DBackpropInputAttrs, Conv2DBackpropInputInputs, KernelConfig, KernelFunc, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmConv2DBackpropInput: (\n dyId: number, filterId: number, batchSize: number, filterHeight: number,\n filterWidth: number, inHeight: number, inWidth: number, inChannels: number,\n outHeight: number, outWidth: number, outChannels: number,\n strideHeight: number, strideWidth: number, topPad: number, leftPad: number,\n fltS0: number, fltS1: number, fltS2: number, xBatchStride: number,\n xRowStride: number, xColStride: number,
xChannelStride: number,\n yBatchStride: number, yRowStride: number, yColStride: number,\n yChannelStride: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n wasmConv2DBackpropInput = backend.wasm.cwrap(Conv2DBackpropInput, null, [\n 'number', // dyId\n 'number', // filterId\n 'number', // batchSize\n 'number', // filterHeight\n 'number', // filterWidth\n 'number', // inHeight\n 'number', // inWidth\n 'number', // inChannels\n 'number', // outHeight\n 'number', // outWidth\n 'number', // outChannels\n 'number', // strideHeight\n 'number', // strideWidth\n 'number', // topPad\n 'number', // leftPad\n 'number', // fltS0\n 'number', // fltS1\n 'number', // fltS2\n 'number', // xBatchStride\n 'number', // xRowStride\n 'number', // xColStride\n 'number', // xChannelStride\n 'number', // yBatchStride\n 'number', // yRowStride\n 'number', // yColStride\n
'number', // yChannelStride\n 'number', // outId\n]);\n}\n\nfunction conv2DBackpropInput(args: {\n backend: BackendWasm,\n inputs: Conv2DBackpropInputInputs,\n attrs: Conv2DBackpropInputAttrs\n}): TensorInfo {\n const {backend, inputs, attrs} = args;\n const {dy, filter} = inputs;\n const {strides, pad, dataFormat, dimRoundingMode, inputShape} = attrs;\n\n const dilations = 1;\n\n const $dataFormat = backend_util.convertConv2DDataFormat(dataFormat);\n const convInfo = backend_util.computeConv2DInfo(\n inputShape, filter.shape as [number, number, number, number], strides,\n dilations, pad, dimRoundingMode, false /* depthwise */, $dataFormat);\n const {\n batchSize,\n filterHeight,\n filterWidth,\n inChannels,\n inHeight,\n inWidth,\n outChannels,\n outHeight,\n outWidth,\n strideHeight,\n strideWidth\n } = convInfo;\n\n const topPad = filterHeight - 1 - convInfo.padInfo.top;\n const leftPad = filterWidth - 1 - convInfo.padInfo.left;\n\n
const isChannelsLast = convInfo.dataFormat === 'channelsLast';\n const dxStrides = util.computeStrides(convInfo.inShape);\n const dyStrides = util.computeStrides(dy.shape);\n const [fltS0, fltS1, fltS2] = util.computeStrides(filter.shape);\n const xBatchStride = dxStrides[0];\n const xRowStride = isChannelsLast ? dxStrides[1] : dxStrides[2];\n const xColStride = isChannelsLast ? dxStrides[2] : 1;\n const xChannelStride = isChannelsLast ? 1 : dxStrides[1];\n const yBatchStride = dyStrides[0];\n const yRowStride = isChannelsLast ? dyStrides[1] : dyStrides[2];\n const yColStride = isChannelsLast ? dyStrides[2] : 1;\n const yChannelStride = isChannelsLast ? 1 : dyStrides[1];\n\n const out = backend.makeOutput(convInfo.inShape, 'float32');\n const outId = backend.dataIdMap.get(out.dataId).id;\n const dyId = backend.dataIdMap.get(dy.dataId).id;\n const filterId = backend.dataIdMap.get(filter.dataId).id;\n\n wasmConv2DBackpropInput(\n dyId, filterId, batchSize,

filterHeight, filterWidth, inHeight, inWidth,\n inChannels, outHeight, outWidth, outChannels, strideHeight, strideWidth,\n topPad, leftPad, fltS0, fltS1, fltS2, xBatchStride, xRowStride,\n xColStride, xChannelStride, yBatchStride, yRowStride, yColStride,\n yChannelStride, outId);\n return out;\n}\n\nexport const conv2DBackpropInputConfig: KernelConfig = {\n kernelName: Conv2DBackpropInput,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: conv2DBackpropInput as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES
OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {Cos, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\n\nexport const cosConfig: KernelConfig = createUnaryKernelConfig(Cos);\n","/**\n * @license\n * Copyright 2021 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the
specific language governing permissions and\n * limitations under the License.\n *
==========\n */\nimport {Cosh, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\n\nexport const coshConfig: KernelConfig = createUnaryKernelConfig(Cosh);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n
* ==========\n */\n\nimport {CropAndResize, CropAndResizeAttrs, CropAndResizeInputs, KernelConfig, KernelFunc, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {cast} from './Cast';\n\n// Must match enum in CropAndResize.cc\nenum InterpolationMethod {\n bilinear = 0,\n nearest = 1\n}\n\nlet wasmCropAndResize: (\n imagesId: number, boxesId: number, boxIndId: number, numBoxes: number,\n imagesShape: Uint8Array, cropHeight: number, cropWidth: number,\n method: number, extrapolationValue: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n wasmCropAndResize = backend.wasm.cwrap(CropAndResize, null /*void*/, [\n 'number', // imagesId\n 'number', // boxesId\n 'number', // boxIndId\n 'number', // numBoxes\n 'array', // images shape\n 'number', // cropHeight\n 'number', // cropWidth\n 'number', // method\n
'number', // extrapolation value\n 'number' // out id\n]);\n}\n\nfunction cropAndResize(args: {\n backend: BackendWasm,\n inputs: CropAndResizeInputs,\n attrs: CropAndResizeAttrs\n}): TensorInfo {\n const {backend, inputs, attrs} = args;\n const {method, extrapolationValue, cropSize} = attrs;\n const {image, boxes, boxInd} = inputs;\n\n const numBoxes = boxes.shape[0];\n\n const [cropHeight, cropWidth] = cropSize as [number, number];\n const outShape = [numBoxes, cropHeight, cropWidth, image.shape[3]];\n\n let imagesData = backend.dataIdMap.get(image.dataId);\n let castedData;\n if (image.dtype !== 'float32') {\n castedData = cast({backend, inputs: {x: image}, attrs: {dtype: 'float32'}});\n imagesData =

backend.dataIdMap.get(castedData.dataId);\n }\n\n const imagesId = imagesData.id;\n const boxesId = backend.dataIdMap.get(boxes.dataId).id;\n const boxIndId = backend.dataIdMap.get(boxInd.dataId).id;\n\n const out = backend.makeOutput(outShape, 'float32');\n
  const outId = backend.dataIdMap.get(out.dataId).id;\n\n const imagesShapeBytes = new Uint8Array(new Int32Array(image.shape).buffer);\n\n wasmCropAndResize(\n   imagesId, boxesId, boxIndId, numBoxes, imagesShapeBytes, cropHeight,\n   cropWidth,\n   InterpolationMethod[method as {} as keyof typeof InterpolationMethod],\n   extrapolationValue, outId);\n\n if (castedData != null) {\n backend.disposeData(castedData.dataId);\n }\n\n return out;\n}\n\nexport const cropAndResizeConfig: KernelConfig = {\n kernelName: CropAndResize,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: cropAndResize as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable
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==\n */\n\nimport {backend_util, KernelConfig, KernelFunc, Cumsum, CumsumAttrs, CumsumInputs, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {CppDType} from './types';\n\nimport {transpose} from './Transpose';\n\nlet wasmCumsum: (xId: number, exclusive: number, reverse: number,\n   finalDim: number, outId: number, dtype: CppDType) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmCumsum = backend.wasm.cwrap(Cumsum, null /* void */, [\n   'number', // x_id\n   'number', // exclusive\n   'number', // reverse\n   'number', // final_dim\n
    'number', // out_id\n   'number' // dtype\n]);\n}\n\nexport function cumsum(\n args: {inputs: CumsumInputs, backend: BackendWasm, attrs: CumsumAttrs}):\nTensorInfo {\n const {inputs, backend, attrs} = args;\n const {x} = inputs;\n const {axis, exclusive, reverse} = attrs;\n const xRank = x.shape.length;\n\n util.assert(x.dtype === 'float32' || x.dtype === 'int32',\n   () => `cumsum does not support ${x.dtype} tensors in the WASM backend`);\n // permute required axis to inner most axis\n const permutation = backend_util.getAxesPermutation([axis], xRank);\n let permutedX = x;\n if (permutation !== null) {\n   permutedX = transpose({inputs: {x}, attrs: {perm: permutation}, backend});\n }\n const permutedAxis = backend_util.getInnerMostAxes(1, xRank)[0];\n backend_util.assertAxesAreInnerMostDims('cumsum', [permutedAxis], xRank);\n\n const permutedOut = backend.makeOutput(permutedX.shape, permutedX.dtype);\n const finalDim = permutedX.shape[permutedAxis];\n const
 permutedXId = backend.dataIdMap.get(permutedX.dataId).id;\n const permutedOutId = backend.dataIdMap.get(permutedOut.dataId).id;\n wasmCumsum(permutedXId, exclusive ? 1 : 0, reverse ? 1 : 0, finalDim,\n   permutedOutId, CppDType[x.dtype]);\n\n // transpose data back if permuted\n let out = permutedOut;\n if (permutation !== null) {\n   const undoPermutation = backend_util.getUndoAxesPermutation(permutation);\n   out = transpose(\n   {inputs: {x: permutedOut}, attrs: {perm: undoPermutation}, backend});\n   backend.disposeData(permutedX.dataId);\n backend.disposeData(permutedOut.dataId);\n }\n return out;\n}\n\nexport const cumsumConfig: KernelConfig = {\n kernelName: Cumsum,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: cumsum as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with
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==========================================================================\n
*/\n\nimport {DepthToSpace, DepthToSpaceAttrs, DepthToSpaceInputs, KernelConfig, KernelFunc, TensorInfo,
util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmDepthToSpace:
(\n    xId: number, blockSize: number, channelsLast: number, xStrides: Uint8Array,\n    xStridesLength: number,
outputShape: Uint8Array, outputStrides: Uint8Array,\n    outSize: number, outId: number) => void;\n\nfunction
setup(backend: BackendWasm): void {\n  wasmDepthToSpace
 = backend.wasm.cwrap(DepthToSpace, null /*void*/, [\n    'number',  // xId\n    'number',  // blockSize\n    'number',
// channelsLast\n    'array',   // xStrides\n    'number',  // xStridesLength\n    'array',   // outputShape\n    'array',   //
outputStrides\n    'number',  // outSize\n    'number',  // outId\n  ]);\n}\n\nexport function depthToSpace(args: {\n
backend: BackendWasm,\n  inputs: DepthToSpaceInputs,\n  attrs: DepthToSpaceAttrs\n}): TensorInfo {\n  const
{backend, inputs, attrs} = args;\n  const {x} = inputs;\n  const {blockSize, dataFormat} = attrs;\n\n  const batchSize
= x.shape[0];\n  const inputHeight = (dataFormat === 'NHWC') ? x.shape[1] : x.shape[2];\n  const inputWidth =
(dataFormat === 'NHWC') ? x.shape[2] : x.shape[3];\n  const inputDepth = (dataFormat === 'NHWC') ? x.shape[3]
: x.shape[1];\n\n  const outputHeight = inputHeight * blockSize;\n  const outputWidth = inputWidth * blockSize;\n
const outputDepth = inputDepth / (blockSize * blockSize);\n\n
  const outputShape = (dataFormat === 'NHWC') ?\n      [batchSize, outputHeight, outputWidth, outputDepth] :\n
[batchSize, outputDepth, outputHeight, outputWidth];\n\n  const out = backend.makeOutput(outputShape,
'float32');\n\n  const xData = backend.dataIdMap.get(x.dataId);\n  const xId = xData.id;\n  const xStridesBytes =\n
new Uint8Array(new Int32Array(util.computeStrides(x.shape)).buffer);\n\n  const outputShapeBytes = new
Uint8Array(new Int32Array(outputShape).buffer);\n  const outStridesBytes =\n      new Uint8Array(new
Int32Array(util.computeStrides(outputShape)).buffer);\n\n  const outId = backend.dataIdMap.get(out.dataId).id;\n
const channelsLast = dataFormat === 'NHWC' ? 1 : 0;\n  wasmDepthToSpace(\n      xId, blockSize, channelsLast,
xStridesBytes, x.shape.length - 1,\n      outputShapeBytes, outStridesBytes, outputShape.length, outId);\n\n  return
out;\n}\n\nexport const depthToSpaceConfig: KernelConfig = {\n  kernelName: DepthToSpace,\n  backendName:
'wasm',\n
  setupFunc: setup,\n  kernelFunc: depthToSpace as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019
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http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing,
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OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language
governing permissions and\n * limitations under the License.\n *
==========================================================================\n
*/\n\nimport {backend_util, DepthwiseConv2dNative, DepthwiseConv2dNativeAttrs,
DepthwiseConv2dNativeInputs, KernelConfig, KernelFunc, Tensor4D} from '@tensorflow/tfjs-core';\n\nimport
{BackendWasm} from
 '../backend_wasm';\n\nlet wasmDepthwiseConv2d: (\n    xId: number, batchSize: number, inputHeight: number,
inputWidth: number,\n    filterId: number, filterHeight: number, filterWidth: number, padTop: number,\n
padRight: number, padBottom: number, padLeft: number, isSamePad: number,\n    dilationHeight: number,
dilationWidth: number, strideHeight: number,\n    strideWidth: number, inputChannels: number, outputChannels:
number,\n    outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n  wasmDepthwiseConv2d =\n
 backend.wasm.cwrap(DepthwiseConv2dNative, null /* void */, [\n      'number',  // xId\n      'number',  //
batchSize\n      'number',  // inputHeight\n      'number',  // inputWidth\n      'number',  // filterId\n      'number',  //
filterHeight\n      'number',  // filterWidth\n      'number',  // padTop\n      'number',  // padRight\n      'number',  //
padBottom\n      'number',  // padLeft\n      'number',  // isSamePad\n
  'number',  // dilationHeight\n      'number',  // dilationWidth\n      'number',  // strideHeight\n      'number',  //
strideWidth\n      'number',  // inputChannels\n      'number',  // outputChannels\n      'number',  // outId\n
]);\n}\n\nfunction depthwiseConv2d(args: {\n  inputs: DepthwiseConv2dNativeInputs,\n  backend:
```

BackendWasm,\n attrs: DepthwiseConv2dNativeAttrs\n}) {\n const {inputs, attrs, backend} = args;\n\n const {x, filter} = inputs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n const filterId = backend.dataIdMap.get(filter.dataId).id;\n\n const {strides, dilations, pad, dimRoundingMode} = attrs;\n\n const $dilations = dilations == null ? [1, 1] : dilations;\n\n const convInfo = backend_util.computeConv2DInfo(\n   (x as Tensor4D).shape, (filter as Tensor4D).shape, strides,\n   ($dilations as number | [number, number]), pad, dimRoundingMode,\n   true /* depthwise */);\n\n const filterHeight = convInfo.filterHeight;\n const filterWidth = convInfo.filterWidth;\n const padTop = convInfo.padInfo.top;\n const padRight = convInfo.padInfo.right;\n const padBottom = convInfo.padInfo.bottom;\n const padLeft = convInfo.padInfo.left;\n const dilationHeight = convInfo.dilationHeight;\n const dilationWidth = convInfo.dilationWidth;\n const strideHeight = convInfo.strideHeight;\n const strideWidth = convInfo.strideWidth;\n const inputChannels = convInfo.inChannels;\n const outputChannels = convInfo.outChannels;\n const isSamePad = convInfo.padInfo.type === 'SAME' ? 1 : 0;\n\n if (convInfo.dataFormat !== 'channelsLast') {\n   throw new Error(\n   `wasm backend DepthwiseConv2dNative does not support dataFormat:` +\n   `${convInfo.dataFormat}'. Please use 'channelsLast'.`);\n }\n\n const out = backend.makeOutput(convInfo.outShape, 'float32');\n const outId = backend.dataIdMap.get(out.dataId).id;\n wasmDepthwiseConv2d(\n   xId, x.shape[0], x.shape[1], x.shape[2], filterId, filterHeight,\n   filterWidth,
 padTop, padRight, padBottom, padLeft, isSamePad,\n   dilationHeight, dilationWidth, strideHeight, strideWidth, inputChannels,\n   outputChannels, outId);\n return out;\n}\n\nexport const depthwiseConv2dNativeConfig: KernelConfig = {\n kernelName: DepthwiseConv2dNative,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: depthwiseConv2d as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2021 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations
 under the License.\n *
==\n
*/\nimport {Elu, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\n\nexport const eluConfig: KernelConfig = createUnaryKernelConfig(Elu);\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n
 */\nimport {Equal, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from './binary_kernel';\n\nconst supportsFullBroadcast = false;\nexport const equalConfig: KernelConfig =\n createBinaryKernelConfig(Equal, supportsFullBroadcast, 'bool');\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
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*/\nimport {Exp, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\n\nexport const expConfig: KernelConfig = createUnaryKernelConfig(Exp, 'float32');\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n==========\n*/\n\nimport {ExpandDims, ExpandDimsAttrs, ExpandDimsInputs,
KernelConfig, KernelFunc, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\nimport {reshape} from './Reshape';\n\nexport function expandDims(args: {\n inputs: ExpandDimsInputs,\n attrs: ExpandDimsAttrs,\n backend: BackendWasm\n}) {\n const {inputs, attrs, backend} = args;\n const {input} = inputs;\n const {dim} = attrs;\n\n const inputRank = input.shape.length;\n const newShape = input.shape.slice();\n let $dim = dim;\n if (dim < 0) {\n   // Negative value is counted from the tail of rank.\n   util.assert(\n   -(inputRank + 1) <= dim,\n   () => `Axis must be in the interval [${- (inputRank + 1)}, ${\n  inputRank}]`);\n $dim = inputRank + dim + 1;\n }\n newShape.splice($dim, 0, 1);\n\n return reshape({inputs: {x: input}, backend, attrs: {shape: newShape}});\n}\n\nexport const expandDimsConfig: KernelConfig = {\n kernelName: ExpandDims,\n backendName: 'wasm',\n kernelFunc: expandDims as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n==========\n*/\n\nimport {KernelConfig, KernelFunc} from '@tensorflow/tfjs-core';\nimport {Fill, FillAttrs} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nexport function fill(args: {attrs: FillAttrs, backend: BackendWasm}) {\n const {attrs: {shape,
value, dtype}, backend} = args;\n const out = backend.makeOutput(shape, dtype);\n const outVals = backend.typedArrayFromHeap(out);\n outVals.fill(value as number);\n return out;\n}\n\nexport const fillConfig: KernelConfig = {\n kernelName: Fill,\n backendName: 'wasm',\n kernelFunc: fill as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n==========\n*/\n\nimport {FlipLeftRight, FlipLeftRightInputs, KernelConfig, KernelFunc, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmFlipLeftRight: (\n   xId: number, batch: number, imageHeight: number, imageWidth: number,\n   numChannels: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmFlipLeftRight = backend.wasm.cwrap(FlipLeftRight, null /* void */, [\n   'number', // xId\n   'number', // batch\n   'number', // imageHeight\n   'number', // imageWidth\n   'number', // numChannels\n   'number', // outId\n]);\n}\n\nexport function flipLeftRight(\n   args: {inputs: FlipLeftRightInputs, backend: BackendWasm}): TensorInfo {\n const {inputs, backend} = args;\n const {image} = inputs;\n\n const out = backend.makeOutput(image.shape, image.dtype);\n const imageId =

backend.dataIdMap.get(image.dataId).id;\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n const [batch, imageHeight, imageWidth, numChannels] = image.shape;\n\n wasmFlipLeftRight(\n   imageId, batch, imageHeight, imageWidth, numChannels, outId);\n return out;\n}\n\nexport const flipLeftRightConfig: KernelConfig = {\n kernelName: FlipLeftRight,\n backendName: 'wasm',\n kernelFunc: flipLeftRight as {} as KernelFunc,\n setupFunc: setup\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under\n the License.\n *\n==========\n*/\nimport {Floor, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\nexport const floorConfig: KernelConfig = createUnaryKernelConfig(Floor);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n==========\n*/\n\nimport {FloorDiv, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from './binary_kernel';\n\nconst supportsFullBroadcast = false;\nexport const floorDivConfig: KernelConfig =\n createBinaryKernelConfig(FloorDiv, supportsFullBroadcast);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n==========\n*/\n\nimport {FusedBatchNorm, FusedBatchNormAttrs, FusedBatchNormInputs, KernelConfig, KernelFunc, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmBatchNorm: (\n   xId: number, meanId: number, varianceId: number, offsetId: number,\n   scaleId: number, varianceEpsilon: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n wasmBatchNorm = backend.wasm.cwrap(\n   FusedBatchNorm, null /* void */,\n   ['number', 'number', 'number', 'number', 'number', 'number', 'number']);\n}\n\nfunction fusedBatchNorm(args: {\n backend: BackendWasm,\n inputs: FusedBatchNormInputs,\n attrs: FusedBatchNormAttrs\n}): TensorInfo {\n const {backend, inputs, attrs} = args;\n const {varianceEpsilon} = attrs;\n const {x, mean, variance, offset, scale} = inputs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n const meanId = backend.dataIdMap.get(mean.dataId).id;\n const varianceId = backend.dataIdMap.get(variance.dataId).id;\n const offsetId = offset != null ? backend.dataIdMap.get(offset.dataId).id : 0;\n const scaleId = scale != null ? backend.dataIdMap.get(scale.dataId).id : 0;\n\n const out = backend.makeOutput(x.shape, x.dtype);\n // Short-circuit zero-sized tensors.\n if (util.sizeFromShape(x.shape) === 0) {\n   return out;\n }\n\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n wasmBatchNorm(\n   xId, meanId, varianceId, offsetId, scaleId, varianceEpsilon, outId);\n return out;\n}\n\nexport const fusedBatchNormConfig: KernelConfig = {\n kernelName: FusedBatchNorm,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: fusedBatchNorm as {} as

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KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========================================================================\n
*/\n\nimport {backend_util, FusedConv2D, FusedConv2DAttrs, FusedConv2DInputs, KernelConfig, KernelFunc, Tensor4D} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {FusableActivation} from './types';\n\nlet wasmFusedConv2d:\n  (xId: number, batchSize: number, inputHeight: number, inputWidth: number,\n   filterId: number, filterHeight: number, filterWidth: number,\n   biasId: number, padTop: number, padRight: number, padBottom: number,\n   padLeft: number, isSamePad: number, dilationHeight: number,\n   dilationWidth:
  number, strideHeight: number, strideWidth: number,\n   inputChannels: number, outputChannels: number, activation: number,\n   preluActivationWeightsId: number, leakyreluAlpha: number, outId: number) =>\n  void;\n\nfunction setup(backend: BackendWasm) {\n  wasmFusedConv2d = backend.wasm.cwrap(FusedConv2D, null /* void */, [\n    'number',  // xId\n    'number',  // batchSize\n    'number',  // inputHeight\n    'number',  // inputWidth\n    'number',  // filterId\n    'number',  // filterHeight\n    'number',  // filterWidth\n    'number',  // biasId\n    'number',  // padTop\n    'number',  // padRight\n    'number',  // padBottom\n    'number',  // padLeft\n    'number',  // isSamePad\n    'number',  // dilationHeight\n    'number',  // dilationWidth\n    'number',  // strideHeight\n    'number',  // strideWidth\n    'number',  // inputChannels\n    'number',  // outputChannels\n    'number',  // activation\n    'number',  // preluActivationWeightsId\n    'number',  //
  leakyreluAlpha\n    'number',  // outId\n  ]);\n}\n\nfunction fusedConv2d(args: {\n  inputs: FusedConv2DInputs,\n  backend: BackendWasm,\n  attrs: FusedConv2DAttrs\n}) {\n  const {inputs, attrs, backend} = args;\n  const {x, filter, bias, preluActivationWeights} = inputs;\n  const {\n    strides,\n    pad,\n    dilations,\n    dataFormat,\n    dimRoundingMode,\n    activation,\n    leakyreluAlpha\n  } = attrs;\n\n  const convInfo = backend_util.computeConv2DInfo(\n      (x as Tensor4D).shape, (filter as Tensor4D).shape, strides, dilations,\n      pad, dimRoundingMode);\n\n  const fusedActivation =\n      FusableActivation[activation as {} as keyof typeof FusableActivation];\n  if (fusedActivation == null) {\n    throw new Error(\n        `${activation} activation not yet supported for FusedConv2D ` +\n        `in the wasm backend.`);\n  }\n\n  const xId = backend.dataIdMap.get(x.dataId).id;\n  const filterId = backend.dataIdMap.get(filter.dataId).id;\n\n  const outputChannels = convInfo.outChannels;\n\n
  let biasId = 0;\n  if (bias != null) {\n    const biasData = backend.dataIdMap.get(bias.dataId);\n    if (biasData.shape.length !== 1) {\n      throw new Error(\n          `FusedConv2D only supports rank-1 bias but got ` +\n          `rank ${biasData.shape.length}.`);\n    }\n    if (biasData.shape[0] !== outputChannels) {\n      throw new Error(\n          `FusedConv2D bias shape (${biasData.shape}) does not ` +\n          `match the number of output channels (${outputChannels})`);\n    }\n    biasId = biasData.id;\n  }\n\n  const filterHeight = convInfo.filterHeight;\n  const filterWidth = convInfo.filterWidth;\n  const padTop = convInfo.padInfo.top;\n  const padRight = convInfo.padInfo.right;\n  const padBottom = convInfo.padInfo.bottom;\n  const padLeft = convInfo.padInfo.left;\n  const dilationHeight = convInfo.dilationHeight;\n  const dilationWidth = convInfo.dilationWidth;\n  const strideHeight = convInfo.strideHeight;\n  const strideWidth = convInfo.strideWidth;\n
  const inputChannels = convInfo.inChannels;\n  const isSamePad = convInfo.padInfo.type === 'SAME' ? 1 : 0;\n  const batchSize = convInfo.batchSize;\n  const inHeight = convInfo.inHeight;\n  const inWidth = convInfo.inWidth;\n\n  if (dataFormat !== 'NHWC') {\n    throw new Error(\n        `wasm backend FusedConv2D does not support dataFormat:` +\n        `${dataFormat}'. Please use 'NHWC'.`);\n  }\n\n  const out = backend.makeOutput(convInfo.outShape, 'float32');\n  const outId = backend.dataIdMap.get(out.dataId).id;\n  const
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preluActivationWeightsId = preluActivationWeights == null ?\n 0 :\n backend.dataIdMap.get(preluActivationWeights.dataId).id;\n\n wasmFusedConv2d(\n xId, batchSize, inHeight, inWidth, filterId, filterHeight, filterWidth,\n biasId, padTop, padRight, padBottom, padLeft, isSamePad, dilationHeight,\n dilationWidth, strideHeight, strideWidth, inputChannels, outputChannels,\n fusedActivation, preluActivationWeightsId, leakyreluAlpha
|| 0, outId);\n\n return out;\n}\n\nexport const fusedConv2DConfig: KernelConfig = {\n kernelName: FusedConv2D,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: fusedConv2d as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n */\n\nimport {backend_util, FusedDepthwiseConv2D, FusedDepthwiseConv2DAttrs,
FusedDepthwiseConv2DInputs, KernelConfig, KernelFunc, Tensor4D} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {FusableActivation} from './types';\n\nlet wasmFusedDepthwiseConv2d:\n (xId: number, batchSize: number, inputHeight: number, inputWidth: number,\n filterId: number, filterHeight: number, filterWidth: number,\n biasId: number, padTop: number, padRight: number, padBottom: number,\n padLeft: number, isSamePad: number, dilationHeight: number,\n dilationWidth: number, strideHeight: number, strideWidth: number,\n inputChannels: number, outputChannels: number, activation: number,\n preluActivationWeightsId: number, leakyreluAlpha: number, outId: number) =>\n void;\n\nfunction setup(backend: BackendWasm) {\n wasmFusedDepthwiseConv2d =\n backend.wasm.cwrap(FusedDepthwiseConv2D, null /* void */, [\n 'number', // xId\n 'number', // batchSize\n 'number', // inputHeight\n
'number', // inputWidth\n 'number', // filterId\n 'number', // filterHeight\n 'number', // filterWidth\n
'number', // biasId\n 'number', // padTop\n 'number', // padRight\n 'number', // padBottom\n
'number', // padLeft\n 'number', // isSamePad\n 'number', // dilationHeight\n 'number', //
dilationWidth\n 'number', // strideHeight\n 'number', // strideWidth\n 'number', // inputChannels\n
'number', // outputChannels\n 'number', // activation\n 'number', // preluActivationWeightsId\n
'number', // leakyreluAlpha\n 'number', // outId\n]);\n}\n\nfunction fusedDepthwiseConv2d(args: {\n inputs: FusedDepthwiseConv2DInputs,\n backend: BackendWasm,\n attrs: FusedDepthwiseConv2DAttrs\n}) {\n const {inputs, attrs, backend} = args;\n const {x, filter, bias, preluActivationWeights} = inputs;\n const {\n strides,\n pad,\n dilations,\n
dataFormat,\n dimRoundingMode,\n activation,\n leakyreluAlpha\n } = attrs;\n\n const convInfo =
backend_util.computeConv2DInfo(\n (x as Tensor4D).shape, (filter as Tensor4D).shape, strides, dilations,\n
pad, dimRoundingMode, true /* depthwise */);\n\n const fusedActivation =\n FusableActivation[activation as {}
as keyof typeof FusableActivation];\n if (fusedActivation == null) {\n throw new Error(\n `${activation}
activation not yet supported for FusedDepthwiseConv2D ` +\n `in the wasm backend.`);\n }\n\n const xId =
backend.dataIdMap.get(x.dataId).id;\n const filterId = backend.dataIdMap.get(filter.dataId).id;\n\n const
outputChannels = convInfo.outChannels;\n\n let biasId = 0;\n if (bias != null) {\n const biasData =
backend.dataIdMap.get(bias.dataId);\n if (biasData.shape.length !== 1) {\n throw new Error(\n
`FusedDepthwiseConv2D only supports rank-1 bias but got ` +\n `rank ${biasData.shape.length}.`);\n
}\n if (biasData.shape[0] !== outputChannels) {\n throw new Error(\n `FusedDepthwiseConv2D bias
shape (${biasData.shape}) does not ` +\n `match the number of output channels (${outputChannels})`);\n }\n
biasId = biasData.id;\n }\n\n const filterHeight = convInfo.filterHeight;\n const filterWidth =
convInfo.filterWidth;\n const padTop = convInfo.padInfo.top;\n const padRight = convInfo.padInfo.right;\n const

padBottom = convInfo.padInfo.bottom;\n const padLeft = convInfo.padInfo.left;\n const dilationHeight = convInfo.dilationHeight;\n const dilationWidth = convInfo.dilationWidth;\n const strideHeight = convInfo.strideHeight;\n const strideWidth = convInfo.strideWidth;\n const inputChannels = convInfo.inChannels;\n const isSamePad = convInfo.padInfo.type === 'SAME' ? 1 : 0;\n const batchSize = convInfo.batchSize;\n const inHeight = convInfo.inHeight;\n const inWidth = convInfo.inWidth;\n\n if (dataFormat !== 'NHWC') {\n
throw new Error(\n   `wasm backend FusedDepthwiseConv2D does not support dataFormat:'` +\n `${dataFormat}'. Please use 'NHWC'.`);\n }\n\n const out = backend.makeOutput(convInfo.outShape, 'float32');\n const outId = backend.dataIdMap.get(out.dataId).id;\n const preluActivationWeightsId = preluActivationWeights == null ?\n   0 :\n   backend.dataIdMap.get(preluActivationWeights.dataId).id;\n\n wasmFusedDepthwiseConv2d(\n   xId, batchSize, inHeight, inWidth, filterId, filterHeight, filterWidth,\n biasId, padTop, padRight, padBottom, padLeft, isSamePad, dilationHeight,\n   dilationWidth, strideHeight, strideWidth, inputChannels, outputChannels,\n   fusedActivation, preluActivationWeightsId, leakyreluAlpha || 0, outId);\n\n return out;\n}\n\nexport const fusedDepthwiseConv2DConfig: KernelConfig = {\n kernelName: FusedDepthwiseConv2D,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: fusedDepthwiseConv2d as {} as KernelFunc\n};\n","/**\n * @license\n
* Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {gather_util, GatherNd, GatherNdInputs, KernelConfig, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {CppDType} from './types';\n\nlet wasmGatherNd: (\n   xId: number, dtype: CppDType, indicesId: number, numSlices: number,\n   sliceRank: number, sliceSize: number, strides: Uint8Array, outId: number) =>\n   void;\n\nfunction setup(backend: BackendWasm): void {\n wasmGatherNd = backend.wasm.cwrap(GatherNd, null /*void*/, [\n   'number', // xId\n   'number', // dtype\n   'number', // indicesId\n   'number', // numSlices\n   'number', // sliceRank\n   'number', // sliceSize\n   'array',   // strides\n   'number'   // outId\n]);\n}\n\nfunction gatherNd(args: {backend: BackendWasm, inputs: GatherNdInputs}):\n   TensorInfo {\n const {backend, inputs} = args;\n const {params, indices} = inputs;\n\n const [resultShape, numSlices, sliceSize, strides] =\n   gather_util.prepareAndValidate(params, indices);\n\n const out = backend.makeOutput(resultShape, params.dtype);\n if (numSlices === 0) {\n   return out;\n }\n\n const indicesShape = indices.shape;\n const sliceRank = indicesShape[indicesShape.length - 1];\n\n const xData = backend.dataIdMap.get(params.dataId);\n const xId = xData.id;\n
const indicesData = backend.dataIdMap.get(indices.dataId);\n const indicesId = indicesData.id;\n\n const stridesBytes = new Uint8Array(new Int32Array(strides).buffer);\n\n const outId = backend.dataIdMap.get(out.dataId).id;\n wasmGatherNd(\n   xId, CppDType[params.dtype], indicesId, numSlices, sliceRank, sliceSize,\n   stridesBytes, outId);\n\n return out;\n}\n\nexport const gatherNdConfig: KernelConfig = {\n kernelName: GatherNd,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: gatherNd\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES
OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *

==========\n*/\n\nimport {backend_util, GatherV2, GatherV2Attrs, GatherV2Inputs, KernelConfig, KernelFunc, Tensor, TensorInfo, TypedArray, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {reshape} from './Reshape';\nimport {CppDType} from './types';\n\nlet wasmGather: (\n xId: number, dtype: CppDType, xStrides: Uint8Array, stridesSize: number,\n indicesId: number, batchSize: number, outStrides: Uint8Array,\n outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n wasmGather = backend.wasm.cwrap('Gather', null /*void*/, [\n 'number', // xId\n 'number', // dtype\n 'array', // xStrides\n 'number', // stridesSize\n 'number', // indicesId\n 'number', // batchSize\n 'array', // outStrides\n 'number' // outId\n]);\n}\n\nfunction gatherV2(\n args: {backend: BackendWasm, inputs: GatherV2Inputs, attrs: GatherV2Attrs}):\n TensorInfo {\n const {backend, inputs, attrs} = args;\n const {x, indices} = inputs;\n const {axis, batchDims} = attrs;\n\n // Throw error when any index is out of bound.\n const parsedAxis = util.parseAxisParam(axis, x.shape)[0];\n const indicesVals = backend.readSync(indices.dataId) as TypedArray;\n const axisDim = x.shape[parsedAxis];\n for (let i = 0; i < indicesVals.length; ++i) {\n const index = indicesVals[i];\n util.assert(\n index <= axisDim - 1 && index >= 0,\n () =>\n `GatherV2: the index value ${index} is not in [0, ${axisDim - 1}]`);\n }\n\n const shapeInfo = backend_util.segment_util.collectGatherOpShapeInfo(\n x as Tensor, indices as Tensor, parsedAxis, batchDims);\n\n const flattenX = reshape({\n inputs: {x},\n attrs: {\n shape: [\n shapeInfo.batchSize, shapeInfo.outerSize, shapeInfo.dimSize,\n shapeInfo.sliceSize\n]\n },\n backend\n });\n const indicesSize = util.sizeFromShape(indices.shape);\n const flattenIndex = reshape({\n inputs: {x: indices},\n attrs: {shape: [shapeInfo.batchSize, indicesSize / shapeInfo.batchSize]},\n backend\n });\n const flattenOutputShape = [\n shapeInfo.batchSize, shapeInfo.outerSize, indicesSize / shapeInfo.batchSize,\n shapeInfo.sliceSize\n];\n\n const out = backend.makeOutput(flattenOutputShape, x.dtype);\n if (util.sizeFromShape(x.shape) === 0) {\n return out;\n }\n const stridesSize = flattenX.shape.length - 1;\n\n const xData = backend.dataIdMap.get(flattenX.dataId);\n const xId = xData.id;\n\n const indicesData = backend.dataIdMap.get(flattenIndex.dataId);\n const indicesId = indicesData.id;\n\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n const xStridesBytes = new Uint8Array(\n new Int32Array(util.computeStrides(flattenX.shape)).buffer);\n const outStridesBytes = new Uint8Array(\n new Int32Array(util.computeStrides(flattenOutputShape)).buffer);\n\n wasmGather(\n xId, CppDType[x.dtype], xStridesBytes, stridesSize, indicesId,\n shapeInfo.batchSize, outStridesBytes, outId);\n\n backend.disposeData(flattenX.dataId);\n backend.disposeData(flattenIndex.dataId);\n\n // reshape\n out.shape = shapeInfo.outputShape;\n return out;\n}\n\nexport const gatherV2Config: KernelConfig = {\n kernelName: GatherV2,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: gatherV2 as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n *\n distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n==========\n*/\nimport {Greater, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from './binary_kernel';\n\nconst supportsFullBroadcast = false;\nexport const greaterConfig: KernelConfig =\n createBinaryKernelConfig(Greater, supportsFullBroadcast, 'bool');\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n

* distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==========\n */\nimport {GreaterEqual, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from './binary_kernel';\n\nconst supportsFullBroadcast = false;\nexport const greaterEqualConfig: KernelConfig =\n createBinaryKernelConfig(GreaterEqual, supportsFullBroadcast, 'bool');\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==========\n */\n\nimport {KernelConfig, KernelFunc, LeakyRelu, LeakyReluAttrs, LeakyReluInputs, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {CppDType} from './types';\n\nlet wasmFunc: (\n xId: number, dtype: number, leakyreluAlpha: number, outId: number) => void;\n\nfunction setupFunc(backend: BackendWasm): void {\n wasmFunc = backend.wasm.cwrap(LeakyRelu, null /* void */, [\n 'number', // x_id\n 'number', // dtype\n 'number', // leakyrelu_alpha\n 'number', // out_id\n]);\n}\n\nexport function leakyRelu(\n args:\n {inputs: LeakyReluInputs, attrs: LeakyReluAttrs, backend: BackendWasm}):\n TensorInfo {\n const {inputs: {x}, attrs: {alpha}, backend} = args;\n\n const xId = backend.dataIdMap.get(x.dataId).id;\n // According to TF API, LeakyRelu returns float32 when input is either float32\n // or int32.\n const out = backend.makeOutput(x.shape, 'float32');\n\n if (util.sizeFromShape(x.shape) !== 0) {\n const outId = backend.dataIdMap.get(out.dataId).id;\n wasmFunc(xId, CppDType[x.dtype], alpha, outId);\n }\n\n return out;\n}\n\nexport const leakyReluConfig: KernelConfig = {\n kernelName: LeakyRelu,\n backendName: 'wasm',\n setupFunc,\n kernelFunc: leakyRelu as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==========\n */\nimport {KernelConfig, Less} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from './binary_kernel';\nconst supportsFullBroadcast = false;\nexport const lessConfig: KernelConfig =\n createBinaryKernelConfig(Less, supportsFullBroadcast, 'bool');\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==========\n */\n\nimport {KernelConfig, LessEqual} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from './binary_kernel';\nconst supportsFullBroadcast = false;\nexport const lessEqualConfig: KernelConfig =\n createBinaryKernelConfig(LessEqual, supportsFullBroadcast, 'bool');\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n *

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WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for
the specific language governing permissions and\n * limitations under the License.\n *
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*/\nimport {KernelConfig, Log} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from
'./unary_kernel';\nexport const logConfig: KernelConfig = createUnaryKernelConfig(Log);\n","/**\n * @license\n *
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on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or
implied.\n * See the License for the specific language governing permissions and\n * limitations under the
License.\n *
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*/\nimport {KernelConfig, LogicalAnd} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from
'./binary_kernel';\nconst supportsFullBroadcast = false;\nexport const logicalAndConfig: KernelConfig =\n
createBinaryKernelConfig(LogicalAnd, supportsFullBroadcast, 'bool');\n","/**\n * @license\n * Copyright 2019
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express or implied.\n * See the License for the specific language governing permissions and\n * limitations under
the License.\n *
==\n
*/\n\nimport {backend_util, KernelConfig, KernelFunc, Max, MaxAttrs, MaxInputs, TensorInfo, util} from
'@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport
{permuteAxesAndTranspose} from './kernel_utils';\nimport {CppDType} from './types';\n\nlet wasmMax: (xId:
number, dtype: number, reduceSize: number, outId: number) =>\n   void;\n\nfunction setup(backend:
BackendWasm): void {\n wasmMax = backend.wasm.cwrap(Max, null /*void*/, [\n   'number', // x_id\n
'number', // dtype\n   'number', // reduce_size\n   'number', // out_id\n]);\n}\n\nfunction max(args: {backend:
BackendWasm, inputs: MaxInputs, attrs: MaxAttrs}):\n   TensorInfo {\n const
{backend, inputs, attrs} = args;\n const {reductionIndices: axis, keepDims} = attrs;\n const {x} = inputs;\n const
xId = backend.dataIdMap.get(x.dataId).id;\n let inputId = xId;\n let input = x;\n\n const {transposed, axes,
originalAxes, inputWasTransposed} =\n   permuteAxesAndTranspose(x, axis, backend);\n\n if
(inputWasTransposed) {\n   const transposedId = backend.dataIdMap.get(transposed.dataId).id;\n   input =
transposed;\n   inputId = transposedId;\n }\n\n const inputRank = input.shape.length;\n
backend_util.assertAxesAreInnerMostDims('max', axes, inputRank);\n const [outShape, reduceShape] =\n
backend_util.computeOutAndReduceShapes(input.shape, axes);\n const reduceSize =
util.sizeFromShape(reduceShape);\n\n const out = backend.makeOutput(outShape, x.dtype);\n if
(util.sizeFromShape(input.shape) !== 0) {\n   const outId = backend.dataIdMap.get(out.dataId).id;\n
wasmMax(inputId, CppDType[x.dtype], reduceSize, outId);\n }\n\n if (inputWasTransposed)
{\n   // dispose of the transposed tensor.\n   backend.disposeData(transposed.dataId);\n }\n\n if (keepDims) {\n
// reshape\n   const newShape = backend_util.expandShapeToKeepDim(out.shape, originalAxes);\n   out.shape =
newShape;\n }\n\n return out;\n}\n\nexport const maxConfig: KernelConfig = {\n kernelName: Max,\n
backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: max as {} as KernelFunc\n};\n","/**\n * @license\n *
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permissions and\n * limitations under the License.\n *
==========\n */\nimport {KernelConfig, Maximum} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from './binary_kernel';\nconst supportsFullBroadcast = false;\nexport const maximumConfig: KernelConfig =\n createBinaryKernelConfig(Maximum, supportsFullBroadcast);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing
permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {backend_util, KernelConfig, KernelFunc, MaxPool, MaxPoolAttrs, MaxPoolInputs, Tensor4D, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmMaxPool: (\n xId: number, batchSize: number, inputHeight: number, inputWidth: number,\n filterHeight: number, filterWidth: number, padTop: number, padRight: number,\n padBottom: number, padLeft: number, dilationHeight: number,\n dilationWidth: number, strideHeight: number, strideWidth: number,\n inputChannels: number, outputChannels: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmMaxPool = backend.wasm.cwrap(MaxPool, null /* void */, [\n 'number', // xId\n 'number', // batchSize\n 'number', // inputHeight\n 'number', // inputWidth\n 'number', // filterHeight\n 'number', // filterWidth\n 'number', // padTop\n 'number', // padRight\n 'number', // padBottom\n 'number', // padLeft\n 'number', // dilationHeight\n 'number', // dilationWidth\n 'number', // strideHeight\n 'number', // strideWidth\n 'number', // inputChannels\n 'number', // outputChannels\n 'number', // outId\n]);\n}\n\nfunction maxPool(\n args: {inputs: MaxPoolInputs, backend: BackendWasm, attrs: MaxPoolAttrs}) {\n const {inputs, attrs, backend} = args;\n\n const x = inputs.x as Tensor4D;\n const xId = backend.dataIdMap.get(x.dataId).id;\n\n // TF API supports int32 input. CPU and WebGL backend also support int32\n // input. WASM backend doesn't support it because it uses xnnpack which only\n // supports float32.\n //\n // Add the following assert only for the WASM backend instead of at core op\n // level.\n //\n // TODO: add support for int32 input.\n util.assert(\n x.dtype === 'float32',\n () =>\n `Error in MaxPool: only float32
input is supported. Got ${x.dtype}.`);\n\n const {filterSize, strides, pad, dimRoundingMode} = attrs;\n const convInfo = backend_util.computePool2DInfo(\n x.shape, filterSize, strides, 1 /* dilations */, pad, dimRoundingMode);\n\n const filterHeight = convInfo.filterHeight;\n const filterWidth = convInfo.filterWidth;\n const padTop = convInfo.padInfo.top;\n const padRight = convInfo.padInfo.right;\n const padBottom = convInfo.padInfo.bottom;\n const padLeft = convInfo.padInfo.left;\n const dilationHeight = convInfo.dilationHeight;\n const dilationWidth = convInfo.dilationWidth;\n const strideHeight = convInfo.strideHeight;\n const strideWidth = convInfo.strideWidth;\n const inputChannels = convInfo.inChannels;\n const outputChannels = convInfo.outChannels;\n\n if (convInfo.dataFormat !== 'channelsLast') {\n throw new Error(\n `wasm backend does not support dataFormat:'` +\n `${convInfo.dataFormat}'. Please use 'channelsLast'.`);\n }\n\n const out
= backend.makeOutput(convInfo.outShape, 'float32');\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n wasmMaxPool(\n xId, x.shape[0], x.shape[1], x.shape[2], filterHeight, filterWidth,\n padTop, padRight, padBottom, padLeft, dilationHeight, dilationWidth,\n strideHeight, strideWidth, inputChannels, outputChannels,

outId);\n return out;\n}\n\nexport const maxPoolConfig: KernelConfig = {\n kernelName: MaxPool,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: maxPool as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES
 OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
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*/\n\nimport {backend_util, KernelConfig, KernelFunc, Mean, MeanAttrs, MeanInputs, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\nimport {cast} from './Cast';\n\nimport {permuteAxesAndTranspose} from './kernel_utils';\n\nlet wasmMean: (xId: number, reduceSize: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n wasmMean =\n backend.wasm.cwrap(Mean, null /*void*/, ['number, number, number']);\n}\n\nexport function mean(\n   args: {backend: BackendWasm, inputs: MeanInputs, attrs: MeanAttrs}):\n   TensorInfo {\n const {backend, inputs, attrs} = args;\n const {axis, keepDims} = attrs;\n const {x} = inputs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n
  let inputId = xId;\n let input = x;\n\n const {transposed, axes, originalAxes, inputWasTransposed} =\n permuteAxesAndTranspose(x, axis, backend);\n\n let reductionAxes = axes;\n if (inputWasTransposed) {\n   const transposedId = backend.dataIdMap.get(transposed.dataId).id;\n   if (transposedId !== xId) {\n   // transpose was not a no-op. We will need to dispose of this\n   // once we are done.\n   input = transposed;\n   inputId = transposedId;\n   reductionAxes = backend_util.getInnerMostAxes(\n   reductionAxes.length, input.shape.length);\n   }\n }\n\n backend_util.assertAxesAreInnerMostDims(\n   'mean', reductionAxes, input.shape.length);\n const [outShape, reduceShape] =\n backend_util.computeOutAndReduceShapes(input.shape, reductionAxes);\n const reduceSize = util.sizeFromShape(reduceShape);\n let castedInput = input;\n if (input.dtype !== 'float32') {\n   castedInput =\n cast({backend, inputs: {x: input}, attrs: {dtype:
 'float32'}});\n   inputId = backend.dataIdMap.get(castedInput.dataId).id;\n }\n\n const out = backend.makeOutput(outShape, 'float32');\n if (util.sizeFromShape(input.shape) !== 0) {\n   const outId = backend.dataIdMap.get(out.dataId).id;\n   wasmMean(inputId, reduceSize, outId);\n }\n\n if (inputWasTransposed) {\n   // dispose of the transposed tensor.\n   backend.disposeData(transposed.dataId);\n }\n\n if (keepDims) {\n   // reshape\n   const newShape = backend_util.expandShapeToKeepDim(out.shape, originalAxes);\n   out.shape = newShape;\n }\n\n if (input.dtype !== 'float32') {\n backend.disposeData(castedInput.dataId);\n }\n\n return out;\n}\n\nexport const meanConfig: KernelConfig = {\n kernelName: Mean,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: mean as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this
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==\n
*/\n\nimport {backend_util, KernelConfig, KernelFunc, Min, MinAttrs, MinInputs, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {permuteAxesAndTranspose} from './kernel_utils';\nimport {CppDType} from './types';\n\nlet wasmMin: (xId: number, dtype: number, reduceSize: number, outId: number) =>\n   void;\n\nfunction setup(backend:

BackendWasm): void {\n wasmMin = backend.wasm.cwrap(Min,
 null /*void*/, [\n   'number', // x_id\n   'number', // dtype\n   'number', // reduce_size\n   'number', // out_id\n
]);\n}\n\nfunction min(args: {backend: BackendWasm, inputs: MinInputs, attrs: MinAttrs}):\n   TensorInfo {\n
const {backend, inputs, attrs} = args;\n const {axis, keepDims} = attrs;\n const {x} = inputs;\n const xId =
backend.dataIdMap.get(x.dataId).id;\n let inputId = xId;\n let input = x;\n\n const {transposed, axes, originalAxes,
inputWasTransposed} =\n   permuteAxesAndTranspose(x, axis, backend);\n\n if (inputWasTransposed) {\n
const transposedId = backend.dataIdMap.get(transposed.dataId).id;\n   if (transposedId !== xId) {\n   // transpose
was not a no-op. We will need to dispose of this\n   // once we are done.\n   input = transposed;\n   inputId =
transposedId;\n   }\n }\n\n const inputRank = input.shape.length;\n\n
backend_util.assertAxesAreInnerMostDims('min', axes, inputRank);\n const [outShape, reduceShape] =\n
    backend_util.computeOutAndReduceShapes(input.shape, axes);\n const reduceSize =
util.sizeFromShape(reduceShape);\n\n const out = backend.makeOutput(outShape, input.dtype);\n if
(util.sizeFromShape(input.shape) !== 0) {\n   const outId = backend.dataIdMap.get(out.dataId).id;\n
wasmMin(inputId, CppDType[x.dtype], reduceSize, outId);\n }\n\n if (inputWasTransposed) {\n   // dispose of the
transposed tensor.\n   backend.disposeData(transposed.dataId);\n }\n\n if (keepDims) {\n   // reshape\n   const
newShape = backend_util.expandShapeToKeepDim(out.shape, originalAxes);\n   out.shape = newShape;\n }\n\n
return out;\n}\n\nexport const minConfig: KernelConfig = {\n kernelName: Min,\n backendName: 'wasm',\n
setupFunc: setup,\n kernelFunc: min as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google
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==\n
*/\nimport {KernelConfig, Minimum} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from
'./binary_kernel';\nconst supportsFullBroadcast = false;\nexport const minimumConfig: KernelConfig =\n
createBinaryKernelConfig(Minimum, supportsFullBroadcast);\n","/**\n * @license\n * Copyright 2021 Google
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==\n
*/\n\nimport {KernelConfig, KernelFunc, MirrorPad, MirrorPadAttrs, MirrorPadInputs} from '@tensorflow/tfjs-
core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {CppDType} from './types';\n\n// Must match
enum in MirrorPad.cc\nenum MirrorPaddingMode {\n reflect = 0,\n symmetric = 1\n}\n\nlet wasmMirrorPad: (\n
xId: number, xShapeBytes: Uint8Array, xShapeLength: number, xDtype: number,\n   prePaddingsBytes:
Uint8Array, postPaddingsBytes: Uint8Array, mode: number,\n
  outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmMirrorPad =
backend.wasm.cwrap(MirrorPad, null /* void */, [\n   'number', // xId\n   'array',   // x.shape\n   'number', //
x.shape.length\n   'number', // x.dtype\n   'array',   // pre-paddings\n   'array',   // post-paddings\n   'number', //
mode\n   'number', // outId\n]);\n}\n\nfunction mirrorPad(args: {\n inputs: MirrorPadInputs,\n backend:
BackendWasm,\n attrs: MirrorPadAttrs\n}) {\n const {inputs: {x}, backend, attrs: {paddings, mode}} = args;\n\n
const outShape = paddings.map(\n   (p, i) => p[0] /* beforePad */ + x.shape[i] + p[1] /* afterPad */);\n const xId =
backend.dataIdMap.get(x.dataId).id;\n const out = backend.makeOutput(outShape, x.dtype);\n const outId =
backend.dataIdMap.get(out.dataId).id;\n const xShapeBytes = new Uint8Array(new

Int32Array(x.shape).buffer);\n\n const prePaddingsFlat = paddings.map(padTuple => padTuple[0]);\n const postPaddingsFlat = paddings.map(padTuple
 => padTuple[1]);\n const prePaddingsBytes =\n   new Uint8Array(new Int32Array(prePaddingsFlat).buffer);\n const postPaddingsBytes =\n   new Uint8Array(new Int32Array(postPaddingsFlat).buffer);\n\n wasmMirrorPad(\n   xId, xShapeBytes, x.shape.length, CppDType[x.dtype], prePaddingsBytes,\n postPaddingsBytes, MirrorPaddingMode[mode], outId);\n return out;\n}\n\nexport const mirrorPadConfig: KernelConfig = {\n kernelName: MirrorPad,\n backendName: 'wasm',\n kernelFunc: mirrorPad as {} as KernelFunc,\n setupFunc: setup\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\"
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 BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==\n */\nimport {KernelConfig, Neg} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\nexport const negConfig: KernelConfig = createUnaryKernelConfig(Neg);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n
 * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==\n */\n\nimport {BackendWasm} from '../backend_wasm';\n\n// Analogous to `struct Result` in `non_max_suppression_impl.h`.\ninterface Result {\n pSelectedIndices: number;\n selectedSize: number;\n pSelectedScores: number;\n pValidOutputs: number;\n}\n/**\n * Parse the result of the c++ method, which has the shape equivalent to\n * `Result`.\n */\nexport function parseResultStruct(\n   backend: BackendWasm, resOffset: number): Result {\n const result = new Int32Array(backend.wasm.HEAPU8.buffer, resOffset, 4);\n const pSelectedIndices = result[0];\n const selectedSize = result[1];\n const pSelectedScores = result[2];\n const pValidOutputs = result[3];\n // Since the result was allocated on the heap, we have to delete it.\n backend.wasm._free(resOffset);\n return {pSelectedIndices, selectedSize,
 pSelectedScores, pValidOutputs};\n}\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language

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==========\n
*/\n\nimport {KernelConfig, KernelFunc, NonMaxSuppressionV3, NonMaxSuppressionV3Attrs,
NonMaxSuppressionV3Inputs, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from
'../backend_wasm';\n\nimport {parseResultStruct} from
'./NonMaxSuppression_util';\n\nlet wasmFunc: (\n boxesId: number, scoresId: number, maxOutputSize:
number,\n iouThreshold: number, scoreThreshold: number) => number;\n\nfunction setup(backend:
BackendWasm): void {\n wasmFunc = backend.wasm.cwrap(\n NonMaxSuppressionV3,\n 'number', //
Result*\n [\n 'number', // boxesId\n 'number', // scoresId\n 'number', // maxOutputSize\n
'number', // iouThreshold\n 'number', // scoreThreshold\n]);\n}\n\nfunction kernelFunc(args: {\n backend:
BackendWasm,\n inputs: NonMaxSuppressionV3Inputs,\n attrs: NonMaxSuppressionV3Attrs\n}): TensorInfo {\n
const {backend, inputs, attrs} = args;\n const {iouThreshold, maxOutputSize, scoreThreshold} = attrs;\n const
{boxes, scores} = inputs;\n\n const boxesId = backend.dataIdMap.get(boxes.dataId).id;\n const scoresId =
backend.dataIdMap.get(scores.dataId).id;\n\n const resOffset =\n wasmFunc(boxesId, scoresId, maxOutputSize,
iouThreshold,
scoreThreshold);\n\n const {pSelectedIndices, selectedSize, pSelectedScores, pValidOutputs} =\n
parseResultStruct(backend, resOffset);\n\n // Since we are not using scores for V3, we have to delete it from the
heap.\n backend.wasm._free(pSelectedScores);\n backend.wasm._free(pValidOutputs);\n\n const
selectedIndicesTensor =\n backend.makeOutput([selectedSize], 'int32', pSelectedIndices);\n\n return
selectedIndicesTensor;\n}\n\nexport const nonMaxSuppressionV3Config: KernelConfig = {\n kernelName:
NonMaxSuppressionV3,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: kernelFunc as {} as
KernelFunc,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the
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==========\n
*/\n\nimport {KernelConfig, KernelFunc, NonMaxSuppressionV4, NonMaxSuppressionV4Attrs,
NonMaxSuppressionV4Inputs, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from
'../backend_wasm';\n\nimport {parseResultStruct} from './NonMaxSuppression_util';\n\nlet wasmFunc: (\n
boxesId: number, scoresId: number, maxOutputSize: number,\n iouThreshold: number, scoreThreshold: number,\n
padToMaxOutputSize: boolean) => number;\n\nfunction setup(backend: BackendWasm): void {\n wasmFunc =
backend.wasm.cwrap(\n NonMaxSuppressionV4,\n 'number', // Result*\n [\n 'number', // boxesId\n

'number', // scoresId\n 'number', // maxOutputSize\n 'number', // iouThreshold\n 'number', //
scoreThreshold\n 'bool', // padToMaxOutputSize\n]);\n}\n\nfunction nonMaxSuppressionV4(args: {\n
backend: BackendWasm,\n inputs: NonMaxSuppressionV4Inputs,\n attrs: NonMaxSuppressionV4Attrs\n}):
TensorInfo[] {\n const {backend, inputs, attrs} = args;\n const {iouThreshold, maxOutputSize, scoreThreshold,
padToMaxOutputSize} =\n attrs;\n const {boxes, scores} = inputs;\n\n const boxesId =
backend.dataIdMap.get(boxes.dataId).id;\n const scoresId = backend.dataIdMap.get(scores.dataId).id;\n\n const
resOffset = wasmFunc(\n boxesId, scoresId, maxOutputSize, iouThreshold, scoreThreshold,\n
padToMaxOutputSize);\n\n const {pSelectedIndices, selectedSize, pSelectedScores, pValidOutputs} =\n
parseResultStruct(backend, resOffset);\n\n // Since we are not using scores for V4, we have to delete it from the
heap.\n backend.wasm._free(pSelectedScores);\n\n
const selectedIndicesTensor =\n backend.makeOutput([selectedSize], 'int32', pSelectedIndices);\n\n const
validOutputsTensor = backend.makeOutput([], 'int32', pValidOutputs);\n\n return [selectedIndicesTensor,

validOutputsTensor];\n}\n\nexport const nonMaxSuppressionV4Config: KernelConfig = {\n kernelName: NonMaxSuppressionV4,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: nonMaxSuppressionV4 as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See
 the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {KernelConfig, KernelFunc, NonMaxSuppressionV5, NonMaxSuppressionV5Attrs, NonMaxSuppressionV5Inputs, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {parseResultStruct} from './NonMaxSuppression_util';\n\nlet wasmFunc:\n (boxesId: number, scoresId: number, maxOutputSize: number,\n   iouThreshold: number, scoreThreshold: number, softNmsSigma: number) =>\n   number;\n\nfunction setup(backend: BackendWasm): void {\n wasmFunc = backend.wasm.cwrap(\n   NonMaxSuppressionV5,\n   'number', // Result*\n   [\n   'number', // boxesId\n   'number', // scoresId\n   'number', // maxOutputSize\n   'number', // iouThreshold\n   'number', // scoreThreshold\n   'number', // softNmsSigma\n   ]);\n}\n\nfunction
 kernelFunc(args: {\n backend: BackendWasm,\n inputs: NonMaxSuppressionV5Inputs,\n attrs: NonMaxSuppressionV5Attrs\n}): TensorInfo[] {\n const {backend, inputs, attrs} = args;\n const {iouThreshold, maxOutputSize, scoreThreshold, softNmsSigma} = attrs;\n const {boxes, scores} = inputs;\n\n const boxesId = backend.dataIdMap.get(boxes.dataId).id;\n const scoresId = backend.dataIdMap.get(scores.dataId).id;\n\n const resOffset = wasmFunc(\n   boxesId, scoresId, maxOutputSize, iouThreshold, scoreThreshold,\n softNmsSigma);\n\n const {pSelectedIndices, selectedSize, pSelectedScores, pValidOutputs} =\n parseResultStruct(backend, resOffset);\n\n // Since we are not using validOutputs for V5, we have to delete it from the\n // heap.\n backend.wasm._free(pValidOutputs);\n\n const selectedIndicesTensor =\n backend.makeOutput([selectedSize], 'int32', pSelectedIndices);\n const selectedScoresTensor =\n backend.makeOutput([selectedSize], 'float32', pSelectedScores);\n\n
  return [selectedIndicesTensor, selectedScoresTensor];\n}\n\nexport const nonMaxSuppressionV5Config: KernelConfig = {\n kernelName: NonMaxSuppressionV5,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: kernelFunc as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\nimport
 {KernelConfig, NotEqual} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from './binary_kernel';\nconst supportsFullBroadcast = false;\nexport const notEqualConfig: KernelConfig =\n createBinaryKernelConfig(NotEqual, supportsFullBroadcast, 'bool');\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *

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*/\n\nimport
 {KernelConfig, KernelFunc, OneHot, OneHotAttrs, OneHotInputs} from '@tensorflow/tfjs-core';\n\nimport
{BackendWasm} from '../backend_wasm';\n\nlet wasmOneHot: (\n    indicesId: number, depth: number, onValue:
number, offValue: number,\n    outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n
wasmOneHot = backend.wasm.cwrap(OneHot, null /* void */, [\n    'number',  // indices_id\n    'number',  // depth,\n
 'number',  // onValue\n    'number',  // offValue\n    'number'   // out_id\n  ]);\n}\n\nfunction oneHot(\n    args:
{inputs: OneHotInputs, attrs: OneHotAttrs, backend: BackendWasm}) {\n  const {inputs, backend, attrs} = args;\n
const {indices} = inputs;\n  const {depth, onValue, offValue} = attrs;\n\n  const out =
backend.makeOutput([...indices.shape, depth], 'int32');\n  const outId = backend.dataIdMap.get(out.dataId).id;\n\n
const indicesData = backend.dataIdMap.get(indices.dataId);\n  const indicesId = indicesData.id;\n\n
wasmOneHot(indicesId, depth,
 onValue, offValue, outId);\n\n  return out;\n}\n\nexport const oneHotConfig: KernelConfig = {\n  kernelName:
OneHot,\n  backendName: 'wasm',\n  setupFunc: setup,\n  kernelFunc: oneHot as {} as KernelFunc,\n};\n","/**\n *
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==========\n
*/\n\nimport {KernelConfig, KernelFunc, OnesLike, OnesLikeInputs}
 from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nfunction onesLike(args:
{inputs: OnesLikeInputs, backend: BackendWasm}) {\n  const {inputs: {x}, backend} = args;\n  const out =
backend.makeOutput(x.shape, x.dtype);\n  const outVals = backend.typedArrayFromHeap(out);\n  outVals.fill(1);\n
return out;\n}\n\nexport const onesLikeConfig: KernelConfig = {\n  kernelName: OnesLike,\n  backendName:
'wasm',\n  kernelFunc: onesLike as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC.
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OR CONDITIONS OF ANY KIND, either express
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License.\n *
==========\n
*/\n\nimport {KernelConfig, KernelFunc, Pack, PackAttrs, PackInputs, TensorInfo, util} from '@tensorflow/tfjs-
core';\nimport {BackendWasm} from '../backend_wasm';\n\nimport {concat} from './Concat';\nimport
{expandDims} from './ExpandDims';\n\nexport function pack(\n    args: {inputs: PackInputs, backend:
BackendWasm, attrs: PackAttrs}):\n    TensorInfo {\n  const {inputs, backend, attrs} = args;\n  const {axis} =
attrs;\n\n  if (inputs.length === 1) {\n    return expandDims(\n        {inputs: {input: inputs[0]}, backend, attrs: {dim:
axis}});\n  }\n\n  const shape = inputs[0].shape;\n  const dtype = inputs[0].dtype;\n\n  inputs.forEach(t => {\n
util.assertShapesMatch(\n        shape, t.shape,\n        'All tensors passed to stack must have matching shapes');\n
util.assert(\n
        dtype === t.dtype,\n        () => 'All tensors passed to stack must have matching dtypes');\n  });\n\n  const
intermediateTensorInfos: TensorInfo[] = [];\n  const expandedTensors = inputs.map(t => {\n    const expandedT =\n
    expandDims({inputs: {input: t}, backend, attrs: {dim: axis}});\n    intermediateTensorInfos.push(expandedT);\n
return expandedT;\n  });\n\n  const result = concat({inputs: expandedTensors, backend, attrs: {axis}});\n\n
intermediateTensorInfos.forEach(t => backend.disposeData(t.dataId));\n\n  return result;\n}\n\nexport const
```

packConfig: KernelConfig = {\n kernelName: Pack,\n backendName: 'wasm',\n kernelFunc: pack as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {KernelConfig, KernelFunc, PadV2, PadV2Attrs, PadV2Inputs, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {fill} from './Fill';\n\nimport {CppDType} from './types';\n\nlet wasmPadV2: (\n   xId: number, xShapeBytes: Uint8Array, xShapeLength: number, xDtype: number,\n   prePaddingsBytes: Uint8Array, postPaddingsBytes: Uint8Array,\n   constantValue: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmPadV2 = backend.wasm.cwrap(PadV2, null /* void */, [\n   'number', // xId\n   'array',   // x.shape\n   'number', // x.shape.length\n   'number', // x.dtype\n   'array',   // pre-paddings\n   'array',   // post-paddings\n   'number', // constantValue\n   'number', // outId\n]);\n}\n\nfunction pad(\n   args: {inputs: PadV2Inputs, backend: BackendWasm, attrs: PadV2Attrs}) {\n const {inputs: {x}, backend, attrs: {paddings, constantValue}} = args;\n\n const outShape = paddings.map(\n   (p, i) => p[0] /* beforePad */ + x.shape[i] + p[1] /* afterPad */);\n\n if (util.sizeFromShape(x.shape) === 0) {\n   // Short-circuit the computation, since x doesn't have value, only\n   // the shape is used to compute output shape to pad.\n   return fill({\n   backend,\n   attrs: {shape: outShape, value: constantValue, dtype: x.dtype}\n   });\n }\n\n const xId = backend.dataIdMap.get(x.dataId).id;\n const out = backend.makeOutput(outShape, x.dtype);\n const outTensorData = backend.dataIdMap.get(out.dataId);\n const outId = outTensorData.id;\n\n const xShapeBytes = new Uint8Array(new Int32Array(x.shape).buffer);\n\n const prePaddingsFlat = paddings.map(padTuple => padTuple[0]);\n const postPaddingsFlat = paddings.map(padTuple => padTuple[1]);\n const prePaddingsBytes =\n   new Uint8Array(new Int32Array(prePaddingsFlat).buffer);\n const postPaddingsBytes =\n   new Uint8Array(new Int32Array(postPaddingsFlat).buffer);\n\n wasmPadV2(\n   xId, xShapeBytes, x.shape.length, CppDType[x.dtype], prePaddingsBytes,\n   postPaddingsBytes, constantValue, outId);\n return out;\n}\n\nexport const padV2Config: KernelConfig = {\n kernelName: PadV2,\n backendName: 'wasm',\n kernelFunc: pad as {} as KernelFunc,\n setupFunc: setup\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\nimport {KernelConfig, Pow} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from './binary_kernel';\nconst supportsFullBroadcast = false;\nexport const powConfig: KernelConfig =\n createBinaryKernelConfig(Pow, supportsFullBroadcast);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *

```
==========\n */\n\nimport {KernelConfig, KernelFunc, Prelu, PreluInputs} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {cast} from './Cast';\n\nlet wasmPrelu: (xId: number, weightsId: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n  wasmPrelu = backend.wasm.cwrap(Prelu, null /* void */, [\n    'number',  // x_id\n    'number',  // weights_id\n    'number'   // out_id\n  ]);\n}\n\nfunction prelu(args: {inputs: PreluInputs, backend: BackendWasm}) {\n  const {inputs, backend} = args;\n  const {x, alpha} = inputs;\n  const xId = backend.dataIdMap.get(x.dataId).id;\n  const weightsId = backend.dataIdMap.get(alpha.dataId).id;\n\n  let inputId = xId;\n  const input = x;\n  let castedInput = input;\n  if (input.dtype !== 'float32') {\n    castedInput = cast({backend, inputs: {x}, attrs: {dtype: 'float32'}});\n    inputId = backend.dataIdMap.get(castedInput.dataId).id;\n  }\n\n  const out = backend.makeOutput(x.shape, 'float32');\n  const outId = backend.dataIdMap.get(out.dataId).id;\n  wasmPrelu(inputId, weightsId, outId);\n\n  if (input.dtype !== 'float32') {\n    backend.disposeData(castedInput.dataId);\n  }\n  return out;\n}\n\nexport const preluConfig: KernelConfig = {\n  kernelName: Prelu,\n  backendName: 'wasm',\n  setupFunc: setup,\n  kernelFunc: prelu as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n==========\n */\n\nimport {backend_util, KernelConfig, KernelFunc, Prod, ProdAttrs, ProdInputs, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {permuteAxesAndTranspose} from './kernel_utils';\n\nimport {CppDType} from './types';\n\nlet wasmProd: (\n    xId: number, reduceSize: number,\n    dtype: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n  wasmProd = backend.wasm.cwrap(Prod, null /*void*/, [\n    'number',\n    'number',\n    'number',\n    'number'\n  ]);\n}\n\nfunction prod(args: {\n  backend: BackendWasm,\n  inputs: ProdInputs,\n  attrs: ProdAttrs\n}): TensorInfo {\n  const {backend, inputs, attrs} = args;\n  const {axis, keepDims} = attrs;\n  const {x} = inputs;\n  const xId = backend.dataIdMap.get(x.dataId).id;\n  let inputId = xId;\n  let input = x;\n\n  const {transposed, axes, originalAxes, inputWasTransposed} =\n      permuteAxesAndTranspose(x, axis, backend);\n\n  let reductionAxes = axes;\n  if (inputWasTransposed) {\n    const transposedId = backend.dataIdMap.get(transposed.dataId).id;\n    if (transposedId !== xId) {\n      // transpose was not a no-op. We will need to dispose of this\n      // once we are done.\n      input = transposed;\n      inputId = transposedId;\n      reductionAxes = backend_util.getInnerMostAxes(\n          reductionAxes.length, input.shape.length);\n    }\n  }\n\n  backend_util.assertAxesAreInnerMostDims(\n      'prod', reductionAxes, input.shape.length);\n  const [outShape, reduceShape]\n      =\n      backend_util.computeOutAndReduceShapes(input.shape, reductionAxes);\n  const reduceSize = util.sizeFromShape(reduceShape);\n\n  const out = backend.makeOutput(outShape, input.dtype);\n  if (util.sizeFromShape(input.shape) !== 0) {\n    const outId = backend.dataIdMap.get(out.dataId).id;\n    wasmProd(inputId, reduceSize, CppDType[out.dtype], outId);\n  }\n\n  if (inputWasTransposed) {\n    // dispose of the transposed tensor.\n    backend.disposeData(transposed.dataId);\n  }\n\n  if (keepDims) {\n    // reshape\n    const newShape = backend_util.expandShapeToKeepDim(out.shape, originalAxes);\n    out.shape = newShape;\n  }\n\n  return out;\n}\n\nexport const prodConfig: KernelConfig = {\n  kernelName: Prod,\n  backendName: 'wasm',\n  setupFunc: setup,\n  kernelFunc: prod as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in
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compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {KernelConfig, KernelFunc, Range, RangeAttrs, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\nimport {rangeImplCPU} from '../kernel_utils/shared';\n\nexport const range =\n (args: {backend: BackendWasm, attrs: RangeAttrs}): TensorInfo => {\n const {backend, attrs} = args;\n const {start, stop, step, dtype} = attrs;\n const values = rangeImplCPU(start, stop, step, dtype);\n\n const out = backend.makeOutput([values.length], dtype);\n const outVals = backend.typedArrayFromHeap(out);\n outVals.set(values);\n return out;\n };\n\nexport const rangeConfig: KernelConfig = {\n kernelName: Range,\n backendName: 'wasm',\n kernelFunc: range as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {KernelConfig, RealDiv} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from './binary_kernel';\n\nconst supportsFullBroadcast = true;\nexport const realDivConfig: KernelConfig =\n createBinaryKernelConfig(RealDiv, supportsFullBroadcast);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\nimport {KernelConfig, Relu} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\nexport const reluConfig: KernelConfig = createUnaryKernelConfig(Relu);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\nimport {KernelConfig, Relu6} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\nexport const relu6Config: KernelConfig = createUnaryKernelConfig(Relu6);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language

governing permissions and\n * limitations under the License.\n *
==========\n
*/\n\nimport {KernelConfig, KernelFunc, ResizeBilinear, ResizeBilinearAttrs, ResizeBilinearInputs, TensorInfo,
util} from '@tensorflow/tfjs-core';\n\nimport
{BackendWasm} from '../backend_wasm';\n\nimport {cast} from './Cast';\n\nlet wasmResizeBilinear: (\n xId:
number, batch: number, oldHeight: number, oldWidth: number,\n numChannels: number, newHeight: number,
newWidth: number,\n alignCorners: number, halfPixelCenters: number, outId: number) => void;\n\nfunction
setup(backend: BackendWasm): void {\n wasmResizeBilinear = backend.wasm.cwrap(ResizeBilinear, null
/*void*/, [\n 'number', // xId\n 'number', // batch\n 'number', // oldHeight\n 'number', // oldWidth\n
'number', // numChannels\n 'number', // newHeight\n 'number', // newWidth\n 'number', // alignCorners\n
'number', // halfPixelCenters\n 'number' // outId\n]);\n}\n\nfunction resizeBilinear(args: {\n backend:
BackendWasm,\n inputs: ResizeBilinearInputs,\n attrs: ResizeBilinearAttrs\n}): TensorInfo {\n const {backend,
inputs, attrs} = args;\n\n const {images} = inputs;\n const {alignCorners, halfPixelCenters, size}
= attrs;\n const [newHeight, newWidth] = size;\n\n const [batch, oldHeight, oldWidth, numChannels] =
images.shape;\n const outShape = [batch, newHeight, newWidth, numChannels];\n\n let xData =
backend.dataIdMap.get(images.dataId);\n let castedData;\n if (xData.dtype !== 'float32') {\n castedData =\n
cast({backend, inputs: {x: images}, attrs: {dtype: 'float32'}});\n xData =
backend.dataIdMap.get(castedData.dataId);\n }\n const xId = xData.id;\n\n const out =
backend.makeOutput(outShape, 'float32');\n if (util.sizeFromShape(images.shape) === 0) {\n return out;\n }\n
const outId = backend.dataIdMap.get(out.dataId).id;\n\n wasmResizeBilinear(\n xId, batch, oldHeight,
oldWidth, numChannels, newHeight, newWidth,\n alignCorners ? 1 : 0, halfPixelCenters ? 1 : 0, outId);\n\n if
(castedData != null) {\n backend.disposeData(castedData.dataId);\n }\n\n return out;\n}\n\nexport const
resizeBilinearConfig: KernelConfig = {\n kernelName: ResizeBilinear,\n
backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: resizeBilinear as {} as KernelFunc\n};\n","/**\n *
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WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for
the specific language governing permissions and\n * limitations under the License.\n *
==========\n
*/\n\nimport {KernelConfig, KernelFunc, Reverse, ReverseAttrs, ReverseInputs, TensorInfo, util} from
'@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport
{identity} from './Identity';\nimport {reshape} from './Reshape';\n\nlet wasmReverse: (\n xId: number, axes:
Uint8Array, axesLength: number, outShape: Uint8Array,\n outShapeLength: number, outId: number) =>
void;\n\nfunction setup(backend: BackendWasm) {\n wasmReverse = backend.wasm.cwrap(Reverse, null, [\n
'number', // x_id\n 'array', // axes\n 'number', // axes_length\n 'array', // out_shape\n 'number', //
out_shape_length\n 'number' // out_id\n]);\n}\n\nexport function reverse(\n args: {inputs: ReverseInputs,
backend: BackendWasm, attrs: ReverseAttrs}):\n TensorInfo {\n const {inputs, backend, attrs} = args;\n const
{x} = inputs;\n const {dims} = attrs;\n\n const axes = util.parseAxisParam(dims, x.shape);\n\n if (x.shape.length
=== 0) {\n return identity({inputs: {x}, backend});\n }\n\n const out = backend.makeOutput(x.shape, x.dtype);\n
const xId = backend.dataIdMap.get(x.dataId).id;\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n
const axesBytes = new Uint8Array(new Int32Array(axes).buffer);\n const outShapeBytes = new Uint8Array(new
Int32Array(x.shape).buffer);\n\n wasmReverse(\n xId, axesBytes, axes.length, outShapeBytes, x.shape.length,
outId);\n\n const reshaped =\n reshape({inputs: {x: out}, attrs: {shape: x.shape}, backend});\n\n
backend.disposeData(out.dataId);\n return reshaped;\n}\n\nexport const reverseConfig: KernelConfig = {\n
kernelName: Reverse,\n backendName: 'wasm',\n kernelFunc: reverse as {} as KernelFunc,\n setupFunc:
setup\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the

Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n==========\n*/\n\nimport {KernelConfig, KernelFunc, RotateWithOffset, RotateWithOffsetAttrs, RotateWithOffsetInputs, TensorInfo} from '@tensorflow/tfjs-core';\nimport {backend_util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmRotate: (\n xId: number, batch: number, imageHeight: number, imageWidth: number,\n numChannels: number, radians: number, centerX: number, centerY: number,\n fillBytes: Uint8Array, fillLength: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmRotate = backend.wasm.cwrap(RotateWithOffset, null /* void */, [\n 'number', // xId\n 'number', // batch\n 'number', // imageHeight\n 'number', // imageWidth\n 'number', // numChannels\n 'number', // radians\n 'number', // centerX\n 'number', // centerY\n 'array', // fillBytes\n 'number', // fillLength\n 'number', // outId\n]);\n}\n\nexport function rotateWithOffset(args: {\n inputs: RotateWithOffsetInputs,\n backend: BackendWasm,\n attrs: RotateWithOffsetAttrs\n}): TensorInfo {\n const {inputs, backend, attrs} = args;\n const {image} = inputs;\n const {radians, fillValue, center} = attrs;\n\n const out = backend.makeOutput(image.shape, image.dtype);\n const imageId = backend.dataIdMap.get(image.dataId).id;\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n const [batch, imageHeight, imageWidth, numChannels] = image.shape;\n\n const [centerX, centerY] =\n backend_util.getImageCenter(center, imageHeight, imageWidth);\n\n const fillIsBlack = fillValue === 0;\n const fullOpacityValue = 255;\n\n const fillValues = typeof fillValue === 'number' ?\n [fillValue, fillValue, fillValue, fillIsBlack ? 0 : fullOpacityValue] :\n [...fillValue, fullOpacityValue];\n const fillBytes = new Uint8Array(new Int32Array(fillValues).buffer);\n\n wasmRotate(\n imageId, batch, imageHeight, imageWidth, numChannels, radians, centerX,\n centerY, fillBytes, fillValues.length, outId);\n return out;\n}\n\nexport const rotateWithOffsetConfig: KernelConfig = {\n kernelName: RotateWithOffset,\n backendName: 'wasm',\n kernelFunc: rotateWithOffset as {} as KernelFunc,\n setupFunc: setup\n};\n","/**\n * @license\n * Copyright 2021 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS
OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n==========\n*/\nimport {KernelConfig, Round} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\n\nexport const roundConfig: KernelConfig = createUnaryKernelConfig(Round);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific
language governing permissions and\n * limitations under the License.\n *\n==========\n*/\nimport {KernelConfig, Rsqrt} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\nexport const rsqrtConfig: KernelConfig = createUnaryKernelConfig(Rsqrt);\n","/**\n *

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 ==\n
*/\n\nimport {KernelConfig, KernelFunc, scatter_util, ScatterNd, ScatterNdAttrs, ScatterNdInputs, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {CppDType} from './types';\n\nlet wasmScatterNd: (\n indicesId: number, updatesId: number, dtype: CppDType, sliceRank: number,\n numUpdates: number, sliceSize: number, strides: Uint8Array,\n outputSize: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n wasmScatterNd = backend.wasm.cwrap(ScatterNd, null /*void*/, [\n 'number', // indicesId\n 'number', // updatesId\n 'number', // dtype\n 'number', // sliceRank\n 'number', // numUpdates\n 'number', // sliceSize\n 'array', // strides\n 'number', // outputSize\n 'number' // outId\n]);\n}\n\nfunction scatterNd(\n args:\n {backend: BackendWasm, inputs: ScatterNdInputs, attrs:
 ScatterNdAttrs}):\n TensorInfo {\n const {backend, inputs, attrs} = args;\n const {indices, updates} = inputs;\n const {shape} = attrs;\n\n const out = backend.makeOutput(shape, updates.dtype);\n if (util.sizeFromShape(shape) === 0) {\n return out;\n }\n\n const {sliceRank, numUpdates, sliceSize, strides, outputSize} =\n scatter_util.calculateShapes(updates, indices, shape);\n\n const indicesData = backend.dataIdMap.get(indices.dataId);\n const indicesId = indicesData.id;\n\n const updatesData = backend.dataIdMap.get(updates.dataId);\n const updatesId = updatesData.id;\n\n const stridesBytes = new Uint8Array(new Int32Array(strides).buffer);\n\n const outId = backend.dataIdMap.get(out.dataId).id;\n wasmScatterNd(\n indicesId, updatesId, CppDType[updates.dtype], sliceRank, numUpdates,\n sliceSize, stridesBytes, outputSize, outId);\n\n return out;\n}\n\nexport const scatterNdConfig: KernelConfig = {\n kernelName: ScatterNd,\n backendName: 'wasm',\n
 setupFunc: setup,\n kernelFunc: scatterNd as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
 ==\n
*/\n\nimport {KernelConfig, KernelFunc, Select, SelectInputs, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmSelect: (\n conditionId: number, tId: number, eId:
 number, offset: number,\n outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmSelect = backend.wasm.cwrap('SelectV2', null, [\n 'number', // conditionId\n 'number', // tId\n 'number', // eId\n 'number', // offset\n 'number', // outId\n]);\n}\n\nfunction select(args: {inputs: SelectInputs, backend: BackendWasm}) {\n const {inputs, backend} = args;\n const {condition, t, e} = inputs;\n\n const conditionId = backend.dataIdMap.get(condition.dataId).id;\n const tId = backend.dataIdMap.get(t.dataId).id;\n const eId = backend.dataIdMap.get(e.dataId).id;\n const out = backend.makeOutput(t.shape, t.dtype);\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n const cRank = condition.shape.length;\n const tRank = t.shape.length;\n\n const offset = cRank === 0 || cRank > 1 || tRank === 1 ?\n 1 :\n util.sizeFromShape(t.shape.slice(1));\n\n wasmSelect(conditionId, tId, eId, offset, outId);\n return out;\n}\n\nexport const selectConfig:
 KernelConfig = {\n kernelName: Select,\n backendName: 'wasm',\n kernelFunc: select as {} as KernelFunc,\n setupFunc: setup\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed

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==========\n */\n\nimport {KernelConfig, KernelFunc, Sigmoid, SigmoidInputs, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm}
from '../backend_wasm';\n\nlet wasmFunc: (xId: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n wasmFunc = backend.wasm.cwrap(Sigmoid, null /* void */, ['number', 'number']);\n}\n\nfunction sigmoid(args: {backend: BackendWasm, inputs: SigmoidInputs}):\n TensorInfo {\n const {backend, inputs: {x}} = args;\n const xId = backend.dataIdMap.get(x.dataId).id;\n const out = backend.makeOutput(x.shape, x.dtype);\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n // Short-circuit zero-sized tensors.\n if (util.sizeFromShape(out.shape) === 0) {\n return out;\n }\n\n wasmFunc(xId, outId);\n return out;\n}\n\nexport const sigmoidConfig: KernelConfig = {\n kernelName: 'Sigmoid',\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: sigmoid as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except
in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\nimport {KernelConfig, Sin} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\nexport const sinConfig: KernelConfig = createUnaryKernelConfig(Sin);\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n
* http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {KernelConfig, KernelFunc, Softmax, SoftmaxAttrs, SoftmaxInputs, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmFunc: (xId: number, outId: number, channels: number, batch: number) =>\n void;\n\nfunction setup(backend: BackendWasm): void {\n wasmFunc = backend.wasm.cwrap(Softmax, null /* void */, [\n 'number', // xId\n 'number', // outId\n 'number', // channels\n 'number' // batch\n]);\n}\n\nfunction softmax(\n args: {backend: BackendWasm,
inputs: SoftmaxInputs, attrs: SoftmaxAttrs}):\n TensorInfo {\n const {backend, inputs: {logits}, attrs: {dim}} = args;\n const xId = backend.dataIdMap.get(logits.dataId).id;\n const out = backend.makeOutput(logits.shape, logits.dtype);\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n const channels = logits.shape[dim];\n const batch = util.sizeFromShape(logits.shape) / channels;\n\n // Short-circuit zero-sized tensors.\n if (util.sizeFromShape(out.shape) === 0) {\n return out;\n }\n\n wasmFunc(xId, outId, channels, batch);\n return out;\n}\n\nexport const softmaxConfig: KernelConfig = {\n kernelName: Softmax,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: softmax as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2021 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not

use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ===\n */\n\nimport {backend_util, KernelConfig, KernelFunc, ReshapeAttrs, ReshapeInputs, SpaceToBatchND, SpaceToBatchNDAttrs, SpaceToBatchNDInputs, TensorInfo, TransposeAttrs, TransposeInputs, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {padV2Config} from './PadV2';\nimport {reshape} from './Reshape';\nimport {transpose} from './Transpose';\n\nfunction spaceToBatchND(args: {\n inputs: SpaceToBatchNDInputs,\n backend: BackendWasm,\n attrs: SpaceToBatchNDAttrs\n}) {\n const {inputs, backend,
  attrs} = args;\n const {x} = inputs;\n const {blockShape, paddings} = attrs;\n\n const prod = util.sizeFromShape(blockShape);\n\n const completePaddings: Array<[number, number]> = [[0, 0]];\n completePaddings.push(...(paddings as Array<[number, number]>));\n\n for (let i = 1 + blockShape.length; i < x.shape.length; ++i) {\n   completePaddings.push([0, 0]);\n }\n\n const paddedX = padV2Config.kernelFunc({\n   inputs: {x},\n   backend,\n   attrs: {paddings: completePaddings, constantValue: 0}\n }) as TensorInfo;\n\n const reshapedPaddedShape =\n   backend_util.getReshaped(paddedX.shape, blockShape, prod, false);\n\n const permutedReshapedPaddedPermutation = backend_util.getPermuted(\n   reshapedPaddedShape.length, blockShape.length, false);\n\n const flattenShape =\n   backend_util.getReshapedPermuted(paddedX.shape, blockShape, prod, false);\n\n const reshapeInputs: ReshapeInputs = {x: paddedX};\n const reshapeAttrs: ReshapeAttrs = {shape: reshapedPaddedShape};\n
  const paddedXReshaped =\n   reshape({inputs: reshapeInputs, backend, attrs: reshapeAttrs});\n\n const transposeInputs: TransposeInputs = {x: paddedXReshaped};\n const transposeAttrs:\n   TransposeAttrs = {perm: permutedReshapedPaddedPermutation};\n const paddedXT =\n   transpose({inputs: transposeInputs, backend, attrs: transposeAttrs});\n\n const resultReshapeInputs: ReshapeInputs = {x: paddedXT};\n const resultReshapeAttrs: ReshapeAttrs = {shape: flattenShape};\n const result = reshape(\n   {inputs: resultReshapeInputs, backend, attrs: resultReshapeAttrs});\n\n backend.disposeData(paddedX.dataId);\n backend.disposeData(paddedXReshaped.dataId);\n backend.disposeData(paddedXT.dataId);\n\n return result;\n}\n\nexport const spaceToBatchNDConfig: KernelConfig = {\n kernelName: SpaceToBatchND,\n backendName: 'wasm',\n kernelFunc: spaceToBatchND as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under
 the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ===\n */\n\nimport {KernelConfig, KernelFunc, SplitV, SplitVAttrs, SplitVInputs, util} from '@tensorflow/tfjs-core';\nimport {backend_util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {slice} from './Slice';\n\nexport function splitV(\n   args: {inputs: SplitVInputs, attrs: SplitVAttrs, backend: BackendWasm}) {\n const {inputs,
  attrs, backend} = args;\n const {x} = inputs;\n const {numOrSizeSplits, axis} = attrs;\n\n const $axis = util.parseAxisParam(axis, x.shape)[0];\n\n const splitSizes = backend_util.prepareSplitSize(x, numOrSizeSplits, $axis);\n const begin = new Array(x.shape.length).fill(0);\n const size = x.shape.slice();\n return splitSizes.map(s => {\n   const xSliceSize = [...size];\n   xSliceSize[$axis] = s;\n   const xSlice =\n   slice({inputs: {x}, attrs: {begin, size: xSliceSize}, backend});\n   begin[$axis] += s;\n   return xSlice;\n });\n}\n\nexport const

splitVConfig: KernelConfig = {\n kernelName: SplitV,\n backendName: 'wasm',\n kernelFunc: splitV as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n==========\n*/\n\nimport {KernelConfig, Sqrt} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\nexport const sqrtConfig: KernelConfig = createUnaryKernelConfig(Sqrt);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n==========\n*/\nimport {KernelConfig, Square} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\nexport const squareConfig: KernelConfig = createUnaryKernelConfig(Square);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n==========\n*/\nimport {KernelConfig, SquaredDifference} from '@tensorflow/tfjs-core';\nimport {createBinaryKernelConfig} from './binary_kernel';\nconst supportsFullBroadcast = true;\nexport const squaredDifferenceConfig: KernelConfig =\n   createBinaryKernelConfig(SquaredDifference, supportsFullBroadcast);\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n==========\n*/\n\nimport {KernelConfig, KernelFunc, Step, StepAttrs, StepInputs, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {CppDType} from './types';\n\nlet wasmStep: (xId: number, alpha: number, dtype: number, outId: number) =>\n   void;\n\nfunction setup(backend: BackendWasm): void {\n wasmStep = backend.wasm.cwrap(Step, null /*void*/, [\n   'number', // x_id\n   'number', // alpha\n   'number', // dtype\n   'number', // out_id\n]);\n}\n\nfunction step(\n   args: {backend: BackendWasm, inputs: StepInputs, attrs: StepAttrs}):\n   TensorInfo {\n const {backend, inputs, attrs} = args;\n const {alpha} = attrs;\n const {x} = inputs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n\n const out = backend.makeOutput(x.shape, x.dtype);\n const outId = backend.dataIdMap.get(out.dataId).id;\n wasmStep(xId, alpha, CppDType[x.dtype], outId);\n return out;\n}\n\nexport const stepConfig: KernelConfig = {\n kernelName: Step,\n backendName: 'wasm',\n setupFunc:

setup,\n kernelFunc: step as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2021 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the
 License.\n *
==========\n */\n\nimport {KernelConfig, KernelFunc, slice_util, StridedSlice, StridedSliceAttrs, StridedSliceInputs, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\nimport {reshape} from './Reshape';\nimport {slice} from './Slice';\n\nlet wasmStridedSlice: (\n   xId: number, xStridesBytes: Uint8Array, xRank: number,\n   beginBytes: Uint8Array, endBytes: Uint8Array, stridesBytes: Uint8Array,\n   outShapeBytes: Uint8Array, outStridesBytes: Uint8Array,\n   outShapeLength: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n wasmStridedSlice = backend.wasm.cwrap(StridedSlice, null /*void*/, [\n   'number', // xId\n   'array',   // xStrides\n   'number', // xRank\n   'array',   // beginBytes\n   'array',   // endBytes\n   'array',   // stridesBytes\n   'array',   // outShapeBytes\n   'array',   // outStridesBytes\n
 'number', // outShapeLength\n   'number', // outId\n]);\n}\n\nexport function stridedSlice(args: {\n backend: BackendWasm,\n inputs: StridedSliceInputs,\n attrs: StridedSliceAttrs\n}): TensorInfo {\n const {backend, inputs, attrs} = args;\n const {x} = inputs;\n\n const {\n   begin,\n   end,\n   strides,\n   beginMask,\n   endMask,\n   ellipsisMask,\n   newAxisMask,\n   shrinkAxisMask\n } = attrs;\n\n const {\n   finalShapeSparse,\n   finalShape,\n   isIdentity,\n   sliceDim0,\n   isSimpleSlice,\n   begin: $begin,\n   end: $end,\n   strides: $strides\n } =\n   slice_util.sliceInfo(\n   x.shape, begin, end, strides, beginMask, endMask, ellipsisMask,\n   newAxisMask, shrinkAxisMask);\n\n let result;\n\n if (isIdentity) {\n   // Optimization #1, slice is a no-op plus reshape\n   result = reshape({inputs: {x}, backend, attrs: {shape: finalShape}});\n } else if (sliceDim0 || isSimpleSlice) {\n   // Optimization #2, slice is memory contiguous
 (only occurs in dim 0)\n   util.assert(\n   x.shape.length >= 1,\n   () => `Input must have rank at least 1, got: ${x.shape.length}`);\n\n   const size = slice_util.computeOutShape($begin, $end, $strides);\n   // To tolerate begin[0] > end[0] (a 0-output slice), we min(begin, end).\n   const sliced = slice({inputs: {x}, backend, attrs: {begin: $begin, size}});\n   result =\n   reshape({inputs: {x: sliced}, backend, attrs: {shape: finalShape}});\n   backend.disposeData(sliced.dataId);\n } else {\n   const out = backend.makeOutput(finalShapeSparse, 'float32');\n\n   const xId = backend.dataIdMap.get(x.dataId).id;\n   const xStridesBytes =\n   new Uint8Array(new Int32Array(util.computeStrides(x.shape)).buffer);\n   const beginBytes = new Uint8Array(new Int32Array($begin).buffer);\n   const endBytes = new Uint8Array(new Int32Array($end).buffer);\n   const stridesBytes = new Uint8Array(new Int32Array($strides).buffer);\n\n   const outputShapeBytes =\n
 new Uint8Array(new Int32Array(finalShapeSparse).buffer);\n   const outStridesBytes = new Uint8Array(\n
 new Int32Array(util.computeStrides(finalShapeSparse)).buffer);\n   const outId =
 backend.dataIdMap.get(out.dataId).id;\n\n   wasmStridedSlice(\n   xId, xStridesBytes, x.shape.length,
 beginBytes, endBytes, stridesBytes,\n   outputShapeBytes, outStridesBytes, finalShapeSparse.length, outId);\n\n   result = reshape({inputs: {x: out}, backend, attrs: {shape: finalShape}});\n\n   backend.disposeData(out.dataId);\n }\n\n return result;\n}\n\nexport const stridedSliceConfig: KernelConfig = {\n kernelName: StridedSlice,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: stridedSlice as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License
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language governing permissions and\n * limitations under the License.\n *
==========\n
*/\nimport {KernelConfig, Sub} from '@tensorflow/tfjs-core';\nimport {createBinaryKernelConfig} from
'./binary_kernel';\nconst supportsFullBroadcast = true;\nexport const subConfig: KernelConfig =\n
createBinaryKernelConfig(Sub, supportsFullBroadcast);\n","/**\n * @license\n * Copyright 2019 Google LLC. All
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distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either
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the License.\n *
==========\n
*/\n\nimport {backend_util, KernelConfig, KernelFunc, Sum, SumAttrs, SumInputs, TensorInfo, util} from
'@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport
{permuteAxesAndTranspose} from './kernel_utils';\nimport {CppDType} from './types';\n\nlet wasmSum: (xId:
number, reduceSize: number, dtype: number, outId: number) =>\n void;\n\nfunction setup(backend:
BackendWasm): void {\n wasmSum = backend.wasm.cwrap(Sum, null /*void*/, [\n 'number', // input_id\n
'number', // reduce_size\n 'number', // dtype\n
  'number', // out_id\n]);\n}\n\nfunction sum(args: {backend: BackendWasm, inputs: SumInputs, attrs:
SumAttrs}):\n TensorInfo {\n const {backend, inputs, attrs} = args;\n const {axis, keepDims} = attrs;\n const
{x} = inputs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n let inputId = xId;\n let input = x;\n\n const
{transposed, axes, originalAxes, inputWasTransposed} =\n permuteAxesAndTranspose(x, axis, backend);\n\n
let reductionAxes = axes;\n if (inputWasTransposed) {\n const transposedId =
backend.dataIdMap.get(transposed.dataId).id;\n if (transposedId !== xId) {\n // transpose was not a no-op. We
will need to dispose of this\n // once we are done.\n input = transposed;\n inputId = transposedId;\n
reductionAxes = backend_util.getInnerMostAxes(\n reductionAxes.length, input.shape.length);\n }\n }\n\n
backend_util.assertAxesAreInnerMostDims(\n 'sum', reductionAxes, input.shape.length);\n const [outShape,
reduceShape] =\n backend_util.computeOutAndReduceShapes(input.shape, reductionAxes);\n const reduceSize
= util.sizeFromShape(reduceShape);\n\n const out = backend.makeOutput(outShape, input.dtype);\n if
(util.sizeFromShape(input.shape) !== 0) {\n const outId = backend.dataIdMap.get(out.dataId).id;\n
wasmSum(inputId, reduceSize, CppDType[out.dtype], outId);\n }\n\n if (inputWasTransposed) {\n // dispose of
the transposed tensor.\n backend.disposeData(transposed.dataId);\n }\n\n if (keepDims) {\n // reshape\n const
newShape = backend_util.expandShapeToKeepDim(out.shape, originalAxes);\n out.shape = newShape;\n }\n\n
return out;\n}\n\nexport const sumConfig: KernelConfig = {\n kernelName: Sum,\n backendName: 'wasm',\n
setupFunc: setup,\n kernelFunc: sum as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2021 Google
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OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language
governing permissions and\n * limitations under the License.\n *
==========\n
*/\nimport {KernelConfig, Tan} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from
'./unary_kernel';\nexport const tanConfig: KernelConfig = createUnaryKernelConfig(Tan);\n","/**\n * @license\n *
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==========\n
*/\nimport {KernelConfig, Tanh} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\nexport const tanhConfig: KernelConfig = createUnaryKernelConfig(Tanh);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law
or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n
/\n\nimport {KernelConfig, KernelFunc, Tile, TileAttrs, TileInputs} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {CppDType} from './types';\n\nlet wasmTile: (\n xId: number, xShape: Uint8Array, xShapeSize: number, newShape: Uint8Array,\n newShapeSize: number, dtype: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmTile = backend.wasm.cwrap(Tile, null / void */, [\n 'number', // x_id\n 'array', // x_shape\n 'number', // x_shape.length\n 'array', // new_shape\n 'number', // new_shape.length\n 'number' // out_id\n]);\n}\n\nfunction tile(\n args: {inputs: TileInputs, backend: BackendWasm, attrs: TileAttrs}) {\n const {inputs, backend, attrs} = args;\n const {x} = inputs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n const {reps} = attrs;\n\n const newShape: number[] = new Array(x.shape.length);\n for (let i = 0; i < newShape.length; i++) {\n newShape[i] = x.shape[i] * reps[i];\n }\n const xShapeBytes = new Uint8Array(new Int32Array(x.shape).buffer);\n const newShapeBytes = new Uint8Array(new Int32Array(newShape).buffer);\n\n const out = backend.makeOutput(newShape, x.dtype);\n const outId = backend.dataIdMap.get(out.dataId).id;\n wasmTile(\n xId, xShapeBytes, x.shape.length, newShapeBytes, newShape.length,\n CppDType[out.dtype], outId);\n return out;\n}\n\nexport const tileConfig: KernelConfig = {\n kernelName: Tile,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: tile as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC.
All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n
*/\n\nimport {KernelConfig, KernelFunc, TensorInfo, TopK, TopKAttrs, TopKInputs} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\nimport {CppDType} from './types';\n\nlet wasmTopK: (\n xId: number, xShapeBytes: Uint8Array, xShapeLength: number,\n xDtype: CppDType, k: number, sorted: boolean,
outValuesId: number,\n outIndicesId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmTopK = backend.wasm.cwrap(TopK, null /* void */, [\n 'number', // xId\n 'array', // x.shape\n 'number', // x.shape.length\n 'number', // x.dtype\n 'number', // k\n 'bool', // sorted\n 'number', // outValuesId\n 'number', // outIndicesId\n]);\n}\n\nexport const topk:\n (args: {inputs: TopKInputs, backend: BackendWasm, attrs: TopKAttrs}) =>\n TensorInfo[] | TensorInfo = ({inputs, backend, attrs}) => {\n const {x} = inputs;\n const {k, sorted} = attrs;\n\n const xId = backend.dataIdMap.get(x.dataId).id;\n const xShapeBytes = new Uint8Array(new Int32Array(x.shape).buffer);\n const outputShape = x.shape.slice();\n

outputShape[outputShape.length - 1] = k;\n const outValues = backend.makeOutput(outputShape, x.dtype);\n const outValuesId = backend.dataIdMap.get(outValues.dataId).id;\n const outIndices = backend.makeOutput(outputShape, 'int32');\n const outIndicesId = backend.dataIdMap.get(outIndices.dataId).id;\n\n wasmTopK(\n xId, xShapeBytes, x.shape.length, CppDType[x.dtype], k, sorted,\n outValuesId, outIndicesId);\n\n return [outValues, outIndices];\n };\n\nexport const topKConfig: KernelConfig = {\n kernelName: TopK,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: topk as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2021 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR
CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {KernelConfig, KernelFunc, TensorInfo, Transform, TransformAttrs, TransformInputs, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmTransform: (\n imageId: number, transformsId: number, isBatchTransform: boolean,\n batch: number, outHeight: number, outWidth: number, numChannels: number,\n imageWidth: number, imageHeight: number, strides: Uint8Array,\n stridesLength: number, interpolationModeId: number, fillModeId: number,\n fillValue: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n wasmTransform = backend.wasm.cwrap(Transform, null /*void*/, [\n 'number', // imageId\n 'number', // transformsId\n 'bool', // isBatchTransform\n 'number', // batch\n 'number', // outHeight\n 'number', // outWidth\n 'number', // numChannels\n 'number', // imageWidth\n 'number', // imageHeight\n 'array', // strides\n 'number', // stridesLength\n 'number', // interpolationModeId\n 'number', // fillModeId\n 'number', // fillValue\n 'number' // outId\n]);\n}\n\nfunction transform(\n args:\n {backend: BackendWasm, inputs: TransformInputs, attrs: TransformAttrs}):\n TensorInfo {\n const {backend, inputs, attrs} = args;\n const {image, transforms} = inputs;\n const {interpolation, fillMode, fillValue, outputShape} = attrs;\n\n const [batch, imageHeight, imageWidth, numChannels] = image.shape;\n const [outHeight, outWidth] =\n outputShape != null ? outputShape : [imageHeight, imageWidth];\n const outShape =\n [batch, outHeight, outWidth,\n numChannels] as [number, number, number, number];\n const strides =\n new Uint8Array(new Int32Array(util.computeStrides(image.shape)).buffer);\n\n const out = backend.makeOutput(outShape, image.dtype);\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n const imageData = backend.dataIdMap.get(image.dataId);\n const imageId = imageData.id;\n\n const transformsData = backend.dataIdMap.get(transforms.dataId);\n const transformsId = transformsData.id;\n\n const interpolationModeId = interpolation === 'nearest' ? 1 : 2;\n let fillModeId;\n switch (fillMode) {\n case 'constant':\n fillModeId = 1;\n break;\n case 'reflect':\n fillModeId = 2;\n break;\n case 'wrap':\n fillModeId = 3;\n break;\n case 'nearest':\n fillModeId = 4;\n break;\n default:\n fillModeId = 1;\n break;\n }\n\n wasmTransform(\n imageId, transformsId, (transforms.shape[0] > 1), batch, outHeight,\n outWidth, numChannels, imageWidth, imageHeight, strides,\n image.shape.length - 1, interpolationModeId, fillModeId, fillValue,\n outId);\n\n return out;\n}\n\nexport const transformConfig: KernelConfig = {\n kernelName: Transform,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: transform as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language

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==========\n
*/\n\nimport {KernelConfig, KernelFunc, TensorInfo, Unpack, UnpackAttrs, UnpackInputs}
from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {slice} from
'./Slice';\n\nfunction unpack(\n args: {inputs: UnpackInputs, backend: BackendWasm, attrs: UnpackAttrs}):\n
TensorInfo[] {\n const {inputs, backend, attrs} = args;\n const {value} = inputs;\n let {axis} = attrs;\n\n if (axis <
0) {\n axis += value.shape.length;\n }\n\n const numOutputs = value.shape[axis];\n const rank =
value.shape.length;\n const outShape: number[] = new Array(rank - 1);\n let outIndex = 0;\n for (let i = 0; i < rank;
i++) {\n if (i !== axis) {\n outShape[outIndex++] = value.shape[i];\n }\n }\n const outs: TensorInfo[] = new
Array(numOutputs);\n const begin = new Array(rank).fill(0);\n const size = value.shape.slice();\n size[axis] = 1;\n
for (let i = 0; i < outs.length; i++) {\n begin[axis] = i;\n outs[i] = slice({inputs: {x: value}, attrs: {begin, size},
backend});\n }\n return outs.map(({dataId, dtype}) => ({dataId, dtype,
shape: outShape}));\n}\n\nexport const unpackConfig: KernelConfig = {\n kernelName: Unpack,\n backendName:
'wasm',\n kernelFunc: unpack as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All
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OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language
governing permissions and\n * limitations under the License.\n *
==========\n
*/\n\nimport {KernelConfig, KernelFunc, ZerosLike, ZerosLikeInputs} from '@tensorflow/tfjs-core';\n\nimport
{BackendWasm}
from '../backend_wasm';\n\nfunction zerosLike(args: {inputs: ZerosLikeInputs, backend: BackendWasm}) {\n
const {inputs: {x}, backend} = args;\n const out = backend.makeOutput(x.shape, x.dtype);\n const outVals =
backend.typedArrayFromHeap(out);\n outVals.fill(0);\n return out;\n}\n\nexport const zerosLikeConfig:
KernelConfig = {\n kernelName: ZerosLike,\n backendName: 'wasm',\n kernelFunc: zerosLike as {} as
KernelFunc,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the
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on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or
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for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n//
We explicitly import the modular kernels so they get registered in the\n// global registry when we compile the
library. A modular build would replace\n// the contents of this file and import only the kernels that are
needed.\nimport {KernelConfig, registerKernel} from '@tensorflow/tfjs-core';\n\nimport {fusedMatMulConfig}
from './kernels/_FusedMatMul';\nimport {absConfig} from './kernels/Abs';\nimport {addConfig} from
'./kernels/Add';\nimport {addNConfig} from './kernels/AddN';\nimport {allConfig} from './kernels/All';\nimport
{anyConfig} from './kernels/Any';\nimport {argMaxConfig} from './kernels/ArgMax';\nimport {avgPoolConfig}
from './kernels/AvgPool';\nimport {batchMatMulConfig} from './kernels/BatchMatMul';\nimport
{batchToSpaceNDConfig} from './kernels/BatchToSpaceND';\nimport {castConfig} from './kernels/Cast';\nimport
{ceilConfig} from './kernels/Ceil';\nimport {clipByValueConfig} from './kernels/ClipByValue';\nimport
{concatConfig} from './kernels/Concat';\nimport {conv2DConfig} from './kernels/Conv2D';\nimport
{conv2DBackpropInputConfig} from './kernels/Conv2DBackpropInput';\nimport {cosConfig} from
'./kernels/Cos';\nimport {coshConfig} from './kernels/Cosh';\nimport {cropAndResizeConfig} from
'./kernels/CropAndResize';\nimport {cumsumConfig} from './kernels/Cumsum';\nimport {depthToSpaceConfig}

from './kernels/DepthToSpace';\nimport {depthwiseConv2dNativeConfig} from
'./kernels/DepthwiseConv2dNative';\nimport {eluConfig} from './kernels/Elu';\nimport {equalConfig} from
'./kernels/Equal';\nimport {expConfig} from './kernels/Exp';\nimport {expandDimsConfig} from
'./kernels/ExpandDims';\nimport {fillConfig} from './kernels/Fill';\nimport {flipLeftRightConfig} from
'./kernels/FlipLeftRight';\nimport {floorConfig} from './kernels/Floor';\nimport {floorDivConfig} from
'./kernels/FloorDiv';\nimport
{fusedBatchNormConfig} from './kernels/FusedBatchNorm';\nimport {fusedConv2DConfig} from
'./kernels/FusedConv2D';\nimport {fusedDepthwiseConv2DConfig} from
'./kernels/FusedDepthwiseConv2D';\nimport {gatherNdConfig} from './kernels/GatherNd';\nimport
{gatherV2Config} from './kernels/GatherV2';\nimport {greaterConfig} from './kernels/Greater';\nimport
{greaterEqualConfig} from './kernels/GreaterEqual';\nimport {identityConfig} from './kernels/Identity';\nimport
{leakyReluConfig} from './kernels/LeakyRelu';\nimport {lessConfig} from './kernels/Less';\nimport
{lessEqualConfig} from './kernels/LessEqual';\nimport {logConfig} from './kernels/Log';\nimport
{logicalAndConfig} from './kernels/LogicalAnd';\nimport {maxConfig} from './kernels/Max';\nimport
{maximumConfig} from './kernels/Maximum';\nimport {maxPoolConfig} from './kernels/MaxPool';\nimport
{meanConfig} from './kernels/Mean';\nimport {minConfig} from './kernels/Min';\nimport {minimumConfig} from
'./kernels/Minimum';\nimport
{mirrorPadConfig} from './kernels/MirrorPad';\nimport {multiplyConfig} from './kernels/Multiply';\nimport
{negConfig} from './kernels/Neg';\nimport {nonMaxSuppressionV3Config} from
'./kernels/NonMaxSuppressionV3';\nimport {nonMaxSuppressionV4Config} from
'./kernels/NonMaxSuppressionV4';\nimport {nonMaxSuppressionV5Config} from
'./kernels/NonMaxSuppressionV5';\nimport {notEqualConfig} from './kernels/NotEqual';\nimport {oneHotConfig}
from './kernels/OneHot';\nimport {onesLikeConfig} from './kernels/OnesLike';\nimport {packConfig} from
'./kernels/Pack';\nimport {padV2Config} from './kernels/PadV2';\nimport {powConfig} from
'./kernels/Pow';\nimport {preluConfig} from './kernels/Prelu';\nimport {prodConfig} from './kernels/Prod';\nimport
{rangeConfig} from './kernels/Range';\nimport {realDivConfig} from './kernels/RealDiv';\nimport {reluConfig}
from './kernels/Relu';\nimport {relu6Config} from './kernels/Relu6';\nimport {reshapeConfig} from
'./kernels/Reshape';\nimport {resizeBilinearConfig}
from './kernels/ResizeBilinear';\nimport {reverseConfig} from './kernels/Reverse';\nimport
{rotateWithOffsetConfig} from './kernels/RotateWithOffset';\nimport {roundConfig} from
'./kernels/Round';\nimport {rsqrtConfig} from './kernels/Rsqrt';\nimport {scatterNdConfig} from
'./kernels/ScatterNd';\nimport {selectConfig} from './kernels/Select';\nimport {sigmoidConfig} from
'./kernels/Sigmoid';\nimport {sinConfig} from './kernels/Sin';\nimport {sliceConfig} from './kernels/Slice';\nimport
{softmaxConfig} from './kernels/Softmax';\nimport {spaceToBatchNDConfig} from
'./kernels/SpaceToBatchND';\nimport {splitVConfig} from './kernels/SplitV';\nimport {sqrtConfig} from
'./kernels/Sqrt';\nimport {squareConfig} from './kernels/Square';\nimport {squaredDifferenceConfig} from
'./kernels/SquaredDifference';\nimport {stepConfig} from './kernels/Step';\nimport {stridedSliceConfig} from
'./kernels/StridedSlice';\nimport {subConfig} from './kernels/Sub';\nimport {sumConfig} from
'./kernels/Sum';\nimport
{tanConfig} from './kernels/Tan';\nimport {tanhConfig} from './kernels/Tanh';\nimport {tileConfig} from
'./kernels/Tile';\nimport {topKConfig} from './kernels/TopK';\nimport {transformConfig} from
'./kernels/Transform';\nimport {transposeConfig} from './kernels/Transpose';\nimport {unpackConfig} from
'./kernels/Unpack';\nimport {zerosLikeConfig} from './kernels/ZerosLike';\n\n// List all kernel configs here\nconst
kernelConfigs: KernelConfig[] = [\n absConfig,\n addConfig,\n addNConfig,\n allConfig,\n anyConfig,\n
argMaxConfig,\n avgPoolConfig,\n batchMatMulConfig,\n batchToSpaceNDConfig,\n castConfig,\n
ceilConfig,\n clipByValueConfig,\n concatConfig,\n conv2DConfig,\n conv2DBackpropInputConfig,\n
cosConfig,\n coshConfig,\n cropAndResizeConfig,\n cumsumConfig,\n depthToSpaceConfig,\n
depthwiseConv2dNativeConfig,\n eluConfig,\n equalConfig,\n expConfig,\n expandDimsConfig,\n fillConfig,\n

flipLeftRightConfig,\n floorConfig,\n floorDivConfig,\n
 fusedMatMulConfig,\n fusedBatchNormConfig,\n fusedConv2DConfig,\n fusedDepthwiseConv2DConfig,\n
gatherNdConfig,\n gatherV2Config,\n greaterConfig,\n greaterEqualConfig,\n identityConfig,\n
leakyReluConfig,\n lessConfig,\n lessEqualConfig,\n logConfig,\n logicalAndConfig,\n maxConfig,\n
maximumConfig,\n maxPoolConfig,\n meanConfig,\n minConfig,\n minimumConfig,\n mirrorPadConfig,\n
multiplyConfig,\n negConfig,\n nonMaxSuppressionV3Config,\n nonMaxSuppressionV4Config,\n
nonMaxSuppressionV5Config,\n notEqualConfig,\n oneHotConfig,\n onesLikeConfig,\n packConfig,\n
padV2Config,\n powConfig,\n preluConfig,\n prodConfig,\n rangeConfig,\n realDivConfig,\n reluConfig,\n
relu6Config,\n reshapeConfig,\n resizeBilinearConfig,\n reverseConfig,\n rotateWithOffsetConfig,\n
rsqrtConfig,\n roundConfig,\n scatterNdConfig,\n selectConfig,\n sigmoidConfig,\n sinConfig,\n sliceConfig,\n
softmaxConfig,\n spaceToBatchNDConfig,\n splitVConfig,\n sqrtConfig,\n
 squareConfig,\n squaredDifferenceConfig,\n stepConfig,\n stridedSliceConfig,\n subConfig,\n sumConfig,\n
tanConfig,\n tanhConfig,\n tileConfig,\n topKConfig,\n transformConfig,\n transposeConfig,\n unpackConfig,\n
zerosLikeConfig\n];\n\nfor (const kernelConfig of kernelConfigs) {\n registerKernel(kernelConfig);\n}\n","/**\n *
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2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a
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WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for
the specific language governing permissions and\n * limitations under the License.\n *
==\n
 */\n\nimport {env} from '@tensorflow/tfjs-core';\n\nconst ENV = env();\n\n/**\n * True if SIMD is supported.\n
*/\n// From: https://github.com/GoogleChromeLabs/wasm-feature-detect\nENV.registerFlag(\n   // This typed array
passed in to WebAssembly.validate is WebAssembly binary\n   // code. In this case it is a small program that
contains SIMD\n   // instructions.\n   'WASM_HAS_SIMD_SUPPORT', async () => WebAssembly.validate(new
Uint8Array([\n   0, 97, 115, 109, 1, 0, 0, 0, 1, 4, 1,   96, 0, 0, 3,\n   2, 1, 0,   10, 9, 1, 7, 0, 65, 0, 253, 15, 26,
11\n   ])));\n\n/**\n * True if threads are supported.\n */\n// From: https://github.com/GoogleChromeLabs/wasm-
feature-detect\nENV.registerFlag('WASM_HAS_MULTITHREAD_SUPPORT', async () => {\n //
TODO(annxingyuan): Enable node support once this is resolved:\n //
https://github.com/tensorflow/tfjs/issues/3830\n if (ENV.get('IS_NODE')) {\n   return false;\n }\n\n try {\n
    // Test for transferability of SABs (needed for Firefox)\n   //
https://groups.google.com/forum/#!msg/mozilla.dev.platform/IHkBZlHETpA/dwsMNchWEQAJ\n   new
MessageChannel().port1.postMessage(new SharedArrayBuffer(1));\n   // This typed array is a WebAssembly
program containing threaded\n   // instructions.\n   return WebAssembly.validate(new Uint8Array([\n   0, 97,
115, 109, 1, 0, 0, 0, 1, 4, 1, 96, 0,   0, 3, 2, 1, 0, 5,\n   4, 1, 3,   1,   1, 10, 11, 1, 9, 0, 65, 0, 254, 16, 2, 0, 26,
11\n   ]));\n } catch (e) {\n   return false;\n }\n});\n","\nvar WasmBackendModuleThreadedSimd = (function() {\n
var _scriptDir = typeof document !== 'undefined' && document.currentScript ? document.currentScript.src :
undefined;\n if (typeof __filename !== 'undefined') _scriptDir = _scriptDir || __filename;\n return
(\nfunction(WasmBackendModuleThreadedSimd) {\n WasmBackendModuleThreadedSimd =
WasmBackendModuleThreadedSimd || {};\n\nfunction
GROWABLE_HEAP_I8(){if(wasmMemory.buffer!=buffer){updateGlobalBufferAndViews(wasmMemory.buffer)}
return
 HEAP8}function
GROWABLE_HEAP_U8(){if(wasmMemory.buffer!=buffer){updateGlobalBufferAndViews(wasmMemory.buffer)
}return HEAPU8}function
GROWABLE_HEAP_I32(){if(wasmMemory.buffer!=buffer){updateGlobalBufferAndViews(wasmMemory.buffer)
}return HEAP32}function
GROWABLE_HEAP_U32(){if(wasmMemory.buffer!=buffer){updateGlobalBufferAndViews(wasmMemory.buffer

)}return HEAPU32}function GROWABLE_HEAP_F64(){if(wasmMemory.buffer!=buffer){updateGlobalBufferAndViews(wasmMemory.buffer)}return HEAPF64}var Module=typeof WasmBackendModuleThreadedSimd!==\"undefined\"?WasmBackendModuleThreadedSimd:{};var readyPromiseResolve,readyPromiseReject;Module[\"ready\"]=new Promise(function(resolve,reject){readyPromiseResolve=resolve;readyPromiseReject=reject});var moduleOverrides={};var key;for(key in Module){if(Module.hasOwnProperty(key)){moduleOverrides[key]=Module[key]}}var arguments_=[];var thisProgram=\"./this.program\";var quit_=function(status,toThrow){throw toThrow};var ENVIRONMENT_IS_WEB=false;var ENVIRONMENT_IS_WORKER=false;var ENVIRONMENT_IS_NODE=false;var ENVIRONMENT_IS_SHELL=false;ENVIRONMENT_IS_WEB=typeof window===\"object\";ENVIRONMENT_IS_WORKER=typeof importScripts===\"function\";ENVIRONMENT_IS_NODE=typeof process===\"object\"&&typeof process.versions===\"object\"&&typeof process.versions.node===\"string\";ENVIRONMENT_IS_SHELL=!ENVIRONMENT_IS_WEB&&!ENVIRONMENT_IS_NODE&&!ENVIRONMENT_IS_WORKER;var ENVIRONMENT_IS_PTHREAD=Module[\"ENVIRONMENT_IS_PTHREAD\"]||false;if(ENVIRONMENT_IS_PTHREAD){buffer=Module[\"buffer\"]}var scriptDirectory=\"\";function locateFile(path){if(Module[\"locateFile\"]){return Module[\"locateFile\"](path,scriptDirectory)}return scriptDirectory+path}var read_,readAsync,readBinary,setWindowTitle;var nodeFS;var nodePath;if(ENVIRONMENT_IS_NODE){if(ENVIRONMENT_IS_WORKER){scriptDirectory=require(\"path\").dirname(scriptDirectory)+\"/\"}else{scriptDirectory=__dirname+\"/\"}read_=function shell_read(filename,binary){if(!nodeFS)nodeFS=require(\"fs\");if(!nodePath)nodePath=require(\"path\");filename=nodePath[\"normalize\"](filename);return nodeFS[\"readFileSync\"](filename,binary?null:\"utf8\")};readBinary=function readBinary(filename){var ret=read_(filename,true);if(!ret.buffer){ret=new Uint8Array(ret)}assert(ret.buffer);return ret};if(process[\"argv\"].length>1){thisProgram=process[\"argv\"][1].replace(/\\\\/g,\"/\")}arguments_=process[\"argv\"].slice(2);process[\"on\"](\"uncaughtException\",function(ex){if(!(ex instanceof ExitStatus)){throw ex}});process[\"on\"](\"unhandledRejection\",abort);quit_=function(status){process[\"exit\"](status)};Module[\"inspect\"]=function(){return\"[Emscripten Module object]\"};var nodeWorkerThreads;try{nodeWorkerThreads=require(\"worker_threads\")}catch(e){console.error('The \"worker_threads\" module is not supported in this node.js build - perhaps a newer version is needed?');throw e}global.Worker=nodeWorkerThreads.Worker}else if(ENVIRONMENT_IS_SHELL){if(typeof read!=\"undefined\"){read_=function shell_read(f){return read(f)}}readBinary=function readBinary(f){var data;if(typeof readbuffer===\"function\"){return new Uint8Array(readbuffer(f))}data=read(f,\"binary\");assert(typeof data===\"object\");return data};if(typeof scriptArgs!=\"undefined\"){arguments_=scriptArgs}else if(typeof arguments!=\"undefined\"){arguments_=arguments}if(typeof quit===\"function\"){quit_=function(status){quit(status)}}if(typeof print!==\"undefined\"){if(typeof console===\"undefined\")console={};console.log=print;console.warn=console.error=typeof printErr!==\"undefined\"?printErr:print}}else if(ENVIRONMENT_IS_WEB||ENVIRONMENT_IS_WORKER){if(ENVIRONMENT_IS_WORKER){scriptDirectory=self.location.href}else if(typeof document!==\"undefined\"&&document.currentScript){scriptDirectory=document.currentScript.src}if(typeof _scriptDir !== \"undefined\" && _scriptDir){scriptDirectory=_scriptDir}if(scriptDirectory.indexOf(\"blob:\")!==0){scriptDirectory=scriptDirectory.substr(0,scriptDirectory.lastIndexOf(\"/\")+1)}else{scriptDirectory=\"\"}if(ENVIRONMENT_IS_NODE){read_=function

shell_read(filename,binary){if(!nodeFS)nodeFS=require(\"fs\");if(!nodePath)nodePath=require(\"path\");filename=nodePath[\"normalize\"](filename);return nodeFS[\"readFileSync\"](filename,binary?null:\"utf8\")};readBinary=function readBinary(filename){var ret=read_(filename,true);if(!ret.buffer){ret=new Uint8Array(ret)}assert(ret.buffer);return ret}}else{read_=function(url){var xhr=new XMLHttpRequest;xhr.open(\"GET\",url,false);xhr.send(null);return xhr.responseText};if(ENVIRONMENT_IS_WORKER){readBinary=function(url){var xhr=new XMLHttpRequest;xhr.open(\"GET\",url,false);xhr.responseType=\"arraybuffer\";xhr.send(null);return new Uint8Array(xhr.response)}}readAsync=function(url,onload,onerror){var xhr=new XMLHttpRequest;xhr.open(\"GET\",url,true);xhr.responseType=\"arraybuffer\";xhr.onload=function(){if(xhr.status==200||xhr.status==0&&xhr.response){onload(xhr.response);return}onerror()};xhr.onerror=onerror;xhr.send(null)}}setWindowTitle=function(title){document.title=title}}else{}if(ENVIRONMENT_IS_NODE){if(typeof performance===\"undefined\"){global.performance=require(\"perf_hooks\").performance}}var out=Module[\"print\"]||console.log.bind(console);var err=Module[\"printErr\"]||console.warn.bind(console);for(key in moduleOverrides){if(moduleOverrides.hasOwnProperty(key)){Module[key]=moduleOverrides[key]}}moduleOverrides=null;if(Module[\"arguments\"])arguments_=Module[\"arguments\"];if(Module[\"thisProgram\"])thisProgram=Module[\"thisProgram\"];if(Module[\"quit\"])quit_=Module[\"quit\"];function warnOnce(text){if(!warnOnce.shown)warnOnce.shown={};if(!warnOnce.shown[text]){warnOnce.shown[text]=1;err(text)}}var Atomics_load=Atomics.load;var Atomics_store=Atomics.store;var Atomics_compareExchange=Atomics.compareExchange;var wasmBinary;if(Module[\"wasmBinary\"])wasmBinary=Module[\"wasmBinary\"];var noExitRuntime=Module[\"noExitRuntime\"]||true;if(typeof WebAssembly!==\"object\"){abort(\"no native wasm support detected\")}var wasmMemory;var wasmModule;var ABORT=false;var EXITSTATUS;function assert(condition,text){if(!condition){abort(\"Assertion failed: \"+text)}}function getCFunc(ident){var func=Module[\"_\"+ident];assert(func,\"Cannot call unknown function \"+ident+\", make sure it is exported\");return func}function ccall(ident,returnType,argTypes,args,opts){var toC={\"string\":function(str){var ret=0;if(str!==null&&str!==undefined&&str!==0){var len=(str.length<<2)+1;ret=stackAlloc(len);stringToUTF8(str,ret,len)}return ret},\"array\":function(arr){var ret=stackAlloc(arr.length);writeArrayToMemory(arr,ret);return ret}};function convertReturnValue(ret){if(returnType===\"string\")return UTF8ToString(ret);if(returnType===\"boolean\")return Boolean(ret);return ret}var func=getCFunc(ident);var cArgs=[];var stack=0;if(args){for(var i=0;i<args.length;i++){var converter=toC[argTypes[i]];if(converter){if(stack===0)stack=stackSave();cArgs[i]=converter(args[i])}else{cArgs[i]=args[i]}}}var ret=func.apply(null,cArgs);ret=convertReturnValue(ret);if(stack!==0)stackRestore(stack);return ret}function cwrap(ident,returnType,argTypes,opts){argTypes=argTypes||[];var numericArgs=argTypes.every(function(type){return type===\"number\"});var numericRet=returnType!==\"string\";if(numericRet&&numericArgs&&!opts){return getCFunc(ident)}return function(){return ccall(ident,returnType,argTypes,arguments,opts)}}function UTF8ArrayToString(heap,idx,maxBytesToRead){var endIdx=idx+maxBytesToRead;var str=\"\";while(!(idx>=endIdx)){var u0=heap[idx++];if(!u0)return str;if(!(u0&128)){str+=String.fromCharCode(u0);continue}var u1=heap[idx++]&63;if((u0&224)==192){str+=String.fromCharCode((u0&31)<<6|u1);continue}var u2=heap[idx++]&63;if((u0&240)==224){u0=(u0&15)<<12|u1<<6|u2}else{u0=(u0&7)<<18|u1<<12|u2<<6|heap[idx++]&63}if(u0<65536){str+=String.fromCharCode(u0)}else{var ch=u0-65536;str+=String.fromCharCode(55296|ch>>10,56320|ch&1023)}}return str}function UTF8ToString(ptr,maxBytesToRead){return

ptr?UTF8ArrayToString(GROWABLE_HEAP_U8(),ptr,maxBytesToRead):\"\"}function stringToUTF8Array(str,heap,outIdx,maxBytesToWrite){if(!(maxBytesToWrite>0))return 0;var startIdx=outIdx;var endIdx=outIdx+maxBytesToWrite-1;for(var i=0;i<str.length;++i){var u=str.charCodeAt(i);if(u>=55296&&u<=57343){var u1=str.charCodeAt(++i);u=65536+((u&1023)<<10)|u1&1023}if(u<=127){if(outIdx>=endIdx)break;heap[outIdx++]=u}else if(u<=2047){if(outIdx+1>=endIdx)break;heap[outIdx++]=192|u>>6;heap[outIdx++]=128|u&63}else if(u<=65535){if(outIdx+2>=endIdx)break;heap[outIdx++]=224|u>>12;heap[outIdx++]=128|u>>6&63;heap[outIdx++]=128|u&63}else{if(outIdx+3>=endIdx)break;heap[outIdx++]=240|u>>18;heap[outIdx++]=128|u>>12&63;heap[outIdx++]=128|u>>6&63;heap[outIdx++]=128|u&63}}heap[outIdx]=0;return outIdx-startIdx}function stringToUTF8(str,outPtr,maxBytesToWrite){return stringToUTF8Array(str,GROWABLE_HEAP_U8(),outPtr,maxBytesToWrite)}function lengthBytesUTF8(str){var len=0;for(var i=0;i<str.length;++i){var u=str.charCodeAt(i);if(u>=55296&&u<=57343)u=65536+((u&1023)<<10)|str.charCodeAt(++i)&1023;if(u<=127)++len;else if(u<=2047)len+=2;else if(u<=65535)len+=3;else len+=4}return len}function writeArrayToMemory(array,buffer){GROWABLE_HEAP_I8().set(array,buffer)}function alignUp(x,multiple){if(x%multiple>0){x+=multiple-x%multiple}return x}var buffer,HEAP8,HEAPU8,HEAP16,HEAPU16,HEAP32,HEAPU32,HEAPF32,HEAPF64;function updateGlobalBufferAndViews(buf){buffer=buf;Module[\"HEAP8\"]=HEAP8=new Int8Array(buf);Module[\"HEAP16\"]=HEAP16=new Int16Array(buf);Module[\"HEAP32\"]=HEAP32=new Int32Array(buf);Module[\"HEAPU8\"]=HEAPU8=new Uint8Array(buf);Module[\"HEAPU16\"]=HEAPU16=new Uint16Array(buf);Module[\"HEAPU32\"]=HEAPU32=new Uint32Array(buf);Module[\"HEAPF32\"]=HEAPF32=new Float32Array(buf);Module[\"HEAPF64\"]=HEAPF64=new Float64Array(buf)}var INITIAL_MEMORY=Module[\"INITIAL_MEMORY\"]||16777216;if(ENVIRONMENT_IS_PTHREAD){wasmMemory=Module[\"wasmMemory\"];buffer=Module[\"buffer\"]}else{if(Module[\"wasmMemory\"]){wasmMemory=Module[\"wasmMemory\"]}else{wasmMemory=new WebAssembly.Memory({\"initial\":INITIAL_MEMORY/65536,\"maximum\":2147483648/65536,\"shared\":true});if(!(wasmMemory.buffer instanceof SharedArrayBuffer)){err(\"requested a shared WebAssembly.Memory but the returned buffer is not a SharedArrayBuffer, indicating that while the browser has SharedArrayBuffer it does not have WebAssembly threads support - you may need to set a flag\");if(ENVIRONMENT_IS_NODE){console.log(\"(on node you may need: --experimental-wasm-threads --experimental-wasm-bulk-memory and also use a recent version)\")}throw Error(\"bad memory\")}}}if(wasmMemory){buffer=wasmMemory.buffer}INITIAL_MEMORY=buffer.byteLength;updateGlobalBufferAndViews(buffer);var wasmTable;var __ATPRERUN__=[];var __ATINIT__=[];var __ATMAIN__=[];var __ATEXIT__=[];var __ATPOSTRUN__=[];var runtimeInitialized=false;var runtimeExited=false;if(!ENVIRONMENT_IS_PTHREAD)__ATINIT__.push({func:function(){___wasm_call_ctors()}});function preRun(){if(ENVIRONMENT_IS_PTHREAD)return;if(Module[\"preRun\"]){if(typeof Module[\"preRun\"]==\"function\")Module[\"preRun\"]=[Module[\"preRun\"]];while(Module[\"preRun\"].length){addOnPreRun(Module[\"preRun\"].shift())}}callRuntimeCallbacks(__ATPRERUN__)}function initRuntime(){runtimeInitialized=true;if(ENVIRONMENT_IS_PTHREAD)return;callRuntimeCallbacks(__ATINIT__)}function preMain(){if(ENVIRONMENT_IS_PTHREAD)return;callRuntimeCallbacks(__ATMAIN__)}function exitRuntime(){if(ENVIRONMENT_IS_PTHREAD)return;runtimeExited=true}function postRun(){if(ENVIRONMENT_IS_PTHREAD)return;if(Module[\"postRun\"]){if(typeof Module[\"postRun\"]==\"function\")Module[\"postRun\"]=[Module[\"postRun\"]];while(Module[\"postRun\"].length){addOnPostRun(Module[\"postRun\"].shift())}}callRuntimeCallbacks(__ATPOSTRUN__)}function addOnPreRun(cb){__ATPRERUN__.unshift(cb)}function addOnPostRun(cb){__ATPOSTRUN__.unshift(cb)}var

runDependencies=0;var runDependencyWatcher=null;var dependenciesFulfilled=null;function addRunDependency(id){assert(!ENVIRONMENT_IS_PTHREAD,\"addRunDependency cannot be used in a pthread worker\");runDependencies++;if(Module[\"monitorRunDependencies\"]){Module[\"monitorRunDependencies\"](runDependencies)}}function removeRunDependency(id){runDependencies--;if(Module[\"monitorRunDependencies\"]){Module[\"monitorRunDependencies\"](runDependencies)}if(runDependencies==0){if(runDependencyWatcher!==null){clearInterval(runDependencyWatcher);runDependencyWatcher=null}if(dependenciesFulfilled){var callback=dependenciesFulfilled;dependenciesFulfilled=null;callback()}}}Module[\"preloadedImages\"]={};Module[\"preloadedAudios\"]={};function abort(what){if(Module[\"onAbort\"]){Module[\"onAbort\"](what)}if(ENVIRONMENT_IS_PTHREAD)console.error(\"Pthread aborting at \"+(new Error).stack);what+=\"\";err(what);ABORT=true;EXITSTATUS=1;what=\"abort(\"+what+\"). Build with -s ASSERTIONS=1 for more info.\";var e=new WebAssembly.RuntimeError(what);readyPromiseReject(e);throw e}function hasPrefix(str,prefix){return String.prototype.startsWith?str.startsWith(prefix):str.indexOf(prefix)===0}var dataURIPrefix=\"data:application/octet-stream; base64,\";function isDataURI(filename){return hasPrefix(filename,dataURIPrefix)}var fileURIPrefix=\"file://\";function isFileURI(filename){return hasPrefix(filename,fileURIPrefix)}var wasmBinaryFile=\"tfjs-backend-wasm-threaded-simd.wasm\";if(!isDataURI(wasmBinaryFile)){wasmBinaryFile=locateFile(wasmBinaryFile)}function getBinary(file){try{if(file==wasmBinaryFile&&wasmBinary){return new Uint8Array(wasmBinary)}if(readBinary){return readBinary(file)}else{throw\"both async and sync fetching of the wasm failed\"}}catch(err){abort(err)}}function getBinaryPromise(){if(!wasmBinary&&(ENVIRONMENT_IS_WEB||ENVIRONMENT_IS_WORKER)){if(typeof fetch===\"function\"&&!isFileURI(wasmBinaryFile)){return fetch(wasmBinaryFile,{credentials:\"same-origin\"}).then(function(response){if(!response[\"ok\"]){throw\"failed to load wasm binary file at '\"+wasmBinaryFile+\"'\"}return response[\"arrayBuffer\"]()}).catch(function(){return getBinary(wasmBinaryFile)})}else{if(readAsync){return new Promise(function(resolve,reject){readAsync(wasmBinaryFile,function(response){resolve(new Uint8Array(response))},reject)})}}}return Promise.resolve().then(function(){return getBinary(wasmBinaryFile)})}function createWasm(){var info={\"a\":asmLibraryArg};function receiveInstance(instance,module){var exports=instance.exports;Module[\"asm\"]=exports;wasmTable=Module[\"asm\"][\"I\"];wasmModule=module;if(!ENVIRONMENT_IS_PTHREAD){var numWorkersToLoad=PThread.unusedWorkers.length;PThread.unusedWorkers.forEach(function(w){PThread.loadWasmModuleToWorker(w,function(){if(!--numWorkersToLoad)removeRunDependency(\"wasm-instantiate\")})})}if(!ENVIRONMENT_IS_PTHREAD){addRunDependency(\"wasm-instantiate\")}function receiveInstantiatedSource(output){receiveInstance(output[\"instance\"],output[\"module\"])}function instantiateArrayBuffer(receiver){return getBinaryPromise().then(function(binary){return WebAssembly.instantiate(binary,info)}).then(receiver,function(reason){err(\"failed to asynchronously prepare wasm: \"+reason);abort(reason)})}function instantiateAsync(){if(!wasmBinary&&typeof WebAssembly.instantiateStreaming===\"function\"&&!isDataURI(wasmBinaryFile)&&!isFileURI(wasmBinaryFile)&&typeof fetch===\"function\"){return fetch(wasmBinaryFile,{credentials:\"same-origin\"}).then(function(response){var result=WebAssembly.instantiateStreaming(response,info);return result.then(receiveInstantiatedSource,function(reason){err(\"wasm streaming compile failed: \"+reason);err(\"falling back to ArrayBuffer instantiation\");return instantiateArrayBuffer(receiveInstantiatedSource)})})}else{return instantiateArrayBuffer(receiveInstantiatedSource)}}if(Module[\"instantiateWasm\"]){try{var exports=Module[\"instantiateWasm\"](info,receiveInstance);return exports}catch(e){err(\"Module.instantiateWasm

callback failed with error: \"+e);return false}}instantiateAsync().catch(readyPromiseReject);return{}}var ASM_CONSTS={10520:function(){throw\"Canceled!\"},10538:function($0,$1){setTimeout(function(){__emscripten_do_dispatch_to_thread($0,$1)},0)}};function initPthreadsJS(){PThread.initRuntime()}function callRuntimeCallbacks(callbacks){while(callbacks.length>0){var callback=callbacks.shift();if(typeof callback==\"function\"){callback(Module);continue}var func=callback.func;if(typeof func===\"number\"){if(callback.arg===undefined){wasmTable.get(func)()}else{wasmTable.get(func)(callback.arg)}}else{func(callback.arg===undefined?null:callback.arg)}}}var ERRNO_CODES={EPERM:63,ENOENT:44,ESRCH:71,EINTR:27,EIO:29,ENXIO:60,E2BIG:1,ENOEXEC:45,EBADF:8,ECHILD:12,EAGAIN:6,EWOULDBLOCK:6,ENOMEM:48,EACCES:2,EFAULT:21,ENOTBLK:105,EBUSY:10,EEXIST:20,EXDEV:75,ENODEV:43,ENOTDIR:54,EISDIR:31,EINVAL:28,ENFILE:41,EMFILE:33,ENOTTY:59,ETXTBSY:74,EFBIG:22,ENOSPC:51,ESPIPE:70,EROFS:69,EMLINK:34,EPIPE:64,EDOM:18,ERANGE:68,ENOMSG:49,EIDRM:24,ECHRNG:106,EL2NSYNC:156,EL3HLT:107,EL3RST:108,ELNRNG:109,EUNATCH:110,ENOCSI:111,EL2HLT:112,EDEADLK:16,ENOLCK:46,EBADE:113,EBADR:114,EXFULL:115,ENOANO:104,EBADRQC:103,EBADSLT:102,EDEADLOCK:16,EBFONT:101,ENOSTR:100,ENODATA:116,ETIME:117,ENOSR:118,ENONET:119,ENOPKG:120,EREMOTE:121,ENOLINK:47,EADV:122,ESRMNT:123,ECOMM:124,EPROTO:65,EMULTIHOP:36,EDOTDOT:125,EBADMSG:9,ENOTUNIQ:126,EBADFD:127,EREMCHG:128,ELIBACC:129,ELIBBAD:130,ELIBSCN:131,ELIBMAX:132,ELIBEXEC:133,ENOSYS:52,ENOTEMPTY:55,ENAMETOOLONG:37,ELOOP:32,EOPNOTSUPP:138,EPFNOSUPPORT:139,ECONNRESET:15,ENOBUFS:42,EAFNOSUPPORT:5,EPROTOTYPE:67,ENOTSOCK:57,ENOPROTOOPT:50,ESHUTDOWN:140,ECONNREFUSED:14,EADDRINUSE:3,ECONNABORTED:13,ENETUNREACH:40,ENETDOWN:38,ETIMEDOUT:73,EHOSTDOWN:142,EHOSTUNREACH:23,EINPROGRESS:26,EALREADY:7,EDESTADDRREQ:17,EMSGSIZE:35,EPROTONOSUPPORT:66,ESOCKTNOSUPPORT:137,EADDRNOTAVAIL:4,ENETRESET:39,EISCONN:30,ENOTCONN:53,ETOOMANYREFS:141,EUSERS:136,EDQUOT:19,ESTALE:72,ENOTSUP:138,ENOMEDIUM:148,EILSEQ:25,EOVERFLOW:61,ECANCELED:11,ENOTRECOVERABLE:56,EOWNERDEAD:62,ESTRPIPE:135};function _emscripten_futex_wake(addr,count){if(addr<=0||addr>GROWABLE_HEAP_I8().length||addr&3!=0||count<0)return-28;if(count==0)return 0;if(count>=2147483647)count=Infinity;var mainThreadWaitAddress=Atomics.load(GROWABLE_HEAP_I32(),__emscripten_main_thread_futex>>2);var mainThreadWoken=0;if(mainThreadWaitAddress==addr){var loadedAddr=Atomics.compareExchange(GROWABLE_HEAP_I32(),__emscripten_main_thread_futex>>2,mainThreadWaitAddress,0);if(loadedAddr==mainThreadWaitAddress){--count;mainThreadWoken=1;if(count<=0)return 1}}var ret=Atomics.notify(GROWABLE_HEAP_I32(),addr>>2,count);if(ret>=0)return ret+mainThreadWoken;throw\"Atomics.notify returned an unexpected value \"+ret}Module[\"_emscripten_futex_wake\"]=_emscripten_futex_wake;function killThread(pthread_ptr){if(ENVIRONMENT_IS_PTHREAD)throw\"Internal Error! killThread() can only ever be called from main application thread!\";if(!pthread_ptr)throw\"Internal Error! Null pthread_ptr in killThread!\";GROWABLE_HEAP_I32()[pthread_ptr+12>>2]=0;var pthread=PThread.pthreads[pthread_ptr];pthread.worker.terminate();PThread.freeThreadData(pthread);PThread.runningWorkers.splice(PThread.runningWorkers.indexOf(pthread.worker),1);pthread.worker.pthread=undefined}function cancelThread(pthread_ptr){if(ENVIRONMENT_IS_PTHREAD)throw\"Internal Error! cancelThread() can only ever be called from main application thread!\";if(!pthread_ptr)throw\"Internal Error! Null pthread_ptr in cancelThread!\";var pthread=PThread.pthreads[pthread_ptr];pthread.worker.postMessage({\"cmd\":\"cancel\"})}function cleanupThread(pthread_ptr){if(ENVIRONMENT_IS_PTHREAD)throw\"Internal Error! cleanupThread() can only ever be called from main application thread!\";if(!pthread_ptr)throw\"Internal Error! Null pthread_ptr in cleanupThread!\";var pthread=PThread.pthreads[pthread_ptr];if(pthread){GROWABLE_HEAP_I32()[pthread_ptr+12>>2]=0;var worker=pthread.worker;PThread.returnWorkerToPool(worker)}}var

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PThread={unusedWorkers:[],runningWorkers:[],initMainThreadBlock:function(){var
 pthreadPoolSize=8;for(var
i=0;i<pthreadPoolSize;++i){PThread.allocateUnusedWorker()}},initRuntime:function(){var
tb=_malloc(228);for(var
i=0;i<228/4;++i)GROWABLE_HEAP_U32()[tb/4+i]=0;GROWABLE_HEAP_I32()[tb+12>>2]=tb;var
headPtr=tb+152;GROWABLE_HEAP_I32()[headPtr>>2]=headPtr;var tlsMemory=_malloc(512);for(var
i=0;i<128;++i)GROWABLE_HEAP_U32()[tlsMemory/4+i]=0;Atomics.store(GROWABLE_HEAP_U32(),tb+100
>>2,tlsMemory);Atomics.store(GROWABLE_HEAP_U32(),tb+40>>2,tb);__emscripten_thread_init(tb,!ENVIRON
MENT_IS_WORKER,1);_emscripten_register_main_browser_thread_id(tb)},initWorker:function(){},pthreads:{},t
hreadExitHandlers:[],setThreadStatus:function(){},runExitHandlers:function(){while(PThread.threadExitHandlers.l
ength>0){PThread.threadExitHandlers.pop()()}if(ENVIRONMENT_IS_PTHREAD&&_pthread_self())___pthread
_tsd_run_dtors()},runExitHandlersAndDeinitThread:function(tb,exitCode){Atomics.store(GROWABLE_HEAP_U
32(),tb+56>>2,1);Atomics.store(GROWABLE_HEAP_U32(),tb+60>>2,0);PThread.runExitHandlers();Atomics.stor
e(GROWABLE_HEAP_U32(),tb+4>>2,exitCode);Atomics.store(GROWABLE_HEAP_U32(),tb+0>>2,1);_emscri
pten_futex_wake(tb+0,2147483647);__emscripten_thread_init(0,0,0)},threadExit:function(exitCode){var
tb=_pthread_self();if(tb){PThread.runExitHandlersAndDeinitThread(tb,exitCode);if(ENVIRONMENT_IS_PTHRE
AD){postMessage({\"cmd\":\"exit\"})}}},threadCancel:function(){PThread.runExitHandlersAndDeinitThread(_pthr
ead_self(),-1);postMessage({\"cmd\":\"cancelDone\"})},terminateAllThreads:function(){for(var t in
PThread.pthreads){var
pthread=PThread.pthreads[t];if(pthread&&pthread.worker){PThread.returnWorkerToPool(pthread.worker)}}PThre
ad.pthreads={};for(var i=0;i<PThread.unusedWorkers.length;++i){var
worker=PThread.unusedWorkers[i];worker.terminate()}PThread.unusedWorkers=[];for(var
i=0;i<PThread.runningWorkers.length;++i){var worker=PThread.runningWorkers[i];var
pthread=worker.pthread;PThread.freeThreadData(pthread);worker.terminate()}PThread.runningWorkers=[]},freeTh
readData:function(pthread){if(!pthread)return;if(pthread.threadInfoStruct){var
tlsMemory=GROWABLE_HEAP_I32()[pthread.threadInfoStruct+100>>2];GROWABLE_HEAP_I32()[pthread.thr
eadInfoStruct+100>>2]=0;_free(tlsMemory);_free(pthread.threadInfoStruct)}pthread.threadInfoStruct=0;if(pthread.
allocatedOwnStack&&pthread.stackBase)_free(pthread.stackBase);pthread.stackBase=0;if(pthread.worker)pthread.
worker.pthread=null},returnWorkerToPool:function(worker){PThread.runWithoutMainThreadQueuedCalls(functio
n(){delete
PThread.pthreads[worker.pthread.threadInfoStruct];PThread.unusedWorkers.push(worker);PThread.runningWorker
s.splice(PThread.runningWorkers.indexOf(worker),1);PThread.freeThreadData(worker.pthread);worker.pthread=un
defined})},runWithoutMainThreadQueuedCalls:function(func){GROWABLE_HEAP_I32()[__emscripten_allow_m
ain_runtime_queued_calls>>2]=0;try{func()}finally{GROWABLE_HEAP_I32()[__emscripten_allow_main_runti
me_queued_calls>>2]=1}},receiveObjectTransfer:function(data){},loadWasmModuleToWorker:function(worker,o
nFinishedLoading){worker.onmessage=function(e){var
 d=e[\"data\"];var
cmd=d[\"cmd\"];if(worker.pthread)PThread.currentProxiedOperationCallerThread=worker.pthread.threadInfoStruct;
if(d[\"targetThread\"]&&d[\"targetThread\"]!=_pthread_self()){var
thread=PThread.pthreads[d.targetThread];if(thread){thread.worker.postMessage(e.data,d[\"transferList\"])}else{con
sole.error('Internal error! Worker sent a message \"'+cmd+'\" to target pthread '+d[\"targetThread\"]+\", but that
thread no longer
exists!\")}PThread.currentProxiedOperationCallerThread=undefined;return}if(cmd===\"processQueuedMainThread
Work\"){_emscripten_main_thread_process_queued_calls()}else
if(cmd===\"spawnThread\"){spawnThread(e.data)}else
if(cmd===\"cleanupThread\"){cleanupThread(d[\"thread\"])}else
if(cmd===\"killThread\"){killThread(d[\"thread\"])}else
if(cmd===\"cancelThread\"){cancelThread(d[\"thread\"])}else
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if(cmd===\"loaded\"){worker.loaded=true;if(onFinishedLoading)onFinishedLoading(worker);if(worker.runPthread){worker.runPthread();delete
worker.runPthread}}else if(cmd===\"print\"){out(\"Thread \"+d[\"threadId\"]+\": \"+d[\"text\"])}else if(cmd===\"printErr\"){err(\"Thread \"+d[\"threadId\"]+\": \"+d[\"text\"])}else if(cmd===\"alert\"){alert(\"Thread \"+d[\"threadId\"]+\": \"+d[\"text\"])}else if(cmd===\"exit\"){var detached=worker.pthread&&Atomics.load(GROWABLE_HEAP_U32(),worker.pthread.threadInfoStruct+64>>2);if(detached){PThread.returnWorkerToPool(worker)}}else if(cmd===\"exitProcess\"){try{exit(d[\"returnCode\"])}catch(e){if(e instanceof ExitStatus)return;throw e}}else if(cmd===\"cancelDone\"){PThread.returnWorkerToPool(worker)}else if(cmd===\"objectTransfer\"){PThread.receiveObjectTransfer(e.data)}else if(e.data.target===\"setimmediate\"){worker.postMessage(e.data)}else{err(\"worker sent an unknown command \"+cmd)}PThread.currentProxiedOperationCallerThread=undefined};worker.onerror=function(e){err(\"pthread sent an error! \"+e.filename+\":\"+e.lineno+\": \"+e.message)};if(ENVIRONMENT_IS_NODE){worker.on(\"message\",function(data){worker.onmessage({data:data})});worker.on(\"error\",function(data){worker.onerror(data)});worker.on(\"exit\",function(data){})}worker.postMessage({\"cmd\":\"load\",\"urlOrBlob\":Module[\"mainScriptUrlOrBlob\"]||_scriptDir,\"wasmMemory\":wasmMemory,\"wasmModule\":wasmModule})},allocateUnusedWorker:function(){var pthreadMainJs=locateFile(\"tfjs-backend-wasm-threaded-simd.worker.js\");PThread.unusedWorkers.push(new Worker(pthreadMainJs))},getNewWorker:function(){if(PThread.unusedWorkers.length==0){PThread.allocateUnusedWorker();PThread.loadWasmModuleToWorker(PThread.unusedWorkers[0])}if(PThread.unusedWorkers.length>0)return PThread.unusedWorkers.pop();else return null},busySpinWait:function(msecs){var t=performance.now()+msecs;while(performance.now()<t){}}};function establishStackSpace(stackTop,stackMax){_emscripten_stack_set_limits(stackTop,stackMax);stackRestore(stackTop)}Module[\"establishStackSpace\"]=establishStackSpace;function getNoExitRuntime(){return noExitRuntime}Module[\"getNoExitRuntime\"]=getNoExitRuntime;function invokeEntryPoint(ptr,arg){return wasmTable.get(ptr)(arg)}Module[\"invokeEntryPoint\"]=invokeEntryPoint;function ___assert_fail(condition,filename,line,func){abort(\"Assertion failed: \"+UTF8ToString(condition)+\", at: \"+[filename?UTF8ToString(filename):\"unknown filename\",line,func?UTF8ToString(func):\"unknown function\"])}function ___call_main(argc,argv){var returnCode=_main(argc,argv)}var _emscripten_get_now;if(ENVIRONMENT_IS_NODE){_emscripten_get_now=function(){var t=process[\"hrtime\"]();return t[0]*1e3+t[1]/1e6}}else if(ENVIRONMENT_IS_PTHREAD){_emscripten_get_now=function(){return performance.now()-Module[\"__performance_now_clock_drift\"]}}else if(typeof dateNow!==\"undefined\"){_emscripten_get_now=dateNow}else _emscripten_get_now=function(){return performance.now()};function setErrNo(value){GROWABLE_HEAP_I32()[___errno_location()>>2]=value;return value}function _atexit(func,arg){if(ENVIRONMENT_IS_PTHREAD)return _emscripten_proxy_to_main_thread_js(1,1,func,arg)}function __emscripten_notify_thread_queue(targetThreadId,mainThreadId){if(targetThreadId==mainThreadId){postMessage({\"cmd\":\"processQueuedMainThreadWork\"})}else if(ENVIRONMENT_IS_PTHREAD){postMessage({\"targetThread\":targetThreadId,\"cmd\":\"processThreadQueue\"})}else{var pthread=PThread.pthreads[targetThreadId];var worker=pthread&&pthread.worker;if(!worker){return}worker.postMessage({\"cmd\":\"processThreadQueue\"})}return 1}function _abort(){abort()}function _emscripten_asm_const_int(code,sigPtr,argbuf){var args=readAsmConstArgs(sigPtr,argbuf);return ASM_CONSTS[code].apply(null,args)}function _emscripten_conditional_set_current_thread_status(expectedStatus,newStatus){}function _emscripten_futex_wait(addr,val,timeout){if(addr<=0||addr>GROWABLE_HEAP_I8().length||addr&3!=0)return-28;if(!ENVIRONMENT_IS_WEB){var

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ret=Atomics.wait(GROWABLE_HEAP_I32(),addr>>2,val,timeout);if(ret===\"timed-out\")return-
73;if(ret===\"not-equal\")return-6;if(ret===\"ok\")return
 0;throw\"Atomics.wait returned an unexpected value
\"+ret}else{if(Atomics.load(GROWABLE_HEAP_I32(),addr>>2)!=val){return-6}var
tNow=performance.now();var tEnd=tNow+timeout;var
lastAddr=Atomics.exchange(GROWABLE_HEAP_I32(),__emscripten_main_thread_futex>>2,addr);while(1){tNo
w=performance.now();if(tNow>tEnd){lastAddr=Atomics.exchange(GROWABLE_HEAP_I32(),__emscripten_mai
n_thread_futex>>2,0);return-
73}lastAddr=Atomics.exchange(GROWABLE_HEAP_I32(),__emscripten_main_thread_futex>>2,0);if(lastAddr==
0){break}_emscripten_main_thread_process_queued_calls();if(Atomics.load(GROWABLE_HEAP_I32(),addr>>2)!
=val){return-
6}lastAddr=Atomics.exchange(GROWABLE_HEAP_I32(),__emscripten_main_thread_futex>>2,addr)}return
0}}function
_emscripten_memcpy_big(dest,src,num){GROWABLE_HEAP_U8().copyWithin(dest,src,src+num)}function
_emscripten_num_logical_cores(){if(ENVIRONMENT_IS_NODE)return require(\"os\").cpus().length;return
navigator[\"hardwareConcurrency\"]}function
 _emscripten_proxy_to_main_thread_js(index,sync){var numCallArgs=arguments.length-2;var
stack=stackSave();var serializedNumCallArgs=numCallArgs;var args=stackAlloc(serializedNumCallArgs*8);var
b=args>>3;for(var i=0;i<numCallArgs;i++){var arg=arguments[2+i];GROWABLE_HEAP_F64()[b+i]=arg}var
ret=_emscripten_run_in_main_runtime_thread_js(index,serializedNumCallArgs,args,sync);stackRestore(stack);retur
n ret}var _emscripten_receive_on_main_thread_js_callArgs=[];var readAsmConstArgsArray=[];function
readAsmConstArgs(sigPtr,buf){readAsmConstArgsArray.length=0;var
ch;buf>>=2;while(ch=GROWABLE_HEAP_U8()[sigPtr++]){var
double=ch<105;if(double&&buf&1)buf++;readAsmConstArgsArray.push(double?GROWABLE_HEAP_F64()[buf
++>>1]:GROWABLE_HEAP_I32()[buf]);++buf}return readAsmConstArgsArray}function
_emscripten_receive_on_main_thread_js(index,numCallArgs,args){_emscripten_receive_on_main_thread_js_callA
rgs.length=numCallArgs;var b=args>>3;for(var
i=0;i<numCallArgs;i++){_emscripten_receive_on_main_thread_js_callArgs[i]=GROWABLE_HEAP_F64()[b+i]}v
ar
 isEmAsmConst=index<0;var func=!isEmAsmConst?proxiedFunctionTable[index]:ASM_CONSTS[-index-
1];return func.apply(null,_emscripten_receive_on_main_thread_js_callArgs)}function
_emscripten_get_heap_size(){return GROWABLE_HEAP_U8().length}function
emscripten_realloc_buffer(size){try{wasmMemory.grow(size-
buffer.byteLength+65535>>>16);updateGlobalBufferAndViews(wasmMemory.buffer);return
1}catch(e){}}function _emscripten_resize_heap(requestedSize){var
oldSize=_emscripten_get_heap_size();if(requestedSize<=oldSize){return false}var
maxHeapSize=2147483648;if(requestedSize>maxHeapSize){return false}for(var
cutDown=1;cutDown<=4;cutDown*=2){var
overGrownHeapSize=oldSize*(1+.2/cutDown);overGrownHeapSize=Math.min(overGrownHeapSize,requestedSize
+100663296);var
newSize=Math.min(maxHeapSize,alignUp(Math.max(requestedSize,overGrownHeapSize),65536));var
replacement=emscripten_realloc_buffer(newSize);if(replacement){return true}}return false}var
JSEvents={inEventHandler:0,removeAllEventListeners:function(){for(var
 i=JSEvents.eventHandlers.length-1;i>=0;--
i){JSEvents._removeHandler(i)}JSEvents.eventHandlers=[];JSEvents.deferredCalls=[]},registerRemoveEventListen
ers:function(){if(!JSEvents.removeEventListenersRegistered){__ATEXIT__.push(JSEvents.removeAllEventListene
rs);JSEvents.removeEventListenersRegistered=true}},deferredCalls:[],deferCall:function(targetFunction,precedence
,argsList){function arraysHaveEqualContent(arrA,arrB){if(arrA.length!=arrB.length)return false;for(var i in
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arrA){if(arrA[i]!=arrB[i])return false}return true}for(var i in JSEvents.deferredCalls){var call=JSEvents.deferredCalls[i];if(call.targetFunction==targetFunction&&arraysHaveEqualContent(call.argsList,argsList)){return}}JSEvents.deferredCalls.push({targetFunction:targetFunction,precedence:precedence,argsList:argsList});JSEvents.deferredCalls.sort(function(x,y){return x.precedence<y.precedence})},removeDeferredCalls:function(targetFunction){for(var i=0;i<JSEvents.deferredCalls.length;++i){if(JSEvents.deferredCalls[i].targetFunction==targetFunction){JSEvents.deferredCalls.splice(i,1);--i}}},canPerformEventHandlerRequests:function(){return JSEvents.inEventHandler&&JSEvents.currentEventHandler.allowsDeferredCalls},runDeferredCalls:function(){if(!JSEvents.canPerformEventHandlerRequests()){return}for(var i=0;i<JSEvents.deferredCalls.length;++i){var call=JSEvents.deferredCalls[i];JSEvents.deferredCalls.splice(i,1);--i;call.targetFunction.apply(null,call.argsList)}},eventHandlers:[],removeAllHandlersOnTarget:function(target,eventTypeString){for(var i=0;i<JSEvents.eventHandlers.length;++i){if(JSEvents.eventHandlers[i].target==target&&(!eventTypeString||eventTypeString==JSEvents.eventHandlers[i].eventTypeString)){JSEvents._removeHandler(i--)}}},_removeHandler:function(i){var h=JSEvents.eventHandlers[i];h.target.removeEventListener(h.eventTypeString,h.eventListenerFunc,h.useCapture);JSEvents.eventHandlers.splice(i,1)},registerOrRemoveHandler:function(eventHandler){var jsEventHandler=function jsEventHandler(event){++JSEvents.inEventHandler;JSEvents.currentEventHandler=eventHandler;JSEvents.runDeferredCalls();eventHandler.handlerFunc(event);JSEvents.runDeferredCalls();--JSEvents.inEventHandler};if(eventHandler.callbackfunc){eventHandler.eventListenerFunc=jsEventHandler;eventHandler.target.addEventListener(eventHandler.eventTypeString,jsEventHandler,eventHandler.useCapture);JSEvents.eventHandlers.push(eventHandler);JSEvents.registerRemoveEventListeners()}else{for(var i=0;i<JSEvents.eventHandlers.length;++i){if(JSEvents.eventHandlers[i].target==eventHandler.target&&JSEvents.eventHandlers[i].eventTypeString==eventHandler.eventTypeString){JSEvents._removeHandler(i--)}}}},queueEventHandlerOnThread_iiii:function(targetThread,eventHandlerFunc,eventTypeId,eventData,userData){var stackTop=stackSave();var varargs=stackAlloc(12);GROWABLE_HEAP_I32()[varargs>>2]=eventTypeId;GROWABLE_HEAP_I32()[varargs+4>>2]=eventData;GROWABLE_HEAP_I32()[varargs+8>>2]=userData;__emscripten_call_on_thread(0,targetThread,637534208,eventHandlerFunc,eventData,varargs);stackRestore(stackTop)},getTargetThreadForEventCallback:function(targetThread){switch(targetThread){case 1:return 0;case 2:return PThread.currentProxiedOperationCallerThread;default:return targetThread}},getNodeNameForTarget:function(target){if(!target)return\"\";if(target==window)return\"#window\";if(target==screen)return\"#screen\";return target&&target.nodeName?target.nodeName:\"\"},fullscreenEnabled:function(){return document.fullscreenEnabled||document.webkitFullscreenEnabled}};function stringToNewUTF8(jsString){var length=lengthBytesUTF8(jsString)+1;var cString=_malloc(length);stringToUTF8(jsString,cString,length);return cString}function _emscripten_set_offscreencanvas_size_on_target_thread_js(targetThread,targetCanvas,width,height){var stackTop=stackSave();var varargs=stackAlloc(12);var targetCanvasPtr=0;if(targetCanvas){targetCanvasPtr=stringToNewUTF8(targetCanvas)}GROWABLE_HEAP_I32()[varargs>>2]=targetCanvasPtr;GROWABLE_HEAP_I32()[varargs+4>>2]=width;GROWABLE_HEAP_I32()[varargs+8>>2]=height;__emscripten_call_on_thread(0,targetThread,657457152,0,targetCanvasPtr,varargs);stackRestore(stackTop)}function _emscripten_set_offscreencanvas_size_on_target_thread(targetThread,targetCanvas,width,height){targetCanvas=targetCanvas?UTF8ToString(targetCanvas):\"\";_emscripten_set_offscreencanvas_size_on_target_thread_js(targetThread,targetCanvas,width,height)}function maybeCStringToJsString(cString){return cString>2?UTF8ToString(cString):cString}var specialHTMLTargets=[0,typeof

document!==\"undefined\"?document:0,typeof window!==\"undefined\"?window:0];function findEventTarget(target){target=maybeCStringToJsString(target);var domElement=specialHTMLTargets[target]||(typeof document!==\"undefined\"?document.querySelector(target):undefined);return domElement}function findCanvasEventTarget(target){return findEventTarget(target)}function _emscripten_set_canvas_element_size_calling_thread(target,width,height){var canvas=findCanvasEventTarget(target);if(!canvas)return-4;if(canvas.canvasSharedPtr){GROWABLE_HEAP_I32()[canvas.canvasSharedPtr>>2]=width;GROWABLE_HEAP_I32()[canvas.canvasSharedPtr+4>>2]=height}if(canvas.offscreenCanvas||!canvas.controlTransferredOffscreen){if(canvas.offscreenCanvas)canvas=canvas.offscreenCanvas;var autoResizeViewport=false;if(canvas.GLctxObject&&canvas.GLctxObject.GLctx){var prevViewport=canvas.GLctxObject.GLctx.getParameter(2978);autoResizeViewport=prevViewport[0]===0&&prevViewport[1]===0&&prevViewport[2]===canvas.width&&prevViewport[3]===canvas.height}canvas.width=width;canvas.height=height;if(autoResizeViewport){canvas.GLctxObject.GLctx.viewport(0,0,width,height)}}else if(canvas.canvasSharedPtr){var targetThread=GROWABLE_HEAP_I32()[canvas.canvasSharedPtr+8>>2];_emscripten_set_offscreencanvas_size_on_target_thread(targetThread,target,width,height);return 1}else{return-4}return 0}function _emscripten_set_canvas_element_size_main_thread(target,width,height){if(ENVIRONMENT_IS_PTHREAD)return _emscripten_proxy_to_main_thread_js(2,1,target,width,height);return _emscripten_set_canvas_element_size_calling_thread(target,width,height)}function _emscripten_set_canvas_element_size(target,width,height){var canvas=findCanvasEventTarget(target);if(canvas){return _emscripten_set_canvas_element_size_calling_thread(target,width,height)}else{return _emscripten_set_canvas_element_size_main_thread(target,width,height)}}function _emscripten_set_current_thread_status(newStatus){}function _emscripten_set_thread_name(threadId,name){}function __webgl_enable_ANGLE_instanced_arrays(ctx){var ext=ctx.getExtension(\"ANGLE_instanced_arrays\");if(ext){ctx[\"vertexAttribDivisor\"]=function(index,divisor){ext[\"vertexAttribDivisorANGLE\"](index,divisor)};ctx[\"drawArraysInstanced\"]=function(mode,first,count,primcount){ext[\"drawArraysInstancedANGLE\"](mode,first,count,primcount)};ctx[\"drawElementsInstanced\"]=function(mode,count,type,indices,primcount){ext[\"drawElementsInstancedANGLE\"](mode,count,type,indices,primcount)};return 1}}function __webgl_enable_OES_vertex_array_object(ctx){var ext=ctx.getExtension(\"OES_vertex_array_object\");if(ext){ctx[\"createVertexArray\"]=function(){return ext[\"createVertexArrayOES\"]()};ctx[\"deleteVertexArray\"]=function(vao){ext[\"deleteVertexArrayOES\"](vao)};ctx[\"bindVertexArray\"]=function(vao){ext[\"bindVertexArrayOES\"](vao)};ctx[\"isVertexArray\"]=function(vao){return ext[\"isVertexArrayOES\"](vao)};return 1}}function __webgl_enable_WEBGL_draw_buffers(ctx){var ext=ctx.getExtension(\"WEBGL_draw_buffers\");if(ext){ctx[\"drawBuffers\"]=function(n,bufs){ext[\"drawBuffersWEBGL\"](n,bufs)};return 1}}function __webgl_enable_WEBGL_multi_draw(ctx){return!!(ctx.multiDrawWebgl=ctx.getExtension(\"WEBGL_multi_draw\"))}var GL={counter:1,buffers:[],programs:[],framebuffers:[],renderbuffers:[],textures:[],uniforms:[],shaders:[],vaos:[],contexts:{},offscreenCanvases:{},timerQueriesEXT:[],programInfos:{},stringCache:{},unpackAlignment:4,recordError:function recordError(errorCode){if(!GL.lastError){GL.lastError=errorCode}},getNewId:function(table){var ret=GL.counter++;for(var i=table.length;i<ret;i++){table[i]=null}return ret},getSource:function(shader,count,string,length){var source=\"\";for(var i=0;i<count;++i){var len=length?GROWABLE_HEAP_I32()[length+i*4>>2]:-

1;source+=UTF8ToString(GROWABLE_HEAP_I32()[string+i*4>>2],len<0?undefined:len)}return source},createContext:function(canvas,webGLContextAttributes){var ctx=canvas.getContext(\"webgl\",webGLContextAttributes);if(!ctx)return 0;var handle=GL.registerContext(ctx,webGLContextAttributes);return handle},registerContext:function(ctx,webGLContextAttributes){var handle=_malloc(8);GROWABLE_HEAP_I32()[handle+4>>2]=_pthread_self();var context={handle:handle,attributes:webGLContextAttributes,version:webGLContextAttributes.majorVersion,GLctx:ctx};if(ctx.canvas)ctx.canvas.GLctxObject=context;GL.contexts[handle]=context;if(typeof webGLContextAttributes.enableExtensionsByDefault===\"undefined\"||webGLContextAttributes.enableExtensionsByDefault){GL.initExtensions(context)}return handle},makeContextCurrent:function(contextHandle){GL.currentContext=GL.contexts[contextHandle];Module.ctx=GLctx=GL.currentContext&&GL.currentContext.GLctx;return!(contextHandle&&!GLctx)},getContext:function(contextHandle){return GL.contexts[contextHandle]},deleteContext:function(contextHandle){if(GL.currentContext===GL.contexts[contextHandle])GL.currentContext=null;if(typeof JSEvents===\"object\")JSEvents.removeAllHandlersOnTarget(GL.contexts[contextHandle].GLctx.canvas);if(GL.contexts[contextHandle]&&GL.contexts[contextHandle].GLctx.canvas)GL.contexts[contextHandle].GLctx.canvas.GLctxObject=undefined;_free(GL.contexts[contextHandle].handle);GL.contexts[contextHandle]=null},initExtensions:function(context){if(!context)context=GL.currentContext;if(context.initExtensionsDone)return;context.initExtensionsDone=true;var GLctx=context.GLctx;__webgl_enable_ANGLE_instanced_arrays(GLctx);__webgl_enable_OES_vertex_array_object(GLctx);__webgl_enable_WEBGL_draw_buffers(GLctx);GLctx.disjointTimerQueryExt=GLctx.getExtension(\"EXT_disjoint_timer_query\");__webgl_enable_WEBGL_multi_draw(GLctx);var exts=GLctx.getSupportedExtensions()||[];exts.forEach(function(ext){if(ext.indexOf(\"lose_context\")<0&&ext.indexOf(\"debug\")<0){GLctx.getExtension(ext)}})},populateUniformTable:function(program){var p=GL.programs[program];var ptable=GL.programInfos[program]={uniforms:{},maxUniformLength:0,maxAttributeLength:-1,maxUniformBlockNameLength:-1};var utable=ptable.uniforms;var numUniforms=GLctx.getProgramParameter(p,35718);for(var i=0;i<numUniforms;++i){var u=GLctx.getActiveUniform(p,i);var name=u.name;ptable.maxUniformLength=Math.max(ptable.maxUniformLength,name.length+1);if(name.slice(-1)==\"]\"){name=name.slice(0,name.lastIndexOf(\"[\"))}var loc=GLctx.getUniformLocation(p,name);if(loc){var id=GL.getNewId(GL.uniforms);utable[name]=[u.size,id];GL.uniforms[id]=loc;for(var j=1;j<u.size;++j){var n=name+\"[\"+j+\"]\";loc=GLctx.getUniformLocation(p,n);id=GL.getNewId(GL.uniforms);GL.uniforms[id]=loc}}}}};var __emscripten_webgl_power_preferences=[\"default\",\"low-power\",\"high-performance\"];function _emscripten_webgl_do_create_context(target,attributes){var a=attributes>>2;var powerPreference=GROWABLE_HEAP_I32()[a+(24>>2)];var contextAttributes={\"alpha\":!!GROWABLE_HEAP_I32()[a+(0>>2)],\"depth\":!!GROWABLE_HEAP_I32()[a+(4>>2)],\"stencil\":!!GROWABLE_HEAP_I32()[a+(8>>2)],\"antialias\":!!GROWABLE_HEAP_I32()[a+(12>>2)],\"premultipliedAlpha\":!!GROWABLE_HEAP_I32()[a+(16>>2)],\"preserveDrawingBuffer\":!!GROWABLE_HEAP_I32()[a+(20>>2)],\"powerPreference\":__emscripten_webgl_power_preferences[powerPreference],\"failIfMajorPerformanceCaveat\":!!GROWABLE_HEAP_I32()[a+(28>>2)],majorVersion:GROWABLE_HEAP_I32()[a+(32>>2)],minorVersion:GROWABLE_HEAP_I32()[a+(36>>2)],enableExtensionsByDefault:GROWABLE_HEAP_I32()[a+(40>>2)],explicitSwapControl:GROWABLE_HEAP_I32()[a+(44>>2)],proxyContextToMainThread:GROWABLE_HEAP_I32()[a+(48>>2)],renderViaOffscreenBackBuffer:GROWABLE_HEAP_I32()[a+(52>>2)]};var canvas=findCanvasEventTarget(target);if(!canvas){return 0}if(contextAttributes.explicitSwapControl){return 0}var contextHandle=GL.createContext(canvas,contextAttributes);return contextHandle}function

_emscripten_webgl_create_context(a0,a1){return _emscripten_webgl_do_create_context(a0,a1)}var SYSCALLS={mappings:{},buffers:[null,[],[]],printChar:function(stream,curr){var buffer=SYSCALLS.buffers[stream];if(curr===0||curr===10){(stream===1?out:err)(UTF8ArrayToString(buffer,0));buffer.length=0}else{buffer.push(curr)}},varargs:undefined,get:function(){SYSCALLS.varargs+=4;var ret=GROWABLE_HEAP_I32()[SYSCALLS.varargs-4>>2];return ret},getStr:function(ptr){var ret=UTF8ToString(ptr);return ret},get64:function(low,high){return low}};function _fd_close(fd){if(ENVIRONMENT_IS_PTHREAD)return _emscripten_proxy_to_main_thread_js(3,1,fd);return 0}function _fd_seek(fd,offset_low,offset_high,whence,newOffset){if(ENVIRONMENT_IS_PTHREAD)return _emscripten_proxy_to_main_thread_js(4,1,fd,offset_low,offset_high,whence,newOffset)}function _fd_write(fd,iov,iovcnt,pnum){if(ENVIRONMENT_IS_PTHREAD)return _emscripten_proxy_to_main_thread_js(5,1,fd,iov,iovcnt,pnum);var num=0;for(var i=0;i<iovcnt;i++){var ptr=GROWABLE_HEAP_I32()[iov+i*8>>2];var len=GROWABLE_HEAP_I32()[iov+(i*8+4)>>2];for(var j=0;j<len;j++){SYSCALLS.printChar(fd,GROWABLE_HEAP_U8()[ptr+j])}num+=len}GROWABLE_HEAP_I32()[pnum>>2]=num;return 0}function _pthread_cleanup_pop(execute){var routine=PThread.threadExitHandlers.pop();if(execute)routine()}function _pthread_cleanup_push(routine,arg){PThread.threadExitHandlers.push(function(){wasmTable.get(routine)(arg)})}function spawnThread(threadParams){if(ENVIRONMENT_IS_PTHREAD)throw\"Internal Error! spawnThread() can only ever be called from main application thread!\";var worker=PThread.getNewWorker();if(worker.pthread!==undefined)throw\"Internal error!\";if(!threadParams.pthread_ptr)throw\"Internal error, no pthread ptr!\";PThread.runningWorkers.push(worker);var tlsMemory=_malloc(128*4);for(var i=0;i<128;++i){GROWABLE_HEAP_I32()[tlsMemory+i*4>>2]=0}var stackHigh=threadParams.stackBase+threadParams.stackSize;var pthread=PThread.pthreads[threadParams.pthread_ptr]={worker:worker,stackBase:threadParams.stackBase,stackSize:threadParams.stackSize,allocatedOwnStack:threadParams.allocatedOwnStack,threadInfoStruct:threadParams.pthread_ptr};var tis=pthread.threadInfoStruct>>2;Atomics.store(GROWABLE_HEAP_U32(),tis+(64>>2),threadParams.detached);Atomics.store(GROWABLE_HEAP_U32(),tis+(100>>2),tlsMemory);Atomics.store(GROWABLE_HEAP_U32(),tis+(40>>2),pthread.threadInfoStruct);Atomics.store(GROWABLE_HEAP_U32(),tis+(80>>2),threadParams.stackSize);Atomics.store(GROWABLE_HEAP_U32(),tis+(76>>2),stackHigh);Atomics.store(GROWABLE_HEAP_U32(),tis+(104>>2),threadParams.stackSize);Atomics.store(GROWABLE_HEAP_U32(),tis+(104+8>>2),stackHigh);Atomics.store(GROWABLE_HEAP_U32(),tis+(104+12>>2),threadParams.detached);var global_libc=_emscripten_get_global_libc();var global_locale=global_libc+40;Atomics.store(GROWABLE_HEAP_U32(),tis+(172>>2),global_locale);worker.pthread=pthread;var msg={\"cmd\":\"run\",\"start_routine\":threadParams.startRoutine,\"arg\":threadParams.arg,\"threadInfoStruct\":threadParams.pthread_ptr,\"stackBase\":threadParams.stackBase,\"stackSize\":threadParams.stackSize};worker.runPthread=function(){msg.time=performance.now();worker.postMessage(msg,threadParams.transferList)};if(worker.loaded){worker.runPthread();delete worker.runPthread}}function _pthread_create(pthread_ptr,attr,start_routine,arg){if(typeof SharedArrayBuffer===\"undefined\"){err(\"Current environment does not support SharedArrayBuffer, pthreads are not available!\");return 6}if(!pthread_ptr){err(\"pthread_create called with a null thread pointer!\");return 28}var transferList=[];var error=0;if(ENVIRONMENT_IS_PTHREAD&&(transferList.length===0||error)){return _emscripten_sync_run_in_main_thread_4(687865856,pthread_ptr,attr,start_routine,arg)}if(error)return error;var stackSize=0;var stackBase=0;var detached=0;if(attr&&attr!=-1){stackSize=GROWABLE_HEAP_I32()[attr>>2];stackSize+=81920;stackBase=GROWABLE_HEAP_I32()[attr+8>>2];detached=GROWABLE_HEAP_I32()[attr+12>>2]!==0}else{stackSize=2097152}var allocatedOwnStack=stackBase==0;if(allocatedOwnStack){stackBase=_memalign(16,stackSize)}else{stackBase-

=stackSize;assert(stackBase>0)}var threadInfoStruct=_malloc(228);for(var i=0;i<228>>2;++i)GROWABLE_HEAP_U32()[(threadInfoStruct>>2)+i]=0;GROWABLE_HEAP_I32()[pthread_ptr>>2]=threadInfoStruct;GROWABLE_HEAP_I32()[threadInfoStruct+12>>2]=threadInfoStruct;var headPtr=threadInfoStruct+152;GROWABLE_HEAP_I32()[headPtr>>2]=headPtr;var threadParams={stackBase:stackBase,stackSize:stackSize,allocatedOwnStack:allocatedOwnStack,detached:detached,startRoutine:start_routine,pthread_ptr:threadInfoStruct,arg:arg,transferList:transferList};if(ENVIRONMENT_IS_PTHREAD){threadParams.cmd=\"spawnThread\";postMessage(threadParams,transferList)}else{spawnThread(threadParams)}return 0}function __pthread_testcancel_js(){if(!ENVIRONMENT_IS_PTHREAD)return;var tb=_pthread_self();if(!tb)return;var cancelDisabled=Atomics.load(GROWABLE_HEAP_U32(),tb+56>>2);if(cancelDisabled)return;var canceled=Atomics.load(GROWABLE_HEAP_U32(),tb+0>>2);if(canceled==2)throw\"Canceled!\"}function _emscripten_check_blocking_allowed(){if(ENVIRONMENT_IS_NODE)return;if(ENVIRONMENT_IS_WORKER)return;warnOnce(\"Blocking on the main thread is very dangerous, see https://emscripten.org/docs/porting/pthreads.html#blocking-on-the-main-browser-thread\")}function __emscripten_do_pthread_join(thread,status,block){if(!thread){err(\"pthread_join attempted on a null thread pointer!\");return ERRNO_CODES.ESRCH}if(ENVIRONMENT_IS_PTHREAD&&_pthread_self()==thread){err(\"PThread \"+thread+\" is attempting to join to itself!\");return ERRNO_CODES.EDEADLK}else if(!ENVIRONMENT_IS_PTHREAD&&_emscripten_main_browser_thread_id()==thread){err(\"Main thread \"+thread+\" is attempting to join to itself!\");return ERRNO_CODES.EDEADLK}var self=GROWABLE_HEAP_I32()[thread+12>>2];if(self!==thread){err(\"pthread_join attempted on thread \"+thread+\", which does not point to a valid thread, or does not exist anymore!\");return ERRNO_CODES.ESRCH}var detached=Atomics.load(GROWABLE_HEAP_U32(),thread+64>>2);if(detached){err(\"Attempted to join thread \"+thread+\", which was already detached!\");return ERRNO_CODES.EINVAL}if(block){_emscripten_check_blocking_allowed()}for(;;){var threadStatus=Atomics.load(GROWABLE_HEAP_U32(),thread+0>>2);if(threadStatus==1){var threadExitCode=Atomics.load(GROWABLE_HEAP_U32(),thread+4>>2);if(status)GROWABLE_HEAP_I32()[status>>2]=threadExitCode;Atomics.store(GROWABLE_HEAP_U32(),thread+64>>2,1);if(!ENVIRONMENT_IS_PTHREAD)cleanupThread(thread);else postMessage({\"cmd\":\"cleanupThread\",\"thread\":thread});return 0}if(!block){return ERRNO_CODES.EBUSY}__pthread_testcancel_js();if(!ENVIRONMENT_IS_PTHREAD)_emscripten_main_thread_process_queued_calls();_emscripten_futex_wait(thread+0,threadStatus,ENVIRONMENT_IS_PTHREAD?100:1)}}function _pthread_join(thread,status){return __emscripten_do_pthread_join(thread,status,true)}function _sysconf(name){if(ENVIRONMENT_IS_PTHREAD)return _emscripten_proxy_to_main_thread_js(6,1,name);switch(name){case 30:return 16384;case 85:var maxHeapSize=2147483648;return maxHeapSize/16384;case 132:case 133:case 12:case 137:case 138:case 15:case 235:case 16:case 17:case 18:case 19:case 20:case 149:case 13:case 10:case 236:case 153:case 9:case 21:case 22:case 159:case 154:case 14:case 77:case 78:case 139:case 82:case 68:case 67:case 164:case 11:case 29:case 47:case 48:case 95:case 52:case 51:case 46:return 200809;case 27:case 246:case 127:case 128:case 23:case 24:case 160:case 161:case 181:case 182:case 242:case 183:case 184:case 243:case 244:case 245:case 165:case 178:case 179:case 49:case 50:case 168:case 169:case 175:case 170:case 171:case 172:case 97:case 76:case 32:case 173:case 35:case 80:case 81:case 79:return-1;case 176:case 177:case 7:case 155:case 8:case 157:case 125:case 126:case 92:case 93:case 129:case 130:case 131:case 94:case 91:return 1;case 74:case 60:case 69:case 70:case 4:return 1024;case 31:case 42:case 72:return 32;case 87:case 26:case 33:return 2147483647;case 34:case 1:return 47839;case 38:case 36:return 99;case 43:case 37:return 2048;case 0:return 2097152;case 3:return

65536;case 28:return 32768;case 44:return 32767;case 75:return 16384;case 39:return 1e3;case 89:return 700;case 71:return 256;case 40:return 255;case 2:return 100;case 180:return 64;case 25:return 20;case 5:return 16;case 6:return 6;case 73:return 4;case 84:{if(typeof navigator===\"object\")return navigator[\"hardwareConcurrency\"]||1;return 1}}setErrNo(28);return-1}if(!ENVIRONMENT_IS_PTHREAD)PThread.initMainThreadBlock();var GLctx;var proxiedFunctionTable=[null,_atexit,_emscripten_set_canvas_element_size_main_thread,_fd_close,_fd_seek,_fd_write,_sysconf];var asmLibraryArg={\"e\":___assert_fail,\"r\":___call_main,\"x\":__emscripten_notify_thread_queue,\"b\":_abort,\"y\":_emscripten_asm_const_int,\"j\":_emscripten_conditional_set_current_thread_status,\"d\":_emscripten_futex_wait,\"c\":_emscripten_futex_wake,\"f\":_emscripten_get_now,\"p\":_emscripten_memcpy_big,\"A\":_emscripten_num_logical_cores,\"u\":_emscripten_receive_on_main_thread_js,\"q\":_emscripten_resize_heap,\"v\":_emscripten_set_canvas_element_size,\"i\":_emscripten_set_current_thread_status,\"s\":_emscripten_set_thread_name,\"w\":_emscripten_webgl_create_context,\"l\":_fd_close,\"n\":_fd_seek,\"g\":_fd_write,\"o\":initPthreadsJS,\"a\":wasmMemory||Module[\"wasmMemory\"],\"z\":_pthread_cleanup_pop,\"k\":_pthread_cleanup_push,\"h\":_pthread_create,\"m\":_pthread_join,\"t\":_sysconf};var asm=createWasm();var ___wasm_call_ctors=Module[\"___wasm_call_ctors\"]=function(){return(___wasm_call_ctors=Module[\"___wasm_call_ctors\"]=Module[\"asm\"][\"B\"]).apply(null,arguments)};var _init=Module[\"_init\"]=function(){return(_init=Module[\"_init\"]=Module[\"asm\"][\"C\"]).apply(null,arguments)};var _init_with_threads_count=Module[\"_init_with_threads_count\"]=function(){return(_init_with_threads_count=Module[\"_init_with_threads_count\"]=Module[\"asm\"][\"D\"]).apply(null,arguments)};var _get_threads_count=Module[\"_get_threads_count\"]=function(){return(_get_threads_count=Module[\"_get_threads_count\"]=Module[\"asm\"][\"E\"]).apply(null,arguments)};var _register_tensor=Module[\"_register_tensor\"]=function(){return(_register_tensor=Module[\"_register_tensor\"]=Module[\"asm\"][\"F\"]).apply(null,arguments)};var _dispose_data=Module[\"_dispose_data\"]=function(){return(_dispose_data=Module[\"_dispose_data\"]=Module[\"asm\"][\"G\"]).apply(null,arguments)};var _dispose=Module[\"_dispose\"]=function(){return(_dispose=Module[\"_dispose\"]=Module[\"asm\"][\"H\"]).apply(null,arguments)};var _Abs=Module[\"_Abs\"]=function(){return(_Abs=Module[\"_Abs\"]=Module[\"asm\"][\"J\"]).apply(null,arguments)};var _Add=Module[\"_Add\"]=function(){return(_Add=Module[\"_Add\"]=Module[\"asm\"][\"K\"]).apply(null,arguments)};var _AddN=Module[\"_AddN\"]=function(){return(_AddN=Module[\"_AddN\"]=Module[\"asm\"][\"L\"]).apply(null,arguments)};var _All=Module[\"_All\"]=function(){return(_All=Module[\"_All\"]=Module[\"asm\"][\"M\"]).apply(null,arguments)};var _Any=Module[\"_Any\"]=function(){return(_Any=Module[\"_Any\"]=Module[\"asm\"][\"N\"]).apply(null,arguments)};var _ArgMax=Module[\"_ArgMax\"]=function(){return(_ArgMax=Module[\"_ArgMax\"]=Module[\"asm\"][\"O\"]).apply(null,arguments)};var _AvgPool=Module[\"_AvgPool\"]=function(){return(_AvgPool=Module[\"_AvgPool\"]=Module[\"asm\"][\"P\"]).apply(null,arguments)};var _BatchMatMul=Module[\"_BatchMatMul\"]=function(){return(_BatchMatMul=Module[\"_BatchMatMul\"]=Module[\"asm\"][\"Q\"]).apply(null,arguments)};var _Ceil=Module[\"_Ceil\"]=function(){return(_Ceil=Module[\"_Ceil\"]=Module[\"asm\"][\"R\"]).apply(null,arguments)};var

_ClipByValue=Module[\"_ClipByValue\"]=function(){return(_ClipByValue=Module[\"_ClipByValue\"]=Module[\"asm\"][\"S\"]).apply(null,arguments)};var
_Conv2D=Module[\"_Conv2D\"]=function(){return(_Conv2D=Module[\"_Conv2D\"]=Module[\"asm\"][\"T\"]).apply(null,arguments)};var
_Conv2DBackpropInput=Module[\"_Conv2DBackpropInput\"]=function(){return(_Conv2DBackpropInput=Module[\"_Conv2DBackpropInput\"]=Module[\"asm\"][\"U\"]).apply(null,arguments)};var
_Cos=Module[\"_Cos\"]=function(){return(_Cos=Module[\"_Cos\"]=Module[\"asm\"][\"V\"]).apply(null,arguments)};var
_Cosh=Module[\"_Cosh\"]=function(){return(_Cosh=Module[\"_Cosh\"]=Module[\"asm\"][\"W\"]).apply(null,arguments)};var
_CropAndResize=Module[\"_CropAndResize\"]=function(){return(_CropAndResize=Module[\"_CropAndResize\"]=Module[\"asm\"][\"X\"]).apply(null,arguments)};var
_Cumsum=Module[\"_Cumsum\"]=function(){return(_Cumsum=Module[\"_Cumsum\"]=Module[\"asm\"][\"Y\"]).apply(null,arguments)};var
_DepthToSpace=Module[\"_DepthToSpace\"]=function(){return(_DepthToSpace=Module[\"_DepthToSpace\"]=Module[\"asm\"][\"Z\"]).apply(null,arguments)};var
_DepthwiseConv2dNative=Module[\"_DepthwiseConv2dNative\"]=function(){return(_DepthwiseConv2dNative=Module[\"_DepthwiseConv2dNative\"]=Module[\"asm\"][\"_\"]).apply(null,arguments)};var
_Elu=Module[\"_Elu\"]=function(){return(_Elu=Module[\"_Elu\"]=Module[\"asm\"][\"$\"]).apply(null,arguments)};var
_Equal=Module[\"_Equal\"]=function(){return(_Equal=Module[\"_Equal\"]=Module[\"asm\"][\"aa\"]).apply(null,arguments)};var
_Exp=Module[\"_Exp\"]=function(){return(_Exp=Module[\"_Exp\"]=Module[\"asm\"][\"ba\"]).apply(null,arguments)};var
_FlipLeftRight=Module[\"_FlipLeftRight\"]=function(){return(_FlipLeftRight=Module[\"_FlipLeftRight\"]=Module[\"asm\"][\"ca\"]).apply(null,arguments)};var
_Floor=Module[\"_Floor\"]=function(){return(_Floor=Module[\"_Floor\"]=Module[\"asm\"][\"da\"]).apply(null,arguments)};var
_FloorDiv=Module[\"_FloorDiv\"]=function(){return(_FloorDiv=Module[\"_FloorDiv\"]=Module[\"asm\"][\"ea\"]).apply(null,arguments)};var
_FusedBatchNorm=Module[\"_FusedBatchNorm\"]=function(){return(_FusedBatchNorm=Module[\"_FusedBatchNorm\"]=Module[\"asm\"][\"fa\"]).apply(null,arguments)};var
_FusedConv2D=Module[\"_FusedConv2D\"]=function(){return(_FusedConv2D=Module[\"_FusedConv2D\"]=Module[\"asm\"][\"ga\"]).apply(null,arguments)};var
_FusedDepthwiseConv2D=Module[\"_FusedDepthwiseConv2D\"]=function(){return(_FusedDepthwiseConv2D=Module[\"_FusedDepthwiseConv2D\"]=Module[\"asm\"][\"ha\"]).apply(null,arguments)};var
_Gather=Module[\"_Gather\"]=function(){return(_Gather=Module[\"_Gather\"]=Module[\"asm\"][\"ia\"]).apply(null,arguments)};var
_GatherNd=Module[\"_GatherNd\"]=function(){return(_GatherNd=Module[\"_GatherNd\"]=Module[\"asm\"][\"ja\"]).apply(null,arguments)};var
_Greater=Module[\"_Greater\"]=function(){return(_Greater=Module[\"_Greater\"]=Module[\"asm\"][\"ka\"]).apply(null,arguments)};var
_GreaterEqual=Module[\"_GreaterEqual\"]=function(){return(_GreaterEqual=Module[\"_GreaterEqual\"]=Module[\"asm\"][\"la\"]).apply(null,arguments)};var
_LeakyRelu=Module[\"_LeakyRelu\"]=function(){return(_LeakyRelu=Module[\"_LeakyRelu\"]=Module[\"asm\"][\"ma\"]).apply(null,arguments)};var
_Less=Module[\"_Less\"]=function(){return(_Less=Module[\"_Less\"]=Module[\"asm\"][\"na\"]).apply(null,arguments)};var

_LessEqual=Module[\"_LessEqual\"]=function(){return(_LessEqual=Module[\"_LessEqual\"]=Module[\"asm\"][\"oa\"]).apply(null,arguments)};var
_Log=Module[\"_Log\"]=function(){return(_Log=Module[\"_Log\"]=Module[\"asm\"][\"pa\"]).apply(null,arguments)};var
_LogicalAnd=Module[\"_LogicalAnd\"]=function(){return(_LogicalAnd=Module[\"_LogicalAnd\"]=Module[\"asm\"][\"qa\"]).apply(null,arguments)};var
_Max=Module[\"_Max\"]=function(){return(_Max=Module[\"_Max\"]=Module[\"asm\"][\"ra\"]).apply(null,arguments)};var
_MaxPool=Module[\"_MaxPool\"]=function(){return(_MaxPool=Module[\"_MaxPool\"]=Module[\"asm\"][\"sa\"]).apply(null,arguments)};var
_Maximum=Module[\"_Maximum\"]=function(){return(_Maximum=Module[\"_Maximum\"]=Module[\"asm\"][\"ta\"]).apply(null,arguments)};var
_Mean=Module[\"_Mean\"]=function(){return(_Mean=Module[\"_Mean\"]=Module[\"asm\"][\"ua\"]).apply(null,arguments)};var
_Min=Module[\"_Min\"]=function(){return(_Min=Module[\"_Min\"]=Module[\"asm\"][\"va\"]).apply(null,arguments)};var
_Minimum=Module[\"_Minimum\"]=function(){return(_Minimum=Module[\"_Minimum\"]=Module[\"asm\"][\"wa\"]).apply(null,arguments)};var
_MirrorPad=Module[\"_MirrorPad\"]=function(){return(_MirrorPad=Module[\"_MirrorPad\"]=Module[\"asm\"][\"xa\"]).apply(null,arguments)};var
_Multiply=Module[\"_Multiply\"]=function(){return(_Multiply=Module[\"_Multiply\"]=Module[\"asm\"][\"ya\"]).apply(null,arguments)};var
_Neg=Module[\"_Neg\"]=function(){return(_Neg=Module[\"_Neg\"]=Module[\"asm\"][\"za\"]).apply(null,arguments)};var
_NonMaxSuppressionV3=Module[\"_NonMaxSuppressionV3\"]=function(){return(_NonMaxSuppressionV3=Module[\"_NonMaxSuppressionV3\"]=Module[\"asm\"][\"Aa\"]).apply(null,arguments)};var
_NonMaxSuppressionV4=Module[\"_NonMaxSuppressionV4\"]=function(){return(_NonMaxSuppressionV4=Module[\"_NonMaxSuppressionV4\"]=Module[\"asm\"][\"Ba\"]).apply(null,arguments)};var
_NonMaxSuppressionV5=Module[\"_NonMaxSuppressionV5\"]=function(){return(_NonMaxSuppressionV5=Module[\"_NonMaxSuppressionV5\"]=Module[\"asm\"][\"Ca\"]).apply(null,arguments)};var
_NotEqual=Module[\"_NotEqual\"]=function(){return(_NotEqual=Module[\"_NotEqual\"]=Module[\"asm\"][\"Da\"]).apply(null,arguments)};var
_OneHot=Module[\"_OneHot\"]=function(){return(_OneHot=Module[\"_OneHot\"]=Module[\"asm\"][\"Ea\"]).apply(null,arguments)};var
_PadV2=Module[\"_PadV2\"]=function(){return(_PadV2=Module[\"_PadV2\"]=Module[\"asm\"][\"Fa\"]).apply(null,arguments)};var
_Pow=Module[\"_Pow\"]=function(){return(_Pow=Module[\"_Pow\"]=Module[\"asm\"][\"Ga\"]).apply(null,arguments)};var
_Prelu=Module[\"_Prelu\"]=function(){return(_Prelu=Module[\"_Prelu\"]=Module[\"asm\"][\"Ha\"]).apply(null,arguments)};var
_Prod=Module[\"_Prod\"]=function(){return(_Prod=Module[\"_Prod\"]=Module[\"asm\"][\"Ia\"]).apply(null,arguments)};var
_RealDiv=Module[\"_RealDiv\"]=function(){return(_RealDiv=Module[\"_RealDiv\"]=Module[\"asm\"][\"Ja\"]).apply(null,arguments)};var
_Relu=Module[\"_Relu\"]=function(){return(_Relu=Module[\"_Relu\"]=Module[\"asm\"][\"Ka\"]).apply(null,arguments)};var
_Relu6=Module[\"_Relu6\"]=function(){return(_Relu6=Module[\"_Relu6\"]=Module[\"asm\"][\"La\"]).apply(null,arguments)};var

_ResizeBilinear=Module[\"_ResizeBilinear\"]=function(){return(_ResizeBilinear=Module[\"_ResizeBilinear\"]=Module[\"asm\"][\"Ma\"]).apply(null,arguments)};var
_Reverse=Module[\"_Reverse\"]=function(){return(_Reverse=Module[\"_Reverse\"]=Module[\"asm\"][\"Na\"]).apply(null,arguments)};var
_RotateWithOffset=Module[\"_RotateWithOffset\"]=function(){return(_RotateWithOffset=Module[\"_RotateWithOffset\"]=Module[\"asm\"][\"Oa\"]).apply(null,arguments)};var
_Round=Module[\"_Round\"]=function(){return(_Round=Module[\"_Round\"]=Module[\"asm\"][\"Pa\"]).apply(null,arguments)};var
_Rsqrt=Module[\"_Rsqrt\"]=function(){return(_Rsqrt=Module[\"_Rsqrt\"]=Module[\"asm\"][\"Qa\"]).apply(null,arguments)};var
_ScatterNd=Module[\"_ScatterNd\"]=function(){return(_ScatterNd=Module[\"_ScatterNd\"]=Module[\"asm\"][\"Ra\"]).apply(null,arguments)};var
_SelectV2=Module[\"_SelectV2\"]=function(){return(_SelectV2=Module[\"_SelectV2\"]=Module[\"asm\"][\"Sa\"]).apply(null,arguments)};var
_Sigmoid=Module[\"_Sigmoid\"]=function(){return(_Sigmoid=Module[\"_Sigmoid\"]=Module[\"asm\"][\"Ta\"]).apply(null,arguments)};var
_Sin=Module[\"_Sin\"]=function(){return(_Sin=Module[\"_Sin\"]=Module[\"asm\"][\"Ua\"]).apply(null,arguments)};var
_Softmax=Module[\"_Softmax\"]=function(){return(_Softmax=Module[\"_Softmax\"]=Module[\"asm\"][\"Va\"]).apply(null,arguments)};var
_Sqrt=Module[\"_Sqrt\"]=function(){return(_Sqrt=Module[\"_Sqrt\"]=Module[\"asm\"][\"Wa\"]).apply(null,arguments)};var
_Square=Module[\"_Square\"]=function(){return(_Square=Module[\"_Square\"]=Module[\"asm\"][\"Xa\"]).apply(null,arguments)};var
_SquaredDifference=Module[\"_SquaredDifference\"]=function(){return(_SquaredDifference=Module[\"_SquaredDifference\"]=Module[\"asm\"][\"Ya\"]).apply(null,arguments)};var
_Step=Module[\"_Step\"]=function(){return(_Step=Module[\"_Step\"]=Module[\"asm\"][\"Za\"]).apply(null,arguments)};var
_StridedSlice=Module[\"_StridedSlice\"]=function(){return(_StridedSlice=Module[\"_StridedSlice\"]=Module[\"asm\"][\"_a\"]).apply(null,arguments)};var
_Sub=Module[\"_Sub\"]=function(){return(_Sub=Module[\"_Sub\"]=Module[\"asm\"][\"$a\"]).apply(null,arguments)};var
_Sum=Module[\"_Sum\"]=function(){return(_Sum=Module[\"_Sum\"]=Module[\"asm\"][\"ab\"]).apply(null,arguments)};var
_Tan=Module[\"_Tan\"]=function(){return(_Tan=Module[\"_Tan\"]=Module[\"asm\"][\"bb\"]).apply(null,arguments)};var
_Tanh=Module[\"_Tanh\"]=function(){return(_Tanh=Module[\"_Tanh\"]=Module[\"asm\"][\"cb\"]).apply(null,arguments)};var
_Tile=Module[\"_Tile\"]=function(){return(_Tile=Module[\"_Tile\"]=Module[\"asm\"][\"db\"]).apply(null,arguments)};var
_TopK=Module[\"_TopK\"]=function(){return(_TopK=Module[\"_TopK\"]=Module[\"asm\"][\"eb\"]).apply(null,arguments)};var
_Transform=Module[\"_Transform\"]=function(){return(_Transform=Module[\"_Transform\"]=Module[\"asm\"][\"fb\"]).apply(null,arguments)};var
_Transpose=Module[\"_Transpose\"]=function(){return(_Transpose=Module[\"_Transpose\"]=Module[\"asm\"][\"gb\"]).apply(null,arguments)};var
__FusedMatMul=Module[\"__FusedMatMul\"]=function(){return(__FusedMatMul=Module[\"__FusedMatMul\"]=Module[\"asm\"][\"hb\"]).apply(null,arguments)};var

_malloc=Module[\"_malloc\"]=function(){return(_malloc=Module[\"_malloc\"]=Module[\"asm\"][\"ib\"]).apply(nul
l,arguments)};var
_free=Module[\"_free\"]=function(){return(_free=Module[\"_free\"]=Module[\"asm\"][\"jb\"]).apply(null,arguments
)};var
___errno_location=Module[\"___errno_location\"]=function(){return(___errno_location=Module[\"___errno_locati
on\"]=Module[\"asm\"][\"kb\"]).apply(null,arguments)};var
_emscripten_get_global_libc=Module[\"_emscripten_get_global_libc\"]=function(){return(_emscripten_get_global
_libc=Module[\"_emscripten_get_global_libc\"]=Module[\"asm\"][\"lb\"]).apply(null,arguments)};var
_pthread_self=Module[\"_pthread_self\"]=function(){return(_pthread_self=Module[\"_pthread_self\"]=Module[\"as
m\"][\"mb\"]).apply(null,arguments)};var
___pthread_tsd_run_dtors=Module[\"___pthread_tsd_run_dtors\"]=function(){return(___pthread_tsd_run_dtors=M
odule[\"___pthread_tsd_run_dtors\"]=Module[\"asm\"][\"nb\"]).apply(null,arguments)};var
_emscripten_main_thread_process_queued_calls=Module[\"_emscripten_main_thread_process_queued_calls\"]=fu
nction(){return(_emscripten_main_thread_process_queued_calls=Module[\"_emscripten_main_thread_process_que
ued_calls\"]=Module[\"asm\"][\"ob\"]).apply(null,arguments)};var
_emscripten_current_thread_process_queued_calls=Module[\"_emscripten_current_thread_process_queued_calls\"]
=function(){return(_emscripten_current_thread_process_queued_calls=Module[\"_emscripten_current_thread_proc
ess_queued_calls\"]=Module[\"asm\"][\"pb\"]).apply(null,arguments)};var
_emscripten_register_main_browser_thread_id=Module[\"_emscripten_register_main_browser_thread_id\"]=functi
on(){return(_emscripten_register_main_browser_thread_id=Module[\"_emscripten_register_main_browser_thread_
id\"]=Module[\"asm\"][\"qb\"]).apply(null,arguments)};var
_emscripten_main_browser_thread_id=Module[\"_emscripten_main_browser_thread_id\"]=function(){return(_ems
cripten_main_browser_thread_id=Module[\"_emscripten_main_browser_thread_id\"]=Module[\"asm\"][\"rb\"]).app
ly(null,arguments)};var
__emscripten_do_dispatch_to_thread=Module[\"__emscripten_do_dispatch_to_thread\"]=function(){return(__emsc
ripten_do_dispatch_to_thread=Module[\"__emscripten_do_dispatch_to_thread\"]=Module[\"asm\"][\"sb\"]).apply(n
ull,arguments)};var
_emscripten_sync_run_in_main_thread_4=Module[\"_emscripten_sync_run_in_main_thread_4\"]=function(){retur
n(_emscripten_sync_run_in_main_thread_4=Module[\"_emscripten_sync_run_in_main_thread_4\"]=Module[\"asm\
"][\"tb\"]).apply(null,arguments)};var
_emscripten_run_in_main_runtime_thread_js=Module[\"_emscripten_run_in_main_runtime_thread_js\"]=function(
){return(_emscripten_run_in_main_runtime_thread_js=Module[\"_emscripten_run_in_main_runtime_thread_js\"]=
Module[\"asm\"][\"ub\"]).apply(null,arguments)};var
__emscripten_call_on_thread=Module[\"__emscripten_call_on_thread\"]=function(){return(__emscripten_call_on_t
hread=Module[\"__emscripten_call_on_thread\"]=Module[\"asm\"][\"vb\"]).apply(null,arguments)};var
_emscripten_tls_init=Module[\"_emscripten_tls_init\"]=function(){return(_emscripten_tls_init=Module[\"_emscript
en_tls_init\"]=Module[\"asm\"][\"wb\"]).apply(null,arguments)};var
__emscripten_thread_init=Module[\"__emscripten_thread_init\"]=function(){return(__emscripten_thread_init=Mod
ule[\"__emscripten_thread_init\"]=Module[\"asm\"][\"xb\"]).apply(null,arguments)};var
stackSave=Module[\"stackSave\"]=function(){return(stackSave=Module[\"stackSave\"]=Module[\"asm\"][\"yb\"]).a
pply(null,arguments)};var
stackRestore=Module[\"stackRestore\"]=function(){return(stackRestore=Module[\"stackRestore\"]=Module[\"asm\"
][\"zb\"]).apply(null,arguments)};var
stackAlloc=Module[\"stackAlloc\"]=function(){return(stackAlloc=Module[\"stackAlloc\"]=Module[\"asm\"][\"Ab\"
]).apply(null,arguments)};var
_emscripten_stack_set_limits=Module[\"_emscripten_stack_set_limits\"]=function(){return(_emscripten_stack_set_
limits=Module[\"_emscripten_stack_set_limits\"]=Module[\"asm\"][\"Bb\"]).apply(null,arguments)};var
_memalign=Module[\"_memalign\"]=function(){return(_memalign=Module[\"_memalign\"]=Module[\"asm\"][\"Cb

\"]).apply(null,arguments)};var
__emscripten_allow_main_runtime_queued_calls=Module[\"__emscripten_allow_main_runtime_queued_calls\"]=10512;var
__emscripten_main_thread_futex=Module[\"__emscripten_main_thread_futex\"]=12148;Module[\"cwrap\"]=cwrap;Module[\"PThread\"]=PThread;Module[\"PThread\"]=PThread;Module[\"wasmMemory\"]=wasmMemory;Module[\"ExitStatus\"]=ExitStatus;var
calledRun;function ExitStatus(status){this.name=\"ExitStatus\";this.message=\"Program terminated with exit(\"+status+\")\";this.status=status}dependenciesFulfilled=function
runCaller(){if(!calledRun)run();if(!calledRun)dependenciesFulfilled=runCaller};function
run(args){args=args||arguments_;if(runDependencies>0){return}if(ENVIRONMENT_IS_PTHREAD){readyPromiseResolve(Module);initRuntime();postMessage({\"cmd\":\"loaded\"});return}preRun();if(runDependencies>0){return}function
doRun(){if(calledRun)return;calledRun=true;Module[\"calledRun\"]=true;if(ABORT)return;initRuntime();preMain();readyPromiseResolve(Module);if(Module[\"onRuntimeInitialized\"])Module[\"onRuntimeInitialized\"]();postRun()}if(Module[\"setStatus\"]){Module[\"setStatus\"](\"Running...\");setTimeout(function(){setTimeout(function(){Module[\"setStatus\"](\"\")},1);doRun()},1)}else{doRun()}}Module[\"run\"]=run;function
exit(status,implicit){if(implicit&&noExitRuntime&&status===0){return}if(!implicit){if(ENVIRONMENT_IS_PTHREAD){postMessage({\"cmd\":\"exitProcess\",\"returnCode\":status});throw
new
ExitStatus(status)}else{}}if(noExitRuntime){}else{PThread.terminateAllThreads();EXITSTATUS=status;exitRuntime();if(Module[\"onExit\"])Module[\"onExit\"](status);ABORT=true}quit_(status,new
ExitStatus(status))}if(Module[\"preInit\"]){if(typeof
Module[\"preInit\"]==\"function\")Module[\"preInit\"]=[Module[\"preInit\"]];while(Module[\"preInit\"].length>0){Module[\"preInit\"].pop()()}}if(ENVIRONMENT_IS_PTHREAD){noExitRuntime=false;PThread.initWorker()}run();\n\n\n return WasmBackendModuleThreadedSimd.ready\n}\n);\n})();\nif (typeof exports === 'object' && typeof module === 'object')\n module.exports = WasmBackendModuleThreadedSimd;\nelse if (typeof define === 'function' && define['amd'])\n define([], function() { return WasmBackendModuleThreadedSimd; });\nelse if (typeof exports === 'object')\n exports[\"WasmBackendModuleThreadedSimd\"]
= WasmBackendModuleThreadedSimd;\n","export const wasmWorkerContents = 'var Module={};function
threadPrintErr(){var text=Array.prototype.slice.call(arguments).join(\" \");console.error(text)}function
threadAlert(){var text=Array.prototype.slice.call(arguments).join(\"
\");postMessage({cmd:\"alert\",text:text,threadId:Module[\"_pthread_self\"]()})}var
err=threadPrintErr;this.alert=threadAlert;Module[\"instantiateWasm\"]=function(info,receiveInstance){var
instance=new
WebAssembly.Instance(Module[\"wasmModule\"],info);Module[\"wasmModule\"]=null;receiveInstance(instance);return instance.exports};function
moduleLoaded(){}this.onmessage=function(e){try{if(e.data.cmd===\"load\"){Module[\"wasmModule\"]=e.data.wasmModule;Module[\"wasmMemory\"]=e.data.wasmMemory;Module[\"buffer\"]=Module[\"wasmMemory\"].buffer;Module[\"ENVIRONMENT_IS_PTHREAD\"]=true;if(typeof
e.data.urlOrBlob===\"string\"){importScripts(e.data.urlOrBlob)}else{var
objectUrl=URL.createObjectURL(e.data.urlOrBlob);importScripts(objectUrl);URL.revokeObjectURL(objectUrl)}
WasmBackendModuleThreadedSimd(Module).then(function(instance){Module=instance;moduleLoaded()})}else
if(e.data.cmd===\"objectTransfer\"){Module[\"PThread\"].receiveObjectTransfer(e.data)}else
if(e.data.cmd===\"run\"){Module[\"__performance_now_clock_drift\"]=performance.now()-e.data.time;Module[\"__emscripten_thread_init\"](e.data.threadInfoStruct,0,0);var max=e.data.stackBase;var
top=e.data.stackBase+e.data.stackSize;Module[\"establishStackSpace\"](top,max);Module[\"_emscripten_tls_init\"]();Module[\"PThread\"].receiveObjectTransfer(e.data);Module[\"PThread\"].setThreadStatus(Module[\"_pthread_self\"](),1);try{var

result=Module[\"invokeEntryPoint\"](e.data.start_routine,e.data.arg);if(!Module[\"getNoExitRuntime\"]())Module[\"PThread\"].threadExit(result)}catch(ex){if(ex===\"Canceled!\"){Module[\"PThread\"].threadCancel()}else if(ex!=\"unwind\"){if(ex instanceof Module[\"ExitStatus\"]){if(Module[\"getNoExitRuntime\"]()){}else{Module[\"PThread\"].threadExit(ex.status)}}else{Module[\"PThread\"].threadExit(-2);throw ex}}}}else if(e.data.cmd===\"cancel\"){if(Module[\"_pthread_self\"]()){Module[\"PThread\"].threadCancel()}}else if(e.data.target===\"setimmediate\"){}else if(e.data.cmd===\"processThreadQueue\"){if(Module[\"_pthread_self\"]()){Module[\"_emscripten_current_thread_process_queued_calls\"]()}}else{err(\"worker.js received unknown command \"+e.data.cmd);err(e.data)}}catch(ex){err(\"worker.js onmessage() captured an uncaught exception: \"+ex);if(ex&&ex.stack)err(ex.stack);throw ex}};if(typeof process===\"object\"&&typeof process.versions===\"object\"&&typeof process.versions.node===\"string\"){self={location:{href:__filename}};var onmessage=this.onmessage;var nodeWorkerThreads=require(\"worker_threads\");global.Worker=nodeWorkerThreads.Worker;var parentPort=nodeWorkerThreads.parentPort;parentPort.on(\"message\",function(data){onmessage({data:data})});var nodeFS=require(\"fs\");var nodeRead=function(filename){return nodeFS.readFileSync(filename,\"utf8\")};function globalEval(x){global.require=require;global.Module=Module;eval.call(null,x)}importScripts=function(f){globalEval(nodeRead(f))};postMessage=function(msg){parentPort.postMessage(msg)};if(typeof performance===\"undefined\"){performance={now:function(){return Date.now()}}}';","\nvar WasmBackendModule = (function() {\n var _scriptDir = typeof document !== 'undefined' && document.currentScript ? document.currentScript.src : undefined;\n if (typeof __filename !== 'undefined') _scriptDir = _scriptDir || __filename;\n return (\nfunction(WasmBackendModule) {\n WasmBackendModule = WasmBackendModule || {};\n\nvar Module=typeof WasmBackendModule!==\"undefined\"?WasmBackendModule:{};var readyPromiseResolve,readyPromiseReject;Module[\"ready\"]=new Promise(function(resolve,reject){readyPromiseResolve=resolve;readyPromiseReject=reject});var moduleOverrides={};var key;for(key in Module){if(Module.hasOwnProperty(key)){moduleOverrides[key]=Module[key]}}var arguments_=[];var thisProgram=\"./this.program\";var quit_=function(status,toThrow){throw toThrow};var ENVIRONMENT_IS_WEB=false;var ENVIRONMENT_IS_WORKER=false;var ENVIRONMENT_IS_NODE=false;var ENVIRONMENT_IS_SHELL=false;ENVIRONMENT_IS_WEB=typeof window===\"object\";ENVIRONMENT_IS_WORKER=typeof importScripts===\"function\";ENVIRONMENT_IS_NODE=typeof process===\"object\"&&typeof process.versions===\"object\"&&typeof process.versions.node===\"string\";ENVIRONMENT_IS_SHELL=!ENVIRONMENT_IS_WEB&&!ENVIRONMENT_IS_NODE&&!ENVIRONMENT_IS_WORKER;var scriptDirectory=\"\";function locateFile(path){if(Module[\"locateFile\"]){return Module[\"locateFile\"](path,scriptDirectory)}return scriptDirectory+path}var read_,readAsync,readBinary,setWindowTitle;var nodeFS;var nodePath;if(ENVIRONMENT_IS_NODE){if(ENVIRONMENT_IS_WORKER){scriptDirectory=require(\"path\").dirname(scriptDirectory)+\"/\"}else{scriptDirectory=__dirname+\"/\"}read_=function shell_read(filename,binary){if(!nodeFS)nodeFS=require(\"fs\");if(!nodePath)nodePath=require(\"path\");filename=nodePath[\"normalize\"](filename);return nodeFS[\"readFileSync\"](filename,binary?null:\"utf8\")};readBinary=function readBinary(filename){var ret=read_(filename,true);if(!ret.buffer){ret=new Uint8Array(ret)}assert(ret.buffer);return ret};if(process[\"argv\"].length>1){thisProgram=process[\"argv\"][1].replace(/\\\\/g,\"/\")}arguments_=process[\"argv\"].slice(2);process[\"on\"](\"uncaughtException\",function(ex){if(!(ex instanceof ExitStatus)){throw

ex}});process[\"on\"](\"unhandledRejection\",abort);quit_=function(status){process[\"exit\"](status)};Module[\"inspect\"]=function(){return\"[Emscripten Module object]\"}}else if(ENVIRONMENT_IS_SHELL){if(typeof read!=\"undefined\"){read_=function shell_read(f){return read(f)}}readBinary=function readBinary(f){var data;if(typeof readbuffer===\"function\"){return new Uint8Array(readbuffer(f))}data=read(f,\"binary\");assert(typeof data===\"object\");return data};if(typeof scriptArgs!=\"undefined\"){arguments_=scriptArgs}else if(typeof arguments!=\"undefined\"){arguments_=arguments}if(typeof quit===\"function\"){quit_=function(status){quit(status)}}if(typeof print!==\"undefined\"){if(typeof console===\"undefined\")console={};console.log=print;console.warn=console.error=typeof printErr!==\"undefined\"?printErr:print}}else if(ENVIRONMENT_IS_WEB||ENVIRONMENT_IS_WORKER){if(ENVIRONMENT_IS_WORKER){scriptDirectory=self.location.href}else if(typeof document!==\"undefined\"&&document.currentScript){scriptDirectory=document.currentScript.src}if(_scriptDir){scriptDirectory=_scriptDir}if(scriptDirectory.indexOf(\"blob:\")!==0){scriptDirectory=scriptDirectory.substr(0,scriptDirectory.lastIndexOf(\"/\")+1)}else{scriptDirectory=\"\"}{read_=function(url){var xhr=new XMLHttpRequest;xhr.open(\"GET\",url,false);xhr.send(null);return xhr.responseText};if(ENVIRONMENT_IS_WORKER){readBinary=function(url){var xhr=new XMLHttpRequest;xhr.open(\"GET\",url,false);xhr.responseType=\"arraybuffer\";xhr.send(null);return new Uint8Array(xhr.response)}}readAsync=function(url,onload,onerror){var xhr=new XMLHttpRequest;xhr.open(\"GET\",url,true);xhr.responseType=\"arraybuffer\";xhr.onload=function(){if(xhr.status==200||xhr.status==0&&xhr.response){onload(xhr.response);return}onerror()};xhr.onerror=onerror;xhr.send(null)}}setWindowTitle=function(title){document.title=title}}else{}var out=Module[\"print\"]||console.log.bind(console);var err=Module[\"printErr\"]||console.warn.bind(console);for(key in moduleOverrides){if(moduleOverrides.hasOwnProperty(key)){Module[key]=moduleOverrides[key]}}moduleOverrides=null;if(Module[\"arguments\"])arguments_=Module[\"arguments\"];if(Module[\"thisProgram\"])thisProgram=Module[\"thisProgram\"];if(Module[\"quit\"])quit_=Module[\"quit\"];var wasmBinary;if(Module[\"wasmBinary\"])wasmBinary=Module[\"wasmBinary\"];var noExitRuntime=Module[\"noExitRuntime\"]||true;if(typeof WebAssembly!==\"object\"){abort(\"no native wasm support detected\")}var wasmMemory;var ABORT=false;var EXITSTATUS;function assert(condition,text){if(!condition){abort(\"Assertion failed: \"+text)}}function getCFunc(ident){var func=Module[\"_\"+ident];assert(func,\"Cannot call unknown function \"+ident+\", make sure it is exported\");return func}function ccall(ident,returnType,argTypes,args,opts){var toC={\"string\":function(str){var ret=0;if(str!==null&&str!==undefined&&str!==0){var len=(str.length<<2)+1;ret=stackAlloc(len);stringToUTF8(str,ret,len)}return ret},\"array\":function(arr){var ret=stackAlloc(arr.length);writeArrayToMemory(arr,ret);return ret}};function convertReturnValue(ret){if(returnType===\"string\")return UTF8ToString(ret);if(returnType===\"boolean\")return Boolean(ret);return ret}var func=getCFunc(ident);var cArgs=[];var stack=0;if(args){for(var i=0;i<args.length;i++){var converter=toC[argTypes[i]];if(converter){if(stack===0)stack=stackSave();cArgs[i]=converter(args[i])}else{cArgs[i]=args[i]}}}var ret=func.apply(null,cArgs);ret=convertReturnValue(ret);if(stack!==0)stackRestore(stack);return ret}function cwrap(ident,returnType,argTypes,opts){argTypes=argTypes||[];var numericArgs=argTypes.every(function(type){return type===\"number\"});var numericRet=returnType!==\"string\";if(numericRet&&numericArgs&&!opts){return getCFunc(ident)}return function(){return ccall(ident,returnType,argTypes,arguments,opts)}}var UTF8Decoder=typeof TextDecoder!==\"undefined\"?new TextDecoder(\"utf8\"):undefined;function UTF8ArrayToString(heap,idx,maxBytesToRead){var endIdx=idx+maxBytesToRead;var endPtr=idx;while(heap[endPtr]&&!(endPtr>=endIdx))++endPtr;if(endPtr-

idx>16&&heap.subarray&&UTF8Decoder){return UTF8Decoder.decode(heap.subarray(idx,endPtr))}else{var str=\"\";while(idx<endPtr){var u0=heap[idx++];if(!(u0&128)){str+=String.fromCharCode(u0);continue}var u1=heap[idx++]&63;if((u0&224)==192){str+=String.fromCharCode((u0&31)<<6|u1);continue}var u2=heap[idx++]&63;if((u0&240)==224){u0=(u0&15)<<12|u1<<6|u2}else{u0=(u0&7)<<18|u1<<12|u2<<6|heap[idx++]&63}if(u0<65536){str+=String.fromCharCode(u0)}else{var ch=u0-65536;str+=String.fromCharCode(55296|ch>>10,56320|ch&1023)}}}return str}function UTF8ToString(ptr,maxBytesToRead){return ptr?UTF8ArrayToString(HEAPU8,ptr,maxBytesToRead):\"\"}function stringToUTF8Array(str,heap,outIdx,maxBytesToWrite){if(!(maxBytesToWrite>0))return 0;var startIdx=outIdx;var endIdx=outIdx+maxBytesToWrite-1;for(var i=0;i<str.length;++i){var u=str.charCodeAt(i);if(u>=55296&&u<=57343){var u1=str.charCodeAt(++i);u=65536+((u&1023)<<10)|u1&1023}if(u<=127){if(outIdx>=endIdx)break;heap[outIdx++]=u}else if(u<=2047){if(outIdx+1>=endIdx)break;heap[outIdx++]=192|u>>6;heap[outIdx++]=128|u&63}else if(u<=65535){if(outIdx+2>=endIdx)break;heap[outIdx++]=224|u>>12;heap[outIdx++]=128|u>>6&63;heap[outIdx++]=128|u&63}else{if(outIdx+3>=endIdx)break;heap[outIdx++]=240|u>>18;heap[outIdx++]=128|u>>12&63;heap[outIdx++]=128|u>>6&63;heap[outIdx++]=128|u&63}}heap[outIdx]=0;return outIdx-startIdx}function stringToUTF8(str,outPtr,maxBytesToWrite){return stringToUTF8Array(str,HEAPU8,outPtr,maxBytesToWrite)}function writeArrayToMemory(array,buffer){HEAP8.set(array,buffer)}function alignUp(x,multiple){if(x%multiple>0){x+=multiple-x%multiple}return x}var buffer,HEAP8,HEAPU8,HEAP16,HEAPU16,HEAP32,HEAPU32,HEAPF32,HEAPF64;function updateGlobalBufferAndViews(buf){buffer=buf;Module[\"HEAP8\"]=HEAP8=new Int8Array(buf);Module[\"HEAP16\"]=HEAP16=new Int16Array(buf);Module[\"HEAP32\"]=HEAP32=new Int32Array(buf);Module[\"HEAPU8\"]=HEAPU8=new Uint8Array(buf);Module[\"HEAPU16\"]=HEAPU16=new Uint16Array(buf);Module[\"HEAPU32\"]=HEAPU32=new Uint32Array(buf);Module[\"HEAPF32\"]=HEAPF32=new Float32Array(buf);Module[\"HEAPF64\"]=HEAPF64=new Float64Array(buf)}var INITIAL_MEMORY=Module[\"INITIAL_MEMORY\"]||16777216;var wasmTable;var __ATPRERUN__=[];var __ATINIT__=[];var __ATMAIN__=[];var __ATPOSTRUN__=[];var runtimeInitialized=false;__ATINIT__.push({func:function(){___wasm_call_ctors()}});function preRun(){if(Module[\"preRun\"]){if(typeof Module[\"preRun\"]==\"function\")Module[\"preRun\"]=[Module[\"preRun\"]];while(Module[\"preRun\"].length){addOnPreRun(Module[\"preRun\"].shift())}}callRuntimeCallbacks(__ATPRERUN__)}function initRuntime(){runtimeInitialized=true;callRuntimeCallbacks(__ATINIT__)}function preMain(){callRuntimeCallbacks(__ATMAIN__)}function postRun(){if(Module[\"postRun\"]){if(typeof Module[\"postRun\"]==\"function\")Module[\"postRun\"]=[Module[\"postRun\"]];while(Module[\"postRun\"].length){addOnPostRun(Module[\"postRun\"].shift())}}callRuntimeCallbacks(__ATPOSTRUN__)}function addOnPreRun(cb){__ATPRERUN__.unshift(cb)}function addOnPostRun(cb){__ATPOSTRUN__.unshift(cb)}var runDependencies=0;var runDependencyWatcher=null;var dependenciesFulfilled=null;function addRunDependency(id){runDependencies++;if(Module[\"monitorRunDependencies\"]){Module[\"monitorRunDependencies\"](runDependencies)}}function removeRunDependency(id){runDependencies--;if(Module[\"monitorRunDependencies\"]){Module[\"monitorRunDependencies\"](runDependencies)}if(runDependencies==0){if(runDependencyWatcher!==null){clearInterval(runDependencyWatcher);runDependencyWatcher=null}if(dependenciesFulfilled){var callback=dependenciesFulfilled;dependenciesFulfilled=null;callback()}}}Module[\"preloadedImages\"]={};Module[\"preloadedAudios\"]={};function abort(what){if(Module[\"onAbort\"]){Module[\"onAbort\"](what)}what+=\"\";err(what);ABORT=true;EXITSTATUS=1;what=\"abort(\"+what+\"). Build with -s ASSERTIONS=1 for more info.\";var e=new

WebAssembly.RuntimeError(what);readyPromiseReject(e);throw e}function hasPrefix(str,prefix){return String.prototype.startsWith?str.startsWith(prefix):str.indexOf(prefix)===0}var dataURIPrefix=\"data:application/octet-stream; base64,\";function isDataURI(filename){return hasPrefix(filename,dataURIPrefix)}var fileURIPrefix=\"file://\";function isFileURI(filename){return hasPrefix(filename,fileURIPrefix)}var wasmBinaryFile=\"tfjs-backend-wasm.wasm\";if(!isDataURI(wasmBinaryFile)){wasmBinaryFile=locateFile(wasmBinaryFile)}function getBinary(file){try{if(file==wasmBinaryFile&&wasmBinary){return new Uint8Array(wasmBinary)}if(readBinary){return readBinary(file)}else{throw\"both async and sync fetching of the wasm failed\"}}catch(err){abort(err)}}function getBinaryPromise(){if(!wasmBinary&&(ENVIRONMENT_IS_WEB||ENVIRONMENT_IS_WORKER)){if(typeof fetch===\"function\"&&!isFileURI(wasmBinaryFile)){return fetch(wasmBinaryFile,{credentials:\"same-origin\"}).then(function(response){if(!response[\"ok\"]){throw\"failed to load wasm binary file at '\"+wasmBinaryFile+\"'\"}return response[\"arrayBuffer\"]()}).catch(function(){return getBinary(wasmBinaryFile)})}else{if(readAsync){return new Promise(function(resolve,reject){readAsync(wasmBinaryFile,function(response){resolve(new Uint8Array(response))},reject)})}}}return Promise.resolve().then(function(){return getBinary(wasmBinaryFile)})}function createWasm(){var info={\"a\":asmLibraryArg};function receiveInstance(instance,module){var exports=instance.exports;Module[\"asm\"]=exports;wasmMemory=Module[\"asm\"][\"j\"];updateGlobalBufferAndViews(wasmMemory.buffer);wasmTable=Module[\"asm\"][\"r\"];removeRunDependency(\"wasm-instantiate\")}addRunDependency(\"wasm-instantiate\");function receiveInstantiatedSource(output){receiveInstance(output[\"instance\"])}function instantiateArrayBuffer(receiver){return getBinaryPromise().then(function(binary){return WebAssembly.instantiate(binary,info)}).then(receiver,function(reason){err(\"failed to asynchronously prepare wasm: \"+reason);abort(reason)})}function instantiateAsync(){if(!wasmBinary&&typeof WebAssembly.instantiateStreaming===\"function\"&&!isDataURI(wasmBinaryFile)&&!isFileURI(wasmBinaryFile)&&typeof fetch===\"function\"){return fetch(wasmBinaryFile,{credentials:\"same-origin\"}).then(function(response){var result=WebAssembly.instantiateStreaming(response,info);return result.then(receiveInstantiatedSource,function(reason){err(\"wasm streaming compile failed: \"+reason);err(\"falling back to ArrayBuffer instantiation\");return instantiateArrayBuffer(receiveInstantiatedSource)})})}else{return instantiateArrayBuffer(receiveInstantiatedSource)}}if(Module[\"instantiateWasm\"]){try{var exports=Module[\"instantiateWasm\"](info,receiveInstance);return exports}catch(e){err(\"Module.instantiateWasm callback failed with error: \"+e);return false}}instantiateAsync().catch(readyPromiseReject);return{}}function callRuntimeCallbacks(callbacks){while(callbacks.length>0){var callback=callbacks.shift();if(typeof callback==\"function\"){callback(Module);continue}var func=callback.func;if(typeof func===\"number\"){if(callback.arg===undefined){wasmTable.get(func)()}else{wasmTable.get(func)(callback.arg)}}else{func(callback.arg===undefined?null:callback.arg)}}}function _abort(){abort()}function _emscripten_memcpy_big(dest,src,num){HEAPU8.copyWithin(dest,src,src+num)}function _emscripten_get_heap_size(){return HEAPU8.length}function emscripten_realloc_buffer(size){try{wasmMemory.grow(size-buffer.byteLength+65535>>>16);updateGlobalBufferAndViews(wasmMemory.buffer);return 1}catch(e){}}function _emscripten_resize_heap(requestedSize){var oldSize=_emscripten_get_heap_size();var maxHeapSize=2147483648;if(requestedSize>maxHeapSize){return false}for(var cutDown=1;cutDown<=4;cutDown*=2){var overGrownHeapSize=oldSize*(1+.2/cutDown);overGrownHeapSize=Math.min(overGrownHeapSize,requestedSize+100663296);var newSize=Math.min(maxHeapSize,alignUp(Math.max(requestedSize,overGrownHeapSize),65536));var

replacement=emscripten_realloc_buffer(newSize);if(replacement){return true}}return false}var SYSCALLS={mappings:{},buffers:[null,[],[]],printChar:function(stream,curr){var buffer=SYSCALLS.buffers[stream];if(curr===0||curr===10){(stream===1?out:err)(UTF8ArrayToString(buffer,0));buffer.length=0}else{buffer.push(curr)}},varargs:undefined,get:function(){SYSCALLS.varargs+=4;var ret=HEAP32[SYSCALLS.varargs-4>>2];return ret},getStr:function(ptr){var ret=UTF8ToString(ptr);return ret},get64:function(low,high){return low}};function _fd_close(fd){return 0}function _fd_seek(fd,offset_low,offset_high,whence,newOffset){}function _fd_write(fd,iov,iovcnt,pnum){var num=0;for(var i=0;i<iovcnt;i++){var ptr=HEAP32[iov+i*8>>2];var len=HEAP32[iov+(i*8+4)>>2];for(var j=0;j<len;j++){SYSCALLS.printChar(fd,HEAPU8[ptr+j])}num+=len}HEAP32[pnum>>2]=num;return 0}function _pthread_create(){return 6}function _pthread_join(){return 28}function setErrNo(value){HEAP32[___errno_location()>>2]=value;return value}function _sysconf(name){switch(name){case 30:return 16384;case 85:var maxHeapSize=2147483648;return maxHeapSize/16384;case 132:case 133:case 12:case 137:case 138:case 15:case 235:case 16:case 17:case 18:case 19:case 20:case 149:case 13:case 10:case 236:case 153:case 9:case 21:case 22:case 159:case 154:case 14:case 77:case 78:case 139:case 82:case 68:case 67:case 164:case 11:case 29:case 47:case 48:case 95:case 52:case 51:case 46:return 200809;case 27:case 246:case 127:case 128:case 23:case 24:case 160:case 161:case 181:case 182:case 242:case 183:case 184:case 243:case 244:case 245:case 165:case 178:case 179:case 49:case 50:case 168:case 169:case 175:case 170:case 171:case 172:case 97:case 76:case 32:case 173:case 35:case 80:case 81:case 79:return-1;case 176:case 177:case 7:case 155:case 8:case 157:case 125:case 126:case 92:case 93:case 129:case 130:case 131:case 94:case 91:return 1;case 74:case 60:case 69:case 70:case 4:return 1024;case 31:case 42:case 72:return 32;case 87:case 26:case 33:return 2147483647;case 34:case 1:return 47839;case 38:case 36:return 99;case 43:case 37:return 2048;case 0:return 2097152;case 3:return 65536;case 28:return 32768;case 44:return 32767;case 75:return 16384;case 39:return 1e3;case 89:return 700;case 71:return 256;case 40:return 255;case 2:return 100;case 180:return 64;case 25:return 20;case 5:return 16;case 6:return 6;case 73:return 4;case 84:{if(typeof navigator===\"object\")return navigator[\"hardwareConcurrency\"]||1;return 1}}setErrNo(28);return-1};var asmLibraryArg={\"a\":_abort,\"d\":_emscripten_memcpy_big,\"e\":_emscripten_resize_heap,\"f\":_fd_close,\"c\":_fd_seek,\"b\":_fd_write,\"h\":_pthread_create,\"g\":_pthread_join,\"i\":_sysconf};var asm=createWasm();var ___wasm_call_ctors=Module[\"___wasm_call_ctors\"]=function(){return(___wasm_call_ctors=Module[\"___wasm_call_ctors\"]=Module[\"asm\"][\"k\"]).apply(null,arguments)};var _init=Module[\"_init\"]=function(){return(_init=Module[\"_init\"]=Module[\"asm\"][\"l\"]).apply(null,arguments)};var _init_with_threads_count=Module[\"_init_with_threads_count\"]=function(){return(_init_with_threads_count=Module[\"_init_with_threads_count\"]=Module[\"asm\"][\"m\"]).apply(null,arguments)};var _get_threads_count=Module[\"_get_threads_count\"]=function(){return(_get_threads_count=Module[\"_get_threads_count\"]=Module[\"asm\"][\"n\"]).apply(null,arguments)};var _register_tensor=Module[\"_register_tensor\"]=function(){return(_register_tensor=Module[\"_register_tensor\"]=Module[\"asm\"][\"o\"]).apply(null,arguments)};var _dispose_data=Module[\"_dispose_data\"]=function(){return(_dispose_data=Module[\"_dispose_data\"]=Module[\"asm\"][\"p\"]).apply(null,arguments)};var _dispose=Module[\"_dispose\"]=function(){return(_dispose=Module[\"_dispose\"]=Module[\"asm\"][\"q\"]).apply(null,arguments)};var _Abs=Module[\"_Abs\"]=function(){return(_Abs=Module[\"_Abs\"]=Module[\"asm\"][\"s\"]).apply(null,arguments)};var _Add=Module[\"_Add\"]=function(){return(_Add=Module[\"_Add\"]=Module[\"asm\"][\"t\"]).apply(null,arguments)};var _AddN=Module[\"_AddN\"]=function(){return(_AddN=Module[\"_AddN\"]=Module[\"asm\"][\"u\"]).apply(null,ar

guments)};var
_All=Module[\"_All\"]=function(){return(_All=Module[\"_All\"]=Module[\"asm\"][\"v\"]).apply(null,arguments)};
var
_Any=Module[\"_Any\"]=function(){return(_Any=Module[\"_Any\"]=Module[\"asm\"][\"w\"]).apply(null,argumen
ts)};var
_ArgMax=Module[\"_ArgMax\"]=function(){return(_ArgMax=Module[\"_ArgMax\"]=Module[\"asm\"][\"x\"]).app
ly(null,arguments)};var
_AvgPool=Module[\"_AvgPool\"]=function(){return(_AvgPool=Module[\"_AvgPool\"]=Module[\"asm\"][\"y\"]).a
pply(null,arguments)};var
_BatchMatMul=Module[\"_BatchMatMul\"]=function(){return(_BatchMatMul=Module[\"_BatchMatMul\"]=Modu
le[\"asm\"][\"z\"]).apply(null,arguments)};var
_Ceil=Module[\"_Ceil\"]=function(){return(_Ceil=Module[\"_Ceil\"]=Module[\"asm\"][\"A\"]).apply(null,argument
s)};var
_ClipByValue=Module[\"_ClipByValue\"]=function(){return(_ClipByValue=Module[\"_ClipByValue\"]=Module[\
"asm\"][\"B\"]).apply(null,arguments)};var
_Conv2D=Module[\"_Conv2D\"]=function(){return(_Conv2D=Module[\"_Conv2D\"]=Module[\"asm\"][\"C\"]).ap
ply(null,arguments)};var
_Conv2DBackpropInput=Module[\"_Conv2DBackpropInput\"]=function(){return(_Conv2DBackpropInput=Modul
e[\"_Conv2DBackpropInput\"]=Module[\"asm\"][\"D\"]).apply(null,arguments)};var
_Cos=Module[\"_Cos\"]=function(){return(_Cos=Module[\"_Cos\"]=Module[\"asm\"][\"E\"]).apply(null,arguments
)};var
_Cosh=Module[\"_Cosh\"]=function(){return(_Cosh=Module[\"_Cosh\"]=Module[\"asm\"][\"F\"]).apply(null,argu
ments)};var
_CropAndResize=Module[\"_CropAndResize\"]=function(){return(_CropAndResize=Module[\"_CropAndResize\"]
=Module[\"asm\"][\"G\"]).apply(null,arguments)};var
_Cumsum=Module[\"_Cumsum\"]=function(){return(_Cumsum=Module[\"_Cumsum\"]=Module[\"asm\"][\"H\"]).a
pply(null,arguments)};var
_DepthToSpace=Module[\"_DepthToSpace\"]=function(){return(_DepthToSpace=Module[\"_DepthToSpace\"]=M
odule[\"asm\"][\"I\"]).apply(null,arguments)};var
_DepthwiseConv2dNative=Module[\"_DepthwiseConv2dNative\"]=function(){return(_DepthwiseConv2dNative=M
odule[\"_DepthwiseConv2dNative\"]=Module[\"asm\"][\"J\"]).apply(null,arguments)};var
_Elu=Module[\"_Elu\"]=function(){return(_Elu=Module[\"_Elu\"]=Module[\"asm\"][\"K\"]).apply(null,arguments)}
;var
_Equal=Module[\"_Equal\"]=function(){return(_Equal=Module[\"_Equal\"]=Module[\"asm\"][\"L\"]).apply(null,arg
uments)};var
_Exp=Module[\"_Exp\"]=function(){return(_Exp=Module[\"_Exp\"]=Module[\"asm\"][\"M\"]).apply(null,argument
s)};var
_FlipLeftRight=Module[\"_FlipLeftRight\"]=function(){return(_FlipLeftRight=Module[\"_FlipLeftRight\"]=Modul
e[\"asm\"][\"N\"]).apply(null,arguments)};var
_Floor=Module[\"_Floor\"]=function(){return(_Floor=Module[\"_Floor\"]=Module[\"asm\"][\"O\"]).apply(null,argu
ments)};var
_FloorDiv=Module[\"_FloorDiv\"]=function(){return(_FloorDiv=Module[\"_FloorDiv\"]=Module[\"asm\"][\"P\"]).
apply(null,arguments)};var
_FusedBatchNorm=Module[\"_FusedBatchNorm\"]=function(){return(_FusedBatchNorm=Module[\"_FusedBatchN
orm\"]=Module[\"asm\"][\"Q\"]).apply(null,arguments)};var
_FusedConv2D=Module[\"_FusedConv2D\"]=function(){return(_FusedConv2D=Module[\"_FusedConv2D\"]=Mod
ule[\"asm\"][\"R\"]).apply(null,arguments)};var
_FusedDepthwiseConv2D=Module[\"_FusedDepthwiseConv2D\"]=function(){return(_FusedDepthwiseConv2D=M

odule[\"_FusedDepthwiseConv2D\"]=Module[\"asm\"][\"S\"]).apply(null,arguments)};var
_Gather=Module[\"_Gather\"]=function(){return(_Gather=Module[\"_Gather\"]=Module[\"asm\"][\"T\"]).apply(null
,arguments)};var
_GatherNd=Module[\"_GatherNd\"]=function(){return(_GatherNd=Module[\"_GatherNd\"]=Module[\"asm\"][\"U\"
]).apply(null,arguments)};var
_Greater=Module[\"_Greater\"]=function(){return(_Greater=Module[\"_Greater\"]=Module[\"asm\"][\"V\"]).apply(
null,arguments)};var
_GreaterEqual=Module[\"_GreaterEqual\"]=function(){return(_GreaterEqual=Module[\"_GreaterEqual\"]=Module[\
"asm\"][\"W\"]).apply(null,arguments)};var
_LeakyRelu=Module[\"_LeakyRelu\"]=function(){return(_LeakyRelu=Module[\"_LeakyRelu\"]=Module[\"asm\"][\
"X\"]).apply(null,arguments)};var
_Less=Module[\"_Less\"]=function(){return(_Less=Module[\"_Less\"]=Module[\"asm\"][\"Y\"]).apply(null,argume
nts)};var
_LessEqual=Module[\"_LessEqual\"]=function(){return(_LessEqual=Module[\"_LessEqual\"]=Module[\"asm\"][\"
Z\"]).apply(null,arguments)};var
_Log=Module[\"_Log\"]=function(){return(_Log=Module[\"_Log\"]=Module[\"asm\"][\"_\"]).apply(null,arguments
)};var
_LogicalAnd=Module[\"_LogicalAnd\"]=function(){return(_LogicalAnd=Module[\"_LogicalAnd\"]=Module[\"asm
\"][\"$\"]).apply(null,arguments)};var
_Max=Module[\"_Max\"]=function(){return(_Max=Module[\"_Max\"]=Module[\"asm\"][\"aa\"]).apply(null,argume
nts)};var
_MaxPool=Module[\"_MaxPool\"]=function(){return(_MaxPool=Module[\"_MaxPool\"]=Module[\"asm\"][\"ba\"]).
apply(null,arguments)};var
_Maximum=Module[\"_Maximum\"]=function(){return(_Maximum=Module[\"_Maximum\"]=Module[\"asm\"][\"ca\"]).apply(null,arguments)};var
_Mean=Module[\"_Mean\"]=function(){return(_Mean=Module[\"_Mean\"]=Module[\"asm\"][\"da\"]).apply(null,ar
guments)};var
_Min=Module[\"_Min\"]=function(){return(_Min=Module[\"_Min\"]=Module[\"asm\"][\"ea\"]).apply(null,argumen
ts)};var
_Minimum=Module[\"_Minimum\"]=function(){return(_Minimum=Module[\"_Minimum\"]=Module[\"asm\"][\"fa\
"]).apply(null,arguments)};var
_MirrorPad=Module[\"_MirrorPad\"]=function(){return(_MirrorPad=Module[\"_MirrorPad\"]=Module[\"asm\"][\"g
a\"]).apply(null,arguments)};var
_Multiply=Module[\"_Multiply\"]=function(){return(_Multiply=Module[\"_Multiply\"]=Module[\"asm\"][\"ha\"]).a
pply(null,arguments)};var
_Neg=Module[\"_Neg\"]=function(){return(_Neg=Module[\"_Neg\"]=Module[\"asm\"][\"ia\"]).apply(null,argument
s)};var
_NonMaxSuppressionV3=Module[\"_NonMaxSuppressionV3\"]=function(){return(_NonMaxSuppressionV3=Mod
ule[\"_NonMaxSuppressionV3\"]=Module[\"asm\"][\"ja\"]).apply(null,arguments)};var
_NonMaxSuppressionV4=Module[\"_NonMaxSuppressionV4\"]=function(){return(_NonMaxSuppressionV4=Mod
ule[\"_NonMaxSuppressionV4\"]=Module[\"asm\"][\"ka\"]).apply(null,arguments)};var
_NonMaxSuppressionV5=Module[\"_NonMaxSuppressionV5\"]=function(){return(_NonMaxSuppressionV5=Mod
ule[\"_NonMaxSuppressionV5\"]=Module[\"asm\"][\"la\"]).apply(null,arguments)};var
_NotEqual=Module[\"_NotEqual\"]=function(){return(_NotEqual=Module[\"_NotEqual\"]=Module[\"asm\"][\"ma\"
]).apply(null,arguments)};var
_OneHot=Module[\"_OneHot\"]=function(){return(_OneHot=Module[\"_OneHot\"]=Module[\"asm\"][\"na\"]).appl
y(null,arguments)};var

_PadV2=Module[\"_PadV2\"]=function(){return(_PadV2=Module[\"_PadV2\"]=Module[\"asm\"][\"oa\"]).apply(null,arguments)};var
_Pow=Module[\"_Pow\"]=function(){return(_Pow=Module[\"_Pow\"]=Module[\"asm\"][\"pa\"]).apply(null,arguments)};var
_Prelu=Module[\"_Prelu\"]=function(){return(_Prelu=Module[\"_Prelu\"]=Module[\"asm\"][\"qa\"]).apply(null,arguments)};var
_Prod=Module[\"_Prod\"]=function(){return(_Prod=Module[\"_Prod\"]=Module[\"asm\"][\"ra\"]).apply(null,arguments)};var
_RealDiv=Module[\"_RealDiv\"]=function(){return(_RealDiv=Module[\"_RealDiv\"]=Module[\"asm\"][\"sa\"]).apply(null,arguments)};var
_Relu=Module[\"_Relu\"]=function(){return(_Relu=Module[\"_Relu\"]=Module[\"asm\"][\"ta\"]).apply(null,arguments)};var
_Relu6=Module[\"_Relu6\"]=function(){return(_Relu6=Module[\"_Relu6\"]=Module[\"asm\"][\"ua\"]).apply(null,arguments)};var
_ResizeBilinear=Module[\"_ResizeBilinear\"]=function(){return(_ResizeBilinear=Module[\"_ResizeBilinear\"]=Module[\"asm\"][\"va\"]).apply(null,arguments)};var
_Reverse=Module[\"_Reverse\"]=function(){return(_Reverse=Module[\"_Reverse\"]=Module[\"asm\"][\"wa\"]).apply(null,arguments)};var
_RotateWithOffset=Module[\"_RotateWithOffset\"]=function(){return(_RotateWithOffset=Module[\"_RotateWithOffset\"]=Module[\"asm\"][\"xa\"]).apply(null,arguments)};var
_Round=Module[\"_Round\"]=function(){return(_Round=Module[\"_Round\"]=Module[\"asm\"][\"ya\"]).apply(null,arguments)};var
_Rsqrt=Module[\"_Rsqrt\"]=function(){return(_Rsqrt=Module[\"_Rsqrt\"]=Module[\"asm\"][\"za\"]).apply(null,arguments)};var
_ScatterNd=Module[\"_ScatterNd\"]=function(){return(_ScatterNd=Module[\"_ScatterNd\"]=Module[\"asm\"][\"Aa\"]).apply(null,arguments)};var
_SelectV2=Module[\"_SelectV2\"]=function(){return(_SelectV2=Module[\"_SelectV2\"]=Module[\"asm\"][\"Ba\"]).apply(null,arguments)};var
_Sigmoid=Module[\"_Sigmoid\"]=function(){return(_Sigmoid=Module[\"_Sigmoid\"]=Module[\"asm\"][\"Ca\"]).apply(null,arguments)};var
_Sin=Module[\"_Sin\"]=function(){return(_Sin=Module[\"_Sin\"]=Module[\"asm\"][\"Da\"]).apply(null,arguments)};var
_Softmax=Module[\"_Softmax\"]=function(){return(_Softmax=Module[\"_Softmax\"]=Module[\"asm\"][\"Ea\"]).apply(null,arguments)};var
_Sqrt=Module[\"_Sqrt\"]=function(){return(_Sqrt=Module[\"_Sqrt\"]=Module[\"asm\"][\"Fa\"]).apply(null,arguments)};var
_Square=Module[\"_Square\"]=function(){return(_Square=Module[\"_Square\"]=Module[\"asm\"][\"Ga\"]).apply(null,arguments)};var
_SquaredDifference=Module[\"_SquaredDifference\"]=function(){return(_SquaredDifference=Module[\"_SquaredDifference\"]=Module[\"asm\"][\"Ha\"]).apply(null,arguments)};var
_Step=Module[\"_Step\"]=function(){return(_Step=Module[\"_Step\"]=Module[\"asm\"][\"Ia\"]).apply(null,arguments)};var
_StridedSlice=Module[\"_StridedSlice\"]=function(){return(_StridedSlice=Module[\"_StridedSlice\"]=Module[\"asm\"][\"Ja\"]).apply(null,arguments)};var
_Sub=Module[\"_Sub\"]=function(){return(_Sub=Module[\"_Sub\"]=Module[\"asm\"][\"Ka\"]).apply(null,arguments)};var
_Sum=Module[\"_Sum\"]=function(){return(_Sum=Module[\"_Sum\"]=Module[\"asm\"][\"La\"]).apply(null,arguments)};var

_Tan=Module[\"_Tan\"]=function(){return(_Tan=Module[\"_Tan\"]=Module[\"asm\"][\"Ma\"]).apply(null,arguments)};var
_Tanh=Module[\"_Tanh\"]=function(){return(_Tanh=Module[\"_Tanh\"]=Module[\"asm\"][\"Na\"]).apply(null,arguments)};var
_Tile=Module[\"_Tile\"]=function(){return(_Tile=Module[\"_Tile\"]=Module[\"asm\"][\"Oa\"]).apply(null,arguments)};var
_TopK=Module[\"_TopK\"]=function(){return(_TopK=Module[\"_TopK\"]=Module[\"asm\"][\"Pa\"]).apply(null,arguments)};var
_Transform=Module[\"_Transform\"]=function(){return(_Transform=Module[\"_Transform\"]=Module[\"asm\"][\"Qa\"]).apply(null,arguments)};var
_Transpose=Module[\"_Transpose\"]=function(){return(_Transpose=Module[\"_Transpose\"]=Module[\"asm\"][\"Ra\"]).apply(null,arguments)};var
__FusedMatMul=Module[\"__FusedMatMul\"]=function(){return(__FusedMatMul=Module[\"__FusedMatMul\"]=Module[\"asm\"][\"Sa\"]).apply(null,arguments)};var
_malloc=Module[\"_malloc\"]=function(){return(_malloc=Module[\"_malloc\"]=Module[\"asm\"][\"Ta\"]).apply(null,arguments)};var
_free=Module[\"_free\"]=function(){return(_free=Module[\"_free\"]=Module[\"asm\"][\"Ua\"]).apply(null,arguments)};var
___errno_location=Module[\"___errno_location\"]=function(){return(___errno_location=Module[\"___errno_location\"]=Module[\"asm\"][\"Va\"]).apply(null,arguments)};var
stackSave=Module[\"stackSave\"]=function(){return(stackSave=Module[\"stackSave\"]=Module[\"asm\"][\"Wa\"]).apply(null,arguments)};var
stackRestore=Module[\"stackRestore\"]=function(){return(stackRestore=Module[\"stackRestore\"]=Module[\"asm\"][\"Xa\"]).apply(null,arguments)};var
stackAlloc=Module[\"stackAlloc\"]=function(){return(stackAlloc=Module[\"stackAlloc\"]=Module[\"asm\"][\"Ya\"]).apply(null,arguments)};Module[\"cwrap\"]=cwrap;var calledRun;function
ExitStatus(status){this.name=\"ExitStatus\";this.message=\"Program terminated with
exit(\"+status+\")\";this.status=status}dependenciesFulfilled=function
runCaller(){if(!calledRun)run();if(!calledRun)dependenciesFulfilled=runCaller};function
run(args){args=args||arguments_;if(runDependencies>0){return}preRun();if(runDependencies>0){return}function
doRun(){if(calledRun)return;calledRun=true;Module[\"calledRun\"]=true;if(ABORT)return;initRuntime();preMain();readyPromiseResolve(Module);if(Module[\"onRuntimeInitialized\"])Module[\"onRuntimeInitialized\"]();postRun()}if(Module[\"setStatus\"]){Module[\"setStatus\"](\"Running...\");setTimeout(function(){setTimeout(function(){Module[\"setStatus\"](\"\")},1);doRun()},1)}else{doRun()}}Module[\"run\"]=run;if(Module[\"preInit\"]){if(typeof
Module[\"preInit\"]==\"function\")Module[\"preInit\"]=[Module[\"preInit\"]];while(Module[\"preInit\"].length>0){
Module[\"preInit\"].pop()()}}run();\n\n\n return WasmBackendModule.ready\n}\n);\n})();\nif (typeof exports ===
'object' && typeof module === 'object')\n module.exports = WasmBackendModule;\nelse if (typeof define ===
 'function' && define['amd'])\n define([], function() { return WasmBackendModule; });\nelse if (typeof exports ===
'object')\n exports[\"WasmBackendModule\"] = WasmBackendModule;\n","/**\n * @license\n * Copyright 2019
Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you
may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n *
http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing,
software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES
OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language
governing permissions and\n * limitations under the License.\n *
==\n
*/\nimport './flags_wasm';\n\nimport {backend_util, BackendTimingInfo, DataStorage, DataType, deprecationWarn,

```
engine, env, KernelBackend, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasmModule, WasmFactoryConfig} from '../wasm-out/tfjs-backend-wasm';\nimport {BackendWasmThreadedSimdModule} from '../wasm-out/tfjs-backend-wasm-threaded-simd';\nimport wasmFactoryThreadedSimd from '../wasm-out/tfjs-backend-wasm-threaded-simd.js';\n// @ts-ignore\nimport {wasmWorkerContents} from '../wasm-out/tfjs-backend-wasm-threaded-simd.worker.js';\nimport wasmFactory from '../wasm-out/tfjs-backend-wasm.js';\n\ninterface TensorData {\n  id: number;\n  memoryOffset: number;\n  shape: number[];\n  dtype: DataType;\n  refCount: number;\n  /** Only used for string tensors, storing encoded bytes. */\n  stringBytes?: Uint8Array[];\n}\n\nexport type DataId = object;  // object instead of {} to force non-primitive.\n\nexport class BackendWasm extends KernelBackend {\n  // 0 is reserved for null data ids.\n  private dataIdNextNumber = 1;\n  dataIdMap: DataStorage<TensorData>;\n\n  constructor(public
 wasm: BackendWasmModule|BackendWasmThreadedSimdModule) {\n    super();\n
this.wasm.tfjs.initWithThreadsCount(threadsCount);\n    actualThreadsCount = this.wasm.tfjs.getThreadsCount();\n
 this.dataIdMap = new DataStorage(this, engine());\n  }\n\n  write(values: backend_util.BackendValues, shape:
number[], dtype: DataType):\n      DataId {\n    const dataId = {id: this.dataIdNextNumber++};\n
this.move(dataId, values, shape, dtype, 1);\n    return dataId;\n  }\n\n  numDataIds(): number {\n    return
this.dataIdMap.numDataIds();\n  }\n\n  async time(f: () => void): Promise<BackendTimingInfo> {\n    const start =
util.now();\n    f();\n    const kernelMs = util.now() - start;\n    return {kernelMs};\n  }\n\n  move(\n      dataId:
DataId, values: backend_util.BackendValues, shape: number[],\n      dtype: DataType, refCount: number): void {\n
const id = this.dataIdNextNumber++;\n    if (dtype === 'string') {\n      const stringBytes = values as Uint8Array[];\n


  this.dataIdMap.set(\n          dataId,\n          {id, stringBytes, shape, dtype, memoryOffset: null, refCount});\n
return;\n    }\n\n    const size = util.sizeFromShape(shape);\n    const numBytes = size *
util.bytesPerElement(dtype);\n    const memoryOffset = this.wasm._malloc(numBytes);\n\n
this.dataIdMap.set(dataId, {id, memoryOffset, shape, dtype, refCount});\n\n    this.wasm.tfjs.registerTensor(id, size,
memoryOffset);\n\n    if (values != null) {\n      this.wasm.HEAPU8.set(\n          new Uint8Array(\n              (values
as backend_util.TypedArray).buffer,\n              (values as backend_util.TypedArray).byteOffset, numBytes),\n
memoryOffset);\n    }\n  }\n\n  async read(dataId: DataId): Promise<backend_util.BackendValues> {\n    return
this.readSync(dataId);\n  }\n\n  readSync(dataId: DataId): backend_util.BackendValues {\n    const {memoryOffset,
dtype, shape, stringBytes} =\n        this.dataIdMap.get(dataId);\n    if (dtype === 'string') {\n      return
 stringBytes;\n    }\n    const bytes = this.wasm.HEAPU8.slice(\n        memoryOffset,\n        memoryOffset +
util.sizeFromShape(shape) * util.bytesPerElement(dtype));\n    return typedArrayFromBuffer(bytes.buffer, dtype);\n
}\n\n  /**\n   * Dispose the memory if the dataId has 0 refCount. Return true if the memory\n   * is released, false
otherwise.\n   * @param dataId\n   * @oaram force Optional, remove the data regardless of refCount\n   */\n
disposeData(dataId: DataId, force = false): boolean {\n    if (this.dataIdMap.has(dataId)) {\n      const data =
this.dataIdMap.get(dataId);\n      data.refCount--;\n      if (!force && data.refCount > 0) {\n        return false;\n
}\n\n      this.wasm._free(data.memoryOffset);\n      this.wasm.tfjs.disposeData(data.id);\n
this.dataIdMap.delete(dataId);\n    }\n    return true;\n  }\n\n  /** Return refCount of a `TensorData`. */\n
refCount(dataId: DataId): number {\n    if (this.dataIdMap.has(dataId)) {\n      const tensorData =
 this.dataIdMap.get(dataId);\n      return tensorData.refCount;\n    }\n    return 0;\n  }\n\n  incRef(dataId: DataId) {\n
 const data = this.dataIdMap.get(dataId);\n    if (data != null) {\n      data.refCount++;\n    }\n  }\n\n  floatPrecision():
32 {\n    return 32;\n  }\n\n  // Returns the memory offset of a tensor. Useful for debugging and unit\n  // testing.\n
getMemoryOffset(dataId: DataId): number {\n    return this.dataIdMap.get(dataId).memoryOffset;\n  }\n\n
dispose() {\n    this.wasm.tfjs.dispose();\n    if ('PThread' in this.wasm) {\n
this.wasm.PThread.terminateAllThreads();\n    }\n    this.wasm = null;\n  }\n\n  memory() {\n    return {unreliable:
false};\n  }\n\n  /**\n   * Make a tensor info for the output of an op. If `memoryOffset` is not\n   * present, this
method allocates memory on the WASM heap. If `memoryOffset`\n   * is present, the memory was allocated
elsewhere (in c++) and we just record\n   * the pointer where that memory lives.\n   */\n  makeOutput(shape:
```

number[], dtype: DataType, memoryOffset?: number):\n TensorInfo {\n let dataId: {};\n if (memoryOffset == null) {\n dataId = this.write(null /* values */, shape, dtype);\n } else {\n const id = this.dataIdNextNumber++;\n dataId = {id};\n this.dataIdMap.set(dataId, {id, memoryOffset, shape, dtype, refCount: 1});\n const size = util.sizeFromShape(shape);\n this.wasm.tfjs.registerTensor(id, size, memoryOffset);\n }\n return {dataId, shape, dtype};\n }\n\n typedArrayFromHeap({shape, dtype, dataId}: TensorInfo):\n backend_util.TypedArray {\n const buffer = this.wasm.HEAPU8.buffer;\n const {memoryOffset} = this.dataIdMap.get(dataId);\n const size = util.sizeFromShape(shape);\n switch (dtype) {\n case 'float32':\n return new Float32Array(buffer, memoryOffset, size);\n case 'int32':\n return new Int32Array(buffer, memoryOffset, size);\n case 'bool':\n return new Uint8Array(buffer, memoryOffset, size);\n default:\n throw new Error(`Unknown dtype ${dtype}`);\n }\n }\n}\n\nfunction createInstantiateWasmFunc(path: string) {\n // this will be replace by rollup plugin patchWechatWebAssembly in\n // minprogram's output.\n // tslint:disable-next-line:no-any\n return (imports: any, callback: any) => {\n util.fetch(path, {credentials: 'same-origin'}).then((response) => {\n if (!response['ok']) {\n imports.env.a(`failed to load wasm binary file at '${path}'`);\n }\n response.arrayBuffer().then(binary => {\n WebAssembly.instantiate(binary, imports).then(output => {\n callback(output.instance, output.module);\n });\n });\n });\n return {};\n };\n}\n\n/**\n * Returns the path of the WASM binary.\n * @param simdSupported whether SIMD is supported\n * @param threadsSupported whether multithreading is supported\n * @param wasmModuleFolder the directory containing the WASM binaries.\n */\nfunction getPathToWasmBinary(\n simdSupported: boolean, threadsSupported: boolean,\n wasmModuleFolder: string) {\n if (wasmPath != null) {\n // If wasmPath is defined, the user has supplied a full path to\n // the vanilla .wasm binary.\n return wasmPath;\n }\n\n let path: WasmBinaryName = 'tfjs-backend-wasm.wasm';\n if (simdSupported && threadsSupported) {\n path = 'tfjs-backend-wasm-threaded-simd.wasm';\n } else if (simdSupported) {\n path = 'tfjs-backend-wasm-simd.wasm';\n }\n\n if (wasmFileMap != null) {\n if (wasmFileMap[path] != null) {\n return wasmFileMap[path];\n }\n }\n\n return wasmModuleFolder + path;\n}\n\n/**\n * Initializes the wasm module and creates the js <--> wasm bridge.\n *\n * NOTE: We wrap the wasm module in a object with property 'wasm' instead of\n * returning Promise<BackendWasmModule> to avoid freezing Chrome (last tested\n * in Chrome 76).\n */\nexport async function init(): Promise<{wasm: BackendWasmModule}> {\n const [simdSupported,
threadsSupported] = await Promise.all([\n env().getAsync('WASM_HAS_SIMD_SUPPORT'),\n env().getAsync('WASM_HAS_MULTITHREAD_SUPPORT')\n]);\n\n return new Promise((resolve, reject) => {\n const factoryConfig: WasmFactoryConfig = {};\n\n /**\n * This function overrides the Emscripten module locateFile utility.\n * @param path The relative path to the file that needs to be loaded.\n * @param prefix The path to the main JavaScript file's directory.\n */\n factoryConfig.locateFile = (path, prefix) => {\n if (path.endsWith('.worker.js')) {\n const response = wasmWorkerContents;\n const blob = new Blob([response], {type: 'application/javascript'});\n return URL.createObjectURL(blob);\n }\n\n if (path.endsWith('.wasm')) {\n return getPathToWasmBinary(\n simdSupported as boolean, threadsSupported as boolean,\n wasmPathPrefix != null ? wasmPathPrefix : prefix);\n }\n return prefix + path;\n
};\n\n // Use the instantiateWasm override when system fetch is not available.\n // Reference:\n // https://github.com/emscripten-core/emscripten/blob/2bca083cbbd5a4133db61fbd74d04f7feecfa907/tests/manual_wasm_instantiate.html#L170\n if (customFetch) {\n factoryConfig.instantiateWasm =\n createInstantiateWasmFunc(getPathToWasmBinary(\n simdSupported as boolean, threadsSupported as boolean,\n wasmPathPrefix != null ? wasmPathPrefix : ''));\n }\n\n let initialized = false;\n factoryConfig.onAbort = () => {\n if (initialized) {\n // Emscripten already called console.warn so no need to double log.\n return;\n }\n if (initAborted) {\n // Emscripten calls `onAbort` twice, resulting in double error\n // messages.\n return;\n }\n initAborted = true;\n const rejectMsg =\n 'Make sure the server can serve the `.wasm` file relative to the ' +\n 'bundled

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 js file. For more details see https://github.com/tensorflow/tfjs/blob/master/tfjs-backend-wasm/README.md#using-bundlers';\n      reject({message: rejectMsg});\n    };\n\n    let wasm: Promise<BackendWasmModule>;\n    // If `wasmPath` has been defined we must initialize the vanilla module.\n    if (threadsSupported && simdSupported && wasmPath == null) {\n      factoryConfig.mainScriptUrlOrBlob = new Blob(\n          [`var WasmBackendModuleThreadedSimd = ` +\n           wasmFactoryThreadedSimd.toString()],\n          {type: 'text/javascript'});\n      wasm = wasmFactoryThreadedSimd(factoryConfig);\n    } else {\n      // The wasmFactory works for both vanilla and SIMD binaries.\n      wasm = wasmFactory(factoryConfig);\n    }\n\n    // The WASM module has been successfully created by the factory.\n    // Any error will be caught by the onAbort callback defined above.\n    wasm.then((module) => {\n      initialized = true;\n      initAborted = false;\n\n      const voidReturnType: string = null;\n      // Using the tfjs namespace to avoid conflict with emscripten's API.\n      module.tfjs = {\n        init: module.cwrap('init', null, []),\n        initWithThreadsCount:\n            module.cwrap('init_with_threads_count', null, ['number']),\n        getThreadsCount: module.cwrap('get_threads_count', 'number', []),\n        registerTensor: module.cwrap(\n            'register_tensor', null,\n            [\n              'number',  // id\n              'number',  // size\n              'number',  // memoryOffset\n            ]),\n        disposeData: module.cwrap('dispose_data', voidReturnType, ['number']),\n        dispose: module.cwrap('dispose', voidReturnType, []),\n      };\n\n      resolve({wasm: module});\n    });\n  });\n}\n\nfunction typedArrayFromBuffer(\n    buffer: ArrayBuffer, dtype: DataType): backend_util.TypedArray {\n  switch (dtype) {\n    case 'float32':\n      return new Float32Array(buffer);\n    case 'int32':\n      return new Int32Array(buffer);\n    case 'bool':\n      return new Uint8Array(buffer);\n    default:\n      throw new Error(`Unknown dtype ${dtype}`);\n  }\n}\n\nconst wasmBinaryNames = [\n  'tfjs-backend-wasm.wasm', 'tfjs-backend-wasm-simd.wasm',\n  'tfjs-backend-wasm-threaded-simd.wasm'\n] as const ;\ntype WasmBinaryName = typeof wasmBinaryNames[number];\n\nlet wasmPath: string = null;\nlet wasmPathPrefix: string = null;\nlet wasmFileMap: {[key in WasmBinaryName]?: string} = {};\nlet initAborted = false;\nlet customFetch = false;\n\n/**\n * @deprecated Use `setWasmPaths` instead.\n * Sets the path to the `.wasm` file which will be fetched when the wasm\n * backend is initialized. See\n * https://github.com/tensorflow/tfjs/blob/master/tfjs-backend-wasm/README.md#using-bundlers\n * for more details.\n * @param path wasm file path or url\n * @param usePlatformFetch optional boolean to use platform fetch to download\n *     the wasm file, default to false.\n *\n * @doc {heading: 'Environment', namespace: 'wasm'}\n */\nexport function setWasmPath(path: string, usePlatformFetch = false): void {\n  deprecationWarn(\n      'setWasmPath has been deprecated in favor of setWasmPaths and' +\n      ' will be removed in a future release.');\n  if (initAborted) {\n    throw new Error(\n        'The WASM backend was already initialized. Make sure you call ' +\n        '`setWasmPath()` before you call `tf.setBackend()` or `tf.ready()`');\n  }\n  wasmPath = path;\n  customFetch = usePlatformFetch;\n}\n\n/**\n * Configures the locations of the WASM binaries.\n *\n * ```js\n * setWasmPaths({\n *  'tfjs-backend-wasm.wasm': 'renamed.wasm',\n *  'tfjs-backend-wasm-simd.wasm': 'renamed-simd.wasm',\n *  'tfjs-backend-wasm-threaded-simd.wasm': 'renamed-threaded-simd.wasm'\n * });\n * tf.setBackend('wasm');\n * ```\n *\n * @param prefixOrFileMap This can be either a string or object:\n *  - (string) The path to the directory where the WASM binaries are located.\n *     Note that this prefix will be used to load each binary (vanilla,\n *     SIMD-enabled, threading-enabled, etc.).\n *  - (object) Mapping from names of WASM binaries to custom\n *     full paths specifying the locations of those binaries. This is useful if\n *     your WASM binaries are not all located in the same directory, or if your\n *     WASM binaries have been renamed.\n * @param usePlatformFetch optional boolean to use platform fetch to download\n *     the wasm file, default to false.\n *\n * @doc {heading: 'Environment', namespace: 'wasm'}\n */\nexport function setWasmPaths(\n    prefixOrFileMap: string|{[key in WasmBinaryName]?: string},\n    usePlatformFetch = false): void {\n  if (initAborted) {\n    throw new Error(\n        'The WASM backend was already initialized. Make sure you call ' +\n        '`setWasmPaths()` before you call `tf.setBackend()` or ' +\n        '`tf.ready()`');\n  }\n\n  if (typeof prefixOrFileMap === 'string') {\n    wasmPathPrefix = prefixOrFileMap;\n  } else {\n    wasmFileMap = prefixOrFileMap;\n    const missingPaths =\n        wasmBinaryNames.filter(name => wasmFileMap[name] == null);\n    if (missingPaths.length > 0) {\n      throw new Error(\n          `There were no entries found for the following binaries: `
```

+\n `${missingPaths.join(',')}. Please either call setWasmPaths with a ` +\n `map providing a path for each binary, or with a string indicating ` +\n `the directory where all the binaries can be found.`);\n }\n }\n\n customFetch = usePlatformFetch;\n}\n\n/** Used in unit tests. */\nexport function resetWasmPath(): void {\n wasmPath = null;\n wasmPathPrefix = null;\n wasmFileMap = {};\n customFetch = false;\n initAborted = false;\n}\n\nlet threadsCount = -1;\nlet actualThreadsCount = -1;\n\n/**\n * Sets the number of threads that will be used by XNNPACK to create\n * threadpool (default to the number of logical CPU cores).\n *\n * This must be called before calling `tf.setBackend('wasm')`.\n */\nexport function setThreadsCount(numThreads: number) {\n threadsCount = numThreads;\n}\n\n/**\n * Gets the actual threads count that is used by XNNPACK.\n *\n * It is set after the backend is intialized.\n */\nexport function getThreadsCount(): number {\n if (actualThreadsCount === -1) {\n throw new Error(`WASM backend not initialized.`);\n }\n return actualThreadsCount;\n}\n","/** @license See the LICENSE file. */\n\n// This code is auto-generated, do not modify this file!\nconst version = '3.11.0';\nexport {version};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND,
either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n */\n\nimport './flags_wasm';\n\nimport {registerBackend} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm, init} from './backend_wasm';\n\nexport {BackendWasm, getThreadsCount, setThreadsCount, setWasmPath, setWasmPaths} from './backend_wasm';\nexport {version as version_wasm} from './version';\n\nconst WASM_PRIORITY = 2;\nregisterBackend('wasm', async () => {\n const {wasm} = await init();\n return new BackendWasm(wasm);\n},
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cpu/dist/kernels/Concat_impl.js","../src/kernels/Conv2D.ts","../src/kernels/Conv2DBackpropInput.ts","../src/kernels/Cos.ts","../src/kernels/Cosh.ts","../src/kernels/CropAndResize.ts","../src/kernels/Cumsum.ts","../src/kernels/DepthToSpace.ts","../src/kernels/DepthwiseConv2dNative.ts","../src/kernels/Elu.ts","../src/kernels/Equal.ts","../src/kernels/Exp.ts","../src/kernels/ExpandDims.ts","../src/kernels/Fill.ts","../src/kernels/FlipLeftRight.ts","../src/kernels/Floor.ts","../src/kernels/FloorDiv.ts","../src/kernels/FusedBatchNorm.ts","../src/kernels/FusedConv2D.ts","../src/kernels/FusedDepthwiseConv2D.ts","../src/kernels/GatherNd.ts","../src/kernels/GatherV2.ts","../src/kernels/Greater.ts","../src/kernels/GreaterEqual.ts","../src/kernels/LeakyRelu.ts","../src/kernels/Less.ts","../src/kernels/LessEqual.ts","../src/kernels/Log.ts","../src/kernels/LogicalAnd.ts","../src/kernels/Max.ts","../src/kernels/Maximum.ts","../src/kernels/MaxPool.ts","../src/kernels/Mean.ts","../src/kernels/Min.ts","../src/kernels/Minimum.ts","../src/kernels/MirrorPad.ts","../src/kernels/Multiply.ts","../src/kernels/Neg.ts","../src/kernels/NonMaxSuppression_util.ts","../src/kernels/NonMaxSuppressionV3.ts","../src/kernels/NonMaxSuppressionV4.ts","../src/kernels/NonMaxSuppressionV5.ts","../src/kernels/NotEqual.ts","../src/kernels/OneHot.ts","../src/kernels/OnesLike.ts","../src/kernels/Pack.ts","../src/kernels/PadV2.ts","../src/kernels/Pow.ts","../src/kernels/Prelu.ts","../src/kernels/Prod.ts","../src/kernels/Range.ts","../node_modules/@tensorflow/tfjs-backend-
cpu/dist/kernels/Range_impl.js","../src/kernels/RealDiv.ts","../src/kernels/Relu.ts","../src/kernels/Relu6.ts","../src/kernels/ResizeBilinear.ts","../src/kernels/Reverse.ts","../src/kernels/RotateWithOffset.ts","../src/kernels/Round.ts","../src/kernels/Rsqrt.ts","../src/kernels/ScatterNd.ts","../src/kernels/Select.ts","../src/kernels/Sigmoid.ts","../src/kernels/Sin.ts","../src/kernels/Softmax.ts","../src/kernels/SpaceToBatchND.ts","../src/kernels/SplitV.ts","../src/kernels/Sqrt.ts","../src/kernels/Square.ts","../src/kernels/SquaredDifference.ts","../src/kernels/Step.ts","../src/kernels/StridedSlice.ts","../src/kernels/Sub.ts","../src/kernels/Sum.ts","../src/kernels/Tan.ts","../src/kernels/Tanh.ts","../src/kernels/Tile.ts","../src/kernels/TopK.ts","../src/kernels/Transform.ts","../src/kernels/ZerosLike.ts","../src/register_all_kernels.ts","../src/kernels/Unpack.ts","../src/flags_wasm.ts","../wasm-out/tfjs-backend-wasm-threaded-simd.js","../wasm-out/tfjs-backend-wasm.js","../src/backend_wasm.ts","../wasm-out/tfjs-backend-wasm-threaded-simd.worker.js","../src/version.ts","../src/base.ts"],"sourcesContent":["/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT
WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\n// This enum must align with the enum defined in cc/backend.h.\nexport enum CppDType {\n float32 = 0,\n int32 = 1,\n bool = 2,\n string = 3,\n complex64 = 4\n}\n\n// Must match enum in cc/fusable_activations.h.\nexport enum FusableActivation {\n linear = 0,\n relu = 1,\n relu6 = 2,\n prelu = 3,\n leakyrelu = 4,\n sigmoid = 5,\n elu = 6\n}\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n
* distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {_FusedMatMul, _FusedMatMulAttrs, _FusedMatMulInputs, KernelConfig, KernelFunc} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {FusableActivation} from './types';\n\nlet wasmFusedMatMul:\n   (aId: number, aShape: Uint8Array, aShapeSize: number, bId: number,\n

bShape: Uint8Array, bShapeSize: number, transposeA: boolean,\n transposeB: boolean, activation: number, biasId: number,\n preluActivationWeightsId: number, leakyreluAlpha: number, outId: number) =>\n void;\n\nfunction setup(backend: BackendWasm) {\n wasmFusedMatMul = backend.wasm.cwrap(_FusedMatMul, null /* void */, [\n 'number', // a_id\n 'array', // a_shape\n 'number', // a_shape.length\n 'number', // b_id\n 'array', // b_shape\n 'number', // b_shape.length\n 'number', // transpose_a\n 'number', // transpose_b\n 'number', // activation\n 'number', // biasId\n 'number', // preluActivationWeightsId\n 'number', // leakyreluAlpha\n 'number' // out_id\n]);\n}\n\nfunction fusedBatchMatMul(args: {\n inputs: _FusedMatMulInputs,\n backend: BackendWasm,\n attrs: _FusedMatMulAttrs\n}) {\n const {inputs, backend, attrs} = args;\n const {a, b, bias, preluActivationWeights} = inputs;\n\n if (a.dtype !== 'float32' || b.dtype !== 'float32') {\n throw new Error(\n `_FusedMatMul for non non-float32 tensors not yet supported.`);\n }\n\n const {transposeA, transposeB, activation, leakyreluAlpha} = attrs;\n const aId = backend.dataIdMap.get(a.dataId).id;\n const bId = backend.dataIdMap.get(b.dataId).id;\n\n let biasId = 0;\n if (bias != null)
{\n const biasData = backend.dataIdMap.get(bias.dataId);\n if (biasData.shape.length !== 1) {\n throw new Error(\n `_FusedMatMul only supports rank-1 bias but got ` +\n `rank ${biasData.shape.length}.`);\n }\n biasId = biasData.id;\n }\n const preluActivationWeightsId = preluActivationWeights == null ?\n 0 :\n backend.dataIdMap.get(preluActivationWeights.dataId).id;\n const fusedActivation =\n FusableActivation[activation as {} as keyof typeof FusableActivation];\n if (fusedActivation == null) {\n throw new Error(\n `${activation} activation not yet supported for FusedConv2D ` +\n `in the wasm backend.`);\n }\n\n const leftDim = transposeA ? a.shape[2] : a.shape[1];\n const rightDim = transposeB ? b.shape[1] : b.shape[2];\n const batchDim = a.shape[0];\n\n const out = backend.makeOutput([batchDim, leftDim, rightDim], a.dtype);\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n const aShapeBytes = new Uint8Array(new
Int32Array(a.shape).buffer);\n const bShapeBytes = new Uint8Array(new Int32Array(b.shape).buffer);\n\n wasmFusedMatMul(\n aId, aShapeBytes, a.shape.length, bId, bShapeBytes, b.shape.length,\n transposeA, transposeB, fusedActivation, biasId, preluActivationWeightsId,\n leakyreluAlpha || 0, outId);\n\n return out;\n}\n\nexport const fusedMatMulConfig: KernelConfig = {\n kernelName: _FusedMatMul,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: fusedBatchMatMul as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES
OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n */\n\nimport {DataType, KernelConfig, TensorInfo, UnaryInputs, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {CppDType} from './types';\n\nexport function createUnaryKernelConfig(\n kernelName: string, outType?: DataType): KernelConfig {\n let wasmFunc: (xId: number, dtype: number, outId: number) => void;\n\n function setupFunc(backend: BackendWasm): void {\n wasmFunc = backend.wasm.cwrap(kernelName, null /* void */, [\n 'number', // x_id\n 'number', // dtype\n 'number', // out_id\n]);\n }\n\n function kernelFunc(args: {backend: BackendWasm, inputs: UnaryInputs}):\n TensorInfo {\n const {backend, inputs: {x}} = args;\n const xId = backend.dataIdMap.get(x.dataId).id;\n
const out = backend.makeOutput(x.shape, outType || x.dtype);\n const outId =
backend.dataIdMap.get(out.dataId).id;\n\n // Short-circuit zero-sized tensors.\n if (util.sizeFromShape(out.shape) === 0) {\n return out;\n }\n\n wasmFunc(xId, CppDType[x.dtype], outId);\n return out;\n }\n\n return {kernelName, backendName: 'wasm', setupFunc, kernelFunc};\n}\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n *

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and\n * limitations under the License.\n *
==========\n */\nimport {Abs, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\n\nexport const absConfig: KernelConfig = createUnaryKernelConfig(Abs);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {backend_util, BinaryInputs, DataType, KernelConfig, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {CppDType} from './types';\n\nexport function createBinaryKernelConfig(\n kernelName: string, supportsFullBroadcast: boolean,\n dtype?: DataType): KernelConfig {\n let wasmFunc:\n (aId: number, aShape: Uint8Array, aShapeLen: number, bId: number,\n bShape: Uint8Array, bShapeLen: number, dtype: number, outId: number) =>\n void;\n\n function setupFunc(backend: BackendWasm): void {\n wasmFunc = backend.wasm.cwrap(kernelName, null /* void */, [\n 'number', // a_id,\n 'array', // a_shape\n 'number', // a_shape.length\n 'number', // b_id\n 'array', // b_shape\n 'number', // b_shape.length\n 'number', // dtype\n 'number' // out_id\n]);\n }\n\n function kernelFunc(args: {backend: BackendWasm, inputs:
BinaryInputs}):\n TensorInfo {\n const {backend, inputs} = args;\n const {a, b} = inputs;\n const aId = backend.dataIdMap.get(a.dataId).id;\n const bId = backend.dataIdMap.get(b.dataId).id;\n\n const outputType = dtype != null ? dtype : a.dtype;\n const newShape = backend_util.assertAndGetBroadcastShape(a.shape, b.shape);\n const out = backend.makeOutput(newShape, outputType);\n\n // Short-circuit zero-sized tensors.\n if (util.sizeFromShape(newShape) === 0) {\n return out;\n }\n\n const aShapeBytes = new Uint8Array(new Int32Array(a.shape).buffer);\n const bShapeBytes = new Uint8Array(new Int32Array(b.shape).buffer);\n const outId = backend.dataIdMap.get(out.dataId).id;\n const kernelFunc = () => wasmFunc(\n aId, aShapeBytes, a.shape.length, bId, bShapeBytes, b.shape.length,\n CppDType[a.dtype], outId);\n\n // Currently only some float operations support full broadcast.\n if (supportsFullBroadcast && a.dtype ===
'float32') {\n kernelFunc();\n return out;\n }\n\n const aBroadcastDims = backend_util.getBroadcastDims(a.shape, newShape);\n const bBroadcastDims = backend_util.getBroadcastDims(b.shape, newShape);\n const loopsOverAllOfA = aBroadcastDims.every((v, i) => v === i);\n const loopsOverAllOfB = bBroadcastDims.every((v, i) => v === i);\n if (loopsOverAllOfA && loopsOverAllOfB) {\n kernelFunc();\n return out;\n } else {\n throw new Error(\n `Broadcasting along outer dims is not yet ` +\n `supported for ${a.dtype} ${kernelName}.`);\n }\n }\n\n return {kernelName, backendName: 'wasm', setupFunc, kernelFunc};\n}\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless
required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {Add, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from

'./binary_kernel';\n\nconst supportsFullBroadcast = true;\n\nexport const addConfig: KernelConfig =\n createBinaryKernelConfig(Add, supportsFullBroadcast);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by
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==========\n */\n\nimport {AddN, KernelConfig, KernelFunc, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {CppDType} from './types';\n\nlet wasmFunc:\n (inputIds: Uint8Array, inputIdsLen: number, dtype: number, outId: number) =>\n void;\n\nfunction setupFunc(backend: BackendWasm): void {\n wasmFunc = backend.wasm.cwrap(AddN, null /* void */, [\n 'array', // input_ids\n 'number', // input_ids.length\n 'number', // dtype\n 'number', // out_id\n]);\n}\n\nfunction addn(args: {inputs: TensorInfo[], backend: BackendWasm}) {\n const
{inputs, backend} = args;\n const out = backend.makeOutput(inputs[0].shape, inputs[0].dtype);\n\n // Short-circuit zero-sized tensors.\n if (util.sizeFromShape(out.shape) === 0) {\n return out;\n }\n\n const inputIds = inputs.map(x => backend.dataIdMap.get(x.dataId).id);\n const inputIdsBytes = new Uint8Array(new Int32Array(inputIds).buffer);\n const outId = backend.dataIdMap.get(out.dataId).id;\n wasmFunc(inputIdsBytes, inputIds.length, CppDType[out.dtype], outId);\n\n return out;\n}\n\nexport const addNConfig: KernelConfig = {\n kernelName: AddN,\n backendName: 'wasm',\n setupFunc,\n kernelFunc: addn as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law
or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {Identity, IdentityInputs, KernelConfig, KernelFunc} from '@tensorflow/tfjs-core';\nimport {TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nexport function identity(args: {inputs: IdentityInputs, backend: BackendWasm}):\n TensorInfo {\n const {inputs: {x}, backend} = args;\n const out = backend.makeOutput(x.shape, x.dtype);\n const inVals = backend.typedArrayFromHeap(x);\n const outVals = backend.typedArrayFromHeap(out);\n outVals.set(inVals);\n return out;\n}\n\nexport const identityConfig: KernelConfig = {\n kernelName: Identity,\n backendName: 'wasm',\n
kernelFunc: identity as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {KernelConfig, KernelFunc, TensorInfo, Transpose, TransposeAttrs, TransposeInputs} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {identity} from './Identity';\nimport {CppDType}
from './types';\n\nlet wasmTranspose: (\n xId: number, xShape: Uint8Array, xShapeLength: number, dtype: CppDType,\n outId: number, perm: Uint8Array, permLength: number) => void;\n\nfunction setup(backend:

BackendWasm) {\n wasmTranspose = backend.wasm.cwrap(Transpose, null /* void */, [\n   'number', // xId\n   'array',   // x.shape\n   'number', // x.shape.length\n   'number', // dtype\n   'number', // outId\n   'array',   // perm\n   'number', // perm.length\n]);\n}\n\nexport function transpose(\n   args:\n   {inputs: TransposeInputs, backend: BackendWasm, attrs: TransposeAttrs}):\n   TensorInfo {\n const {inputs, backend, attrs} = args;\n // Reduce any dimensions with size one. Lower-rank transpose kernel performs\n // better due to simpler memory access pattern.\n const [reducedShape, perm] = removeOneSizeDims(inputs.x.shape, attrs.perm);\n\n let permIsNoOp = true;\n for (let i = 0; i < perm.length; i++) {\n   if (perm[i] !== i) {\n   permIsNoOp = false;\n   }\n }\n const outShape = computeOutShape(inputs.x.shape, attrs.perm);\n const x = {\n   dataId: inputs.x.dataId,\n   shape: reducedShape,\n   dtype: inputs.x.dtype\n };\n\n if (permIsNoOp) {\n   const cloned = identity({inputs, backend});\n   cloned.shape = outShape;\n   return cloned;\n }\n\n const out = backend.makeOutput(outShape, x.dtype);\n const xId = backend.dataIdMap.get(x.dataId).id;\n const outId = backend.dataIdMap.get(out.dataId).id;\n const permBytes = new Uint8Array(new Int32Array(perm).buffer);\n const xShapeBytes = new Uint8Array(new Int32Array(x.shape).buffer);\n\n wasmTranspose(\n   xId, xShapeBytes, x.shape.length, CppDType[x.dtype], outId, permBytes,\n   perm.length);\n return out;\n}\n\nfunction computeOutShape(inShape: number[], perm: number[]): number[] {\n const outShape = new Array(inShape.length);\n for (let i = 0; i < outShape.length; i++) {\n   outShape[i] = inShape[perm[i]];\n }\n return outShape;\n}\n\nfunction
  removeOneSizeDims(\n   shape: number[], perm: number[]): [number[], number[]] {\n const newShape: number[] = [];\n const newPerm: number[] = [];\n for (let i = 0; i < shape.length; ++i) {\n   if (shape[i] !== 1) {\n   newShape.push(shape[i]);\n   }\n   if (shape[perm[i]] !== 1) {\n   newPerm.push(perm[i]);\n   }\n }\n for (let i = 0; i < newPerm.length; ++i) {\n   let minValIdx = -1;\n   for (let j = 0; j < newPerm.length; ++j) {\n   if (newPerm[j] >= i &&\n   (minValIdx === -1 || newPerm[minValIdx] > newPerm[j])) {\n   minValIdx = j;\n   }\n   }\n   newPerm[minValIdx] = i;\n }\n return [newShape, newPerm];\n}\n\nexport const transposeConfig: KernelConfig = {\n kernelName: Transpose,\n backendName: 'wasm',\n kernelFunc: transpose as {} as KernelFunc,\n setupFunc: setup,\n};\n","/**\n * @license\n * Copyright 2020 Google Inc. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use
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  ==\n
  */\n\nimport {backend_util, TensorInfo, util} from '@tensorflow/tfjs-core';\nimport {BackendWasm} from '../backend_wasm';\nimport {transpose} from './Transpose';\n\n/**\n * Compute permutation axes and do a transpose if necessary.\n *\n * Used by reduction ops.\n * @param x input TensorInfo\n * @param axis reduction axes\n * @param backend wasm backend instance\n */\nexport function permuteAxesAndTranspose(\n   x: TensorInfo, axis: number|number[],
  backend: BackendWasm): {\n transposed: TensorInfo|null,\n axes: number[],\n originalAxes: number[],\n inputWasTransposed: boolean\n} {\n const xShape = x.shape;\n const xRank = x.shape.length;\n\n const originalAxes = util.parseAxisParam(axis, xShape);\n let axes = originalAxes;\n const permutedAxes = backend_util.getAxesPermutation(axes, xRank);\n let xTransposed = null;\n let inputWasTransposed = false;\n if (permutedAxes != null) {\n   const newShape: number[] = new Array(xRank);\n   for (let i = 0; i < newShape.length; i++) {\n   newShape[i] = xShape[permutedAxes[i]];\n   }\n\n   axes = backend_util.getInnerMostAxes(axes.length, xRank);\n   xTransposed =\n   transpose({inputs: {x}, attrs: {perm: permutedAxes}, backend});\n\n   const xId = backend.dataIdMap.get(x.dataId).id;\n   const transposedId = backend.dataIdMap.get(xTransposed.dataId).id;\n   if (transposedId !== xId) {\n   inputWasTransposed = true;\n   }\n }\n\n return {transposed:

xTransposed, originalAxes, axes, inputWasTransposed};\n}\n","/**\n * @license\n * Copyright 2021 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {All, AllAttrs, AllInputs, backend_util, KernelConfig, KernelFunc, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {permuteAxesAndTranspose} from './kernel_utils';\n\nlet wasmAll: (xId: number, reduceSize: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n wasmAll = backend.wasm.cwrap(All, null /*void*/, ['number, number, number']);\n}\n\nfunction all(args: {backend: BackendWasm, inputs: AllInputs, attrs: AllAttrs}):\n TensorInfo {\n const {backend, inputs, attrs} = args;\n const {axis, keepDims} = attrs;\n const {x} = inputs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n let inputId = xId;\n let input = x;\n\n const {transposed, axes, originalAxes, inputWasTransposed} =\n permuteAxesAndTranspose(x, axis, backend);\n\n if (inputWasTransposed) {\n const transposedId = backend.dataIdMap.get(transposed.dataId).id;\n input = transposed;\n inputId = transposedId;\n }\n\n const inputRank = input.shape.length;\n backend_util.assertAxesAreInnerMostDims('all', axes, inputRank);\n const [outShape, reduceShape] =\n backend_util.computeOutAndReduceShapes(input.shape,\n axes);\n const reduceSize = util.sizeFromShape(reduceShape);\n\n const out = backend.makeOutput(outShape, x.dtype);\n if (util.sizeFromShape(input.shape) !== 0) {\n const outId = backend.dataIdMap.get(out.dataId).id;\n wasmAll(inputId, reduceSize, outId);\n }\n\n if (inputWasTransposed) {\n // dispose of the transposed tensor.\n backend.disposeData(transposed.dataId);\n }\n\n if (keepDims) {\n // reshape\n const newShape = backend_util.expandShapeToKeepDim(out.shape, originalAxes);\n out.shape = newShape;\n }\n\n return out;\n}\n\nexport const allConfig: KernelConfig = {\n kernelName: All,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: all as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2021 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {Any, AnyAttrs, AnyInputs, backend_util, KernelConfig, KernelFunc, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {permuteAxesAndTranspose} from './kernel_utils';\n\nlet wasmAny: (xId: number, reduceSize: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n wasmAny = backend.wasm.cwrap(Any, null /*void*/, ['number, number, number']);\n}\n\nfunction any(args: {backend: BackendWasm, inputs: AnyInputs, attrs: AnyAttrs}):\n TensorInfo {\n const {backend,\n inputs, attrs} = args;\n const {axis, keepDims} = attrs;\n const {x} = inputs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n let inputId = xId;\n let input = x;\n\n const {transposed, axes, originalAxes, inputWasTransposed} =\n permuteAxesAndTranspose(x, axis, backend);\n\n if (inputWasTransposed) {\n const transposedId = backend.dataIdMap.get(transposed.dataId).id;\n input = transposed;\n inputId = transposedId;\n }\n\n const inputRank = input.shape.length;\n backend_util.assertAxesAreInnerMostDims('any', axes, inputRank);\n const [outShape, reduceShape] =\n

backend_util.computeOutAndReduceShapes(input.shape, axes);\n const reduceSize = util.sizeFromShape(reduceShape);\n\n const out = backend.makeOutput(outShape, x.dtype);\n if (util.sizeFromShape(input.shape) !== 0) {\n   const outId = backend.dataIdMap.get(out.dataId).id;\n wasmAny(inputId, reduceSize, outId);\n }\n\n if (inputWasTransposed) {\n   // dispose of the transposed tensor.\n   backend.disposeData(transposed.dataId);\n }\n\n if (keepDims) {\n   // reshape\n   const newShape = backend_util.expandShapeToKeepDim(out.shape, originalAxes);\n   out.shape = newShape;\n }\n\n return out;\n}\n\nexport const anyConfig: KernelConfig = {\n kernelName: Any,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: any as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the
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/\n\nimport {ArgMax, ArgMaxAttrs, ArgMaxInputs, KernelConfig, KernelFunc, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {permuteAxesAndTranspose} from './kernel_utils';\nimport {CppDType} from './types';\n\nlet wasmFunc: (\n   xId: number, dtype: number, outerSize: number, innerSize: number,\n   outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmFunc = backend.wasm.cwrap(ArgMax, null / void */, [\n   'number', // x_id\n   'number', // dtype\n 'number', // outer_size\n   'number', // inner_size\n   'number'   // out_id\n]);\n}\n\nfunction argmax(\n   args: {inputs: ArgMaxInputs, backend: BackendWasm, attrs: ArgMaxAttrs}) {\n const {backend, inputs, attrs} = args;\n const {axis} = attrs as {} as ArgMaxAttrs;\n const {x} = inputs as {} as ArgMaxInputs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n let
 inputId = xId;\n let input = x;\n\n const {transposed, axes, inputWasTransposed} =\n permuteAxesAndTranspose(x, axis, backend);\n\n if (inputWasTransposed) {\n   const transposedId = backend.dataIdMap.get(transposed.dataId).id;\n   if (transposedId !== xId) {\n   // transpose was not a no-op. We will need to dispose of this\n   // once we are done.\n   input = transposed;\n   inputId = transposedId;\n   }\n }\n\n const outShape = input.shape.slice(0, -1);\n const out = backend.makeOutput(outShape, 'int32');\n const outId = backend.dataIdMap.get(out.dataId).id;\n const outerSize = util.sizeFromShape(out.shape);\n const innerSize = input.shape[axes[0]];\n wasmFunc(inputId, CppDType[input.dtype], outerSize, innerSize, outId);\n\n if (inputWasTransposed) {\n   // dispose of the transposed tensor.\n   backend.disposeData(transposed.dataId);\n }\n\n return out;\n}\n\nexport const argMaxConfig: KernelConfig = {\n kernelName: ArgMax,\n backendName: 'wasm',\n
  kernelFunc: argmax as {} as KernelFunc,\n setupFunc: setup\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
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*/\n\nimport {AvgPool, AvgPoolAttrs, AvgPoolInputs, backend_util, KernelConfig, KernelFunc, Tensor4D} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmAvgPool: (\n xId: number, batchSize: number, inputHeight: number, inputWidth: number,\n   filterHeight: number, filterWidth: number, padTop: number, padRight: number,\n   padBottom: number, padLeft: number, strideHeight: number,\n stride Width: number, channels: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n

wasmAvgPool = backend.wasm.cwrap(AvgPool, null /* void */, [\n 'number', // xId\n 'number', // batchSize\n 'number', // inputHeight\n 'number', // inputWidth\n 'number', // filterHeight\n 'number', // filterWidth\n 'number', // padTop\n 'number', // padRight\n 'number', // padBottom\n 'number', // padLeft\n 'number', // strideHeight\n 'number', // strideWidth\n 'number', // channels\n 'number', // outId\n]);\n}\n\nfunction avgPool(\n args: {inputs: AvgPoolInputs, backend: BackendWasm, attrs: AvgPoolAttrs}) {\n const {inputs, attrs, backend} = args;\n\n const x = inputs.x as Tensor4D;\n const xId = backend.dataIdMap.get(x.dataId).id;\n\n const {filterSize, strides, pad, dimRoundingMode} = attrs;\n const convInfo = backend_util.computePool2DInfo(\n x.shape, filterSize, strides, 1 /* dilations */, pad, dimRoundingMode);\n\n const filterHeight = convInfo.filterHeight;\n const filterWidth = convInfo.filterWidth;\n const padTop = convInfo.padInfo.top;\n const padRight = convInfo.padInfo.right;\n const padBottom = convInfo.padInfo.bottom;\n const padLeft = convInfo.padInfo.left;\n const strideHeight = convInfo.strideHeight;\n const strideWidth = convInfo.strideWidth;\n const channels = convInfo.inChannels;\n\n if (convInfo.dataFormat !== 'channelsLast') {\n throw new Error(\n `wasm backend does not support dataFormat:` +\n `${convInfo.dataFormat}'. Please use 'channelsLast'.`);\n }\n\n if (convInfo.dilationWidth !== 1 || convInfo.dilationHeight !== 1) {\n throw new Error(\n `was backend only supports average pooling with dilation = [1, 1],\n ` +\n `got [${convInfo.dilationHeight}, ${convInfo.dilationWidth}].`);\n }\n\n const out = backend.makeOutput(convInfo.outShape, 'float32');\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n wasmAvgPool(\n xId, x.shape[0], x.shape[1], x.shape[2], filterHeight, filterWidth,\n padTop, padRight, padBottom, padLeft, strideHeight, strideWidth, channels,\n outId);\n return out;\n}\n\nexport const avgPoolConfig: KernelConfig = {\n kernelName: AvgPool,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: avgPool as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==*/\n\nimport {KernelConfig, KernelFunc, Reshape, ReshapeAttrs, ReshapeInputs, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nexport function reshape(\n args: {inputs: ReshapeInputs, attrs: ReshapeAttrs, backend: BackendWasm}) {\n const {inputs, attrs} = args;\n const {x} = inputs;\n const {shape} = attrs;\n\n const xSize = util.sizeFromShape(x.shape);\n const $shape = util.inferFromImplicitShape(shape, xSize);\n\n util.assert(\n xSize === util.sizeFromShape($shape),\n () => `new shape: ${$shape}, old shape: ${x.shape}. New shape and old ` +\n `shape must have the same number of elements.`);\n\n // Backend needs to track refCount for the dataId for reshape op\n args.backend.incRef(x.dataId);\n return {dataId: x.dataId, shape: $shape, dtype: x.dtype};\n}\n\nexport const reshapeConfig: KernelConfig = {\n kernelName: Reshape,\n backendName: 'wasm',\n kernelFunc: reshape as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==*/

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*/\n\nimport {BatchMatMul, BatchMatMulAttrs, BatchMatMulInputs, KernelConfig, KernelFunc, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {reshape} from './Reshape';\n\nlet wasmBatchMatMul: (\n  aId: number, aShape: Uint8Array, aShapeSize: number, bId: number,\n  bShape: Uint8Array, bShapeSize: number, transposeA: boolean,\n  transposeB: boolean, outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n  wasmBatchMatMul = backend.wasm.cwrap(BatchMatMul, null /* void */, [\n    'number',  // a_id\n    'array',   // a_shape\n    'number',  // a_shape.length\n    'number',  // b_id\n    'array',   // b_shape\n    'number',  // b_shape.length\n    'number',  // transpose_a\n    'number',  // transpose_b\n    'number'   // out_id\n  ]);\n}\n\nfunction batchMatMul(args: {\n  inputs: BatchMatMulInputs,\n  backend: BackendWasm,\n  attrs: BatchMatMulAttrs\n}) {\n  const {inputs, backend, attrs} = args;\n  const {a, b} = inputs;\n  const
  {transposeA, transposeB} = attrs;\n\n  if (a.dtype !== 'float32' || b.dtype !== 'float32') {\n    throw new Error(\n`BatchMatMul for non non-float32 tensors not yet supported.`);\n  }\n\n  const aRank = a.shape.length;\n  const bRank = b.shape.length;\n\n  const innerShapeA = transposeA ? a.shape[aRank - 2] : a.shape[aRank - 1];\n  const innerShapeB = transposeB ? b.shape[bRank - 1] : b.shape[bRank - 2];\n\n  const outerShapeA = transposeA ? a.shape[aRank - 1] : a.shape[aRank - 2];\n  const outerShapeB = transposeB ? b.shape[bRank - 2] : b.shape[bRank - 1];\n\n  const outerDimsA = a.shape.slice(0, -2);\n  const outerDimsB = b.shape.slice(0, -2);\n\n  const batchDimA = util.sizeFromShape(outerDimsA);\n  const batchDimB = util.sizeFromShape(outerDimsB);\n\n  const batchDimsCompatible =\n      batchDimA === batchDimB || batchDimA === 1 || batchDimB === 1;\n\n  util.assert(\n      aRank >= 2 && bRank >= 2 && batchDimsCompatible,\n      () => `Error in matMul: the input batch dimensions
  must either be the ` +\n          `same or at least one input batch dimension must be 1. Got input ` +\n          `batch dimensions of (${outerDimsA}) and (${outerDimsB}).`);\n\n  const outShapeOuterDims =\n      batchDimA > batchDimB ? a.shape.slice(0, -2) : b.shape.slice(0, -2);\n  const outShape = outShapeOuterDims.concat([outerShapeA, outerShapeB]);\n\n  util.assert(\n      innerShapeA === innerShapeB,\n      () => `Error in matMul: inner shapes (${innerShapeA}) and (` +\n          `${innerShapeB}) of Tensors with shapes ${a.shape} and ` +\n          `${b.shape} and transposeA=${transposeA}` +\n          ` and transposeB=${transposeB} must match.`);\n\n  const a3dShape = transposeA ? [batchDimA, innerShapeA, outerShapeA] :\n      [batchDimA, outerShapeA, innerShapeA];\n  const b3dShape = transposeB ? [batchDimB, outerShapeB, innerShapeB] :\n                                [batchDimB, innerShapeB, outerShapeB];\n\n  // The rest of the implementation
  is designed to operate on rank-3 tensors\n  const a3d = reshape({inputs: {x: a}, backend, attrs: {shape: a3dShape}});\n  const b3d = reshape({inputs: {x: b}, backend, attrs: {shape: b3dShape}});\n\n  const a3dId = backend.dataIdMap.get(a3d.dataId).id;\n  const b3dId = backend.dataIdMap.get(b3d.dataId).id;\n\n  const leftDim = transposeA ? a3d.shape[2] : a3d.shape[1];\n  const rightDim = transposeB ? b3d.shape[1] : b3d.shape[2];\n  const batchDim = Math.max(batchDimA, batchDimB);\n\n  const out = backend.makeOutput([batchDim, leftDim, rightDim], a3d.dtype);\n  const outId = backend.dataIdMap.get(out.dataId).id;\n\n  const aShapeBytes = new Uint8Array(new Int32Array(a3d.shape).buffer);\n  const bShapeBytes = new Uint8Array(new Int32Array(b3d.shape).buffer);\n\n  wasmBatchMatMul(\n      a3dId, aShapeBytes, a3d.shape.length, b3dId, bShapeBytes,\n      b3d.shape.length, transposeA, transposeB, outId);\n\n  backend.disposeData(a3d.dataId);\n  backend.disposeData(b3d.dataId);\n\n  out.shape
  = outShape;\n  return out;\n}\n\nexport const batchMatMulConfig: KernelConfig = {\n  kernelName: BatchMatMul,\n  backendName: 'wasm',\n  setupFunc: setup,\n  kernelFunc: batchMatMul as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the
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*/\nimport { backend_util, buffer, Slice, slice_util, util } from '@tensorflow/tfjs-core';\nimport
{ assertNotComplex } from '../cpu_util';\nexport function sliceImpl(vals, begin, size, shape, dtype) {\n const
isContinous = slice_util.isSliceContinous(shape, begin, size);\n const length = util.sizeFromShape(size);\n const
xStrides = util.computeStrides(shape);\n if (isContinous) {\n const flatOffset =
slice_util.computeFlatOffset(begin, xStrides);\n if (dtype === 'string') {\n return vals.slice(flatOffset,
flatOffset + length);\n }\n return vals.subarray(flatOffset, flatOffset + length);\n }\n const decodedData
= dtype === 'string' ?\n backend_util.fromUint8ToStringArray(vals) :\n vals;\n const inBuf =
buffer(shape, dtype, decodedData);\n const outBuf = buffer(size, dtype);\n for (let i = 0; i < outBuf.size; ++i) {\n
const outLoc = outBuf.indexToLoc(i);\n const inLoc = outLoc.map((idx, j) => idx + begin[j]);\n
outBuf.set(inBuf.get(...inLoc), ...outLoc);\n
}\n if (dtype === 'string') {\n return backend_util.fromStringArrayToUint8(outBuf.values);\n }\n return
outBuf.values;\n}\nexport function slice(args) {\n const { inputs, backend, attrs } = args;\n const { x } =
inputs;\n const { begin, size } = attrs;\n assertNotComplex(x, 'slice');\n const [$begin, $size] =
slice_util.parseSliceParams(x, begin, size);\n slice_util.assertParamsValid(x, $begin, $size);\n const vals =
backend.data.get(x.dataId).values;\n const outVals = sliceImpl(vals, $begin, $size, x.shape, x.dtype);\n return
backend.makeTensorInfo($size, x.dtype, outVals);\n}\nexport const sliceConfig = {\n kernelName: Slice,\n
backendName: 'cpu',\n kernelFunc: slice\n};\n//#
sourceMappingURL=data:application/json; base64,eyJ2ZXJzaW9uIjozLCJmaWxlIjoiU2xpY2UuanMiLCJzb3VyY2
VSb290IjoiIiwic291cmNlcyI6WyIuLi8uLi8uLi8uLi8uLi8uLi90ZmpzLWJhY2tlbmQtY3B1L3NyYy9rZXJuZWxzL
1NsaWNlLnRzIl0sIm5hbWVzIjpbXSwibWFwcGluZ3MiOiJBQUFBOzs7Ozs7Ozs7Ozs7R0FlRztBQUVILE9sRUFBQyxxZQUFZLEVBBQWlCLE1BQU0sRUFBc0MsMsS0FBSUFBSSxFQUFBQyxFQUFBQyxFQUFBQy

sQ0FBQyxFQUFDLEdBQUcsTUFBTSxDQUFDO0lBQ25CLE1BQU0sRUFBQyxLQUFLLEVBQUUsSUFBSSx
FQUFDLEdBQUcsS0FBSyxDQUFDO0lBRTVCLGdCQUFnQixDQUFDLENBQUMsRUFBRSxPQUFPLENBQ
UMsQ0FBQztJQUU3QixNQUFNLENBQUMsTUFBTSxFQUFFLEtBQUssQ0FBQyxHQUFHLFVBQVUsQ0FB
QyxnQkFBZ0IsQ0FBQyxDQUFDLEVBQUUsS0FBSyxFLElBQUksQ0FBQyxDQUFDLEVBQUUsQ3BFLFVBQ
VUsQ0FBQyxpQkFBaUIsQ0FBQyxDQUFDLEVBQUUsTUFBTSxFQUFFLEtBQUssQ0FBQyxDQUFDLEVBQUUsQ3BFLFVBQ
9DLE1BQU0sSUFBSSxHQUE9BQU8sQ0FBQyxDQUFDLEVBQUUsSUFBSSxFQUFFLENBQUMsR0FBRyxDQUFDLENBQUMsQ0FBQ
yxNQUFNLENBQUMsQ0FBQyxNQUFNLENBQUM7SUFEL0MsTUFBTSxPQUFPLEdBQUcsQUFBQyxDQUFDLEVBQUUsTUFBTSxFQUFFLEtBQUssQ
DLElBQUksRUFBRSxNQUFNLEVBQUUsS0FBSyxFLENBQUMsQ0FBQyxFQUFFLEtBQUssQ0FBQyxDQUFDLEVBQUUsQ0FBQyxDQUFDLEVBQUUsQ
xDQUFDLEtBQUssQ0FBQyxDQUFDLEVBQUUsQ0FBQyxDQUFDLEVBQUUsQ3pFLE9BQU8sT0FBTyxDQUFDLEVBQUUsQ0FBQyxDQUFDLEVBQUUsQ
VBQUUsQ0FBQyxDQUFDLEVBQUUsQ0FBQyxDQUFDLEVBQUUsQ3pFLE9BQU8sT0FBTyxDQUFDLEVBQUUsQ0FBQyxDQUFDLEVBQUUsQ
TUFBTSxDQUFDLENBQUMsRUFBRSxDQUFDLEVBQUUsQ3pFLE9BQU8sT0FBTyxDQUFDLEVBQUUsQ0FBQyxDQUFDLEVBQUUsQ
VBQUUsQ0FBQyxDQUFDLEVBQUUsQ0FBQyxDQUFDLEVBQUUsQ3pFLE9BQU8sT0FBTyxDQUFDLEVBQUUsQ0FBQyxDQUFDLEVBQUUsQ
bIi8qKlxuICogQGxpY2Vuc2VcbiAqIENvcHlyaWdodCAyMDIwIEdvb2dsZSBMTEMuIEFsbCBSaWdodHMgUm
VzZXJ2ZWQuXG4gKiBMaWNlbnNlZCB1bmRlciB0aGUgQXBhY2hlIExpY2Vuc2UsIFZlcnNpb24gMi4wIHh0a
GUgXCJMaWNlbnNlXCIpO1xuICogeW91IG1heSBub3QgdXNlIHRoaXMgZmlsZSBleGNlcHQgaW4gY29tcGxp
YW5jZSB3aXRoIHRoZSBMaWNlbnNlLlxuICogWW91IG1heSBvYnRhaW4gYSBjb3B5IG9mIHRoZSBMaWNlb
nNlIGF0XG4gKlxuICogaHR0cDovL3d3dy5hcGFjaGUub3JnL2xpY2Vuc2VzL0xJQ0VOU0UtMi4wXG4gKlxuICog
ogVW5sZXNzIHJlcXVpcmVkIGJ5IGFwcGxpcGUgbGF3IG9yIGFncmVlZCB0byBpbiB3cml0aW5nLCBzb2
Z0d2FyZVxuICogZGlzdHJpYnV0ZWQgdW5kZXIgdGhlIExpY2Vuc2UgaXMgZGlzdHJpYnV0ZWQgb24gYW4g
XCJBUyBJU1wiIEJBU0lTLFxuICogV0lUSE9VVCBXQVJSQU5USUVTIE9SIENPTkRJVElPTlMgT0YgQU5ZI
EtJTkQsIGVpdGhlciBleHByZXNzIG9yIGltcGxpZWQuXG4gKiBTZWUgdGhlIExpY2Vuc2UgZm9yIHRoZSBzc
GVjaWZpYyBsYW5ndWFnZSBnb3Zlcm5pbmcgcGVybWlzc2lvbnMgYW5kXG4gKiBsaW1pdGF0aW9ucyB1bm
RlciB0aGUgTGljZW5zZS5cbiAqID09PT09PT09PT09PT09PT09PT09PT09PT09PT09PT09PT09PT09PT09PT09P
T09PT09PT09PT09PT09PT09PT09PT09PT09PT09XG4gKi9cblxuaW1wb3J0IHtiYWNrZW5kX3V0aWwsIE
JhY2tlbmRWYWx1ZXMsIGJ1ZmZlciwgRGF0YVR5cGUsIEtlcm5lbENvbmZpZywgS2VybmVsRnVuYywgU2xp
Y2UsIHNsaWNlX3V0aWwsIFNsaWNlQXR0cnMsIFNsaWNlSW5wdXRzLCBUZW5zb3JJbmZvLCBSZWFEF
ycmF5LCB1dGlsfSBmcm9tICcuAdGVuc29yZmxvdy90ZmpzLWNvcmUnO1xuXG5pbXBvcnQge01hdGhCYWNr
ZW5kQ1BVfSBmcm9tICcuLi9iYWNrZW5kX2NwdSc7XG5pbXBvcnQge2Fzc2VydE5vdENvbXBsZXh9IGZyb2
0gJy4uL2NwdV91dGlsJztcblxuZXhwb3J0IGZ1bmN0aW9uIHNsaWNlSW1wbChcbiAgICB2YWxzOiBCYWNrZ
W5kVmFsdWVzLCBiZWdpbjogbnVtYmVyW10sIHNpemU6IG51bWJlcltdLCBzaGFwZTogbnVtYmVyW10sXG
4gICAgZHR5cGU6IERhdGFUeXBlKTogQmFja2VuZFZhbHVlcyB7XG4gIGNvbnN0IGlzQ29udGlub3VzID0gc2
xpY2VfdXRpbC5pc1NsaWNlQ29udGlub3VzKHNoYXBlLCBzdHJpZGVzLCBiZWdpbiwgc2l6ZSk7XG4gIC
BiZWdpbjogbnVtYmVyW10gPSBbXTtcbiAgY29uc3QgeFN0cmlkZXMgPSBuZXcgQXJyYXk8bnVtYmVyPihzaGFw
ZS5sZW5ndGgpO1xuICBmb3IgKGxldCBpID0geFN0cmlkZXMubGVuZ3RoIC0gMjsgaSA+PSAwOyBpLS0pIHtc
bnVtYmVyW10gPSBbXTtcbiAgY29uc3QgeFN0cmlkZXMgPSBuZXcgQXJyYXk8bnVtYmVyPihzaGFwZS5sZW5ndGgpO1xuICBmb3IgKGxldCBpID0gc2hhcGUubGVuZ3RoIC0gMjsgaSA+PSAwOyBpLS0pIHtcbiAgICBiZWdpbltpXSA9IGJlZ2luW2kgKyAxXSArIHNoYXBlW2kgKyAxXTtcbiAgICB4U3RyaWRlc1tpXSA9IHhTdHJpZGVzW2kgKyAxXSAqIHNpemVbaSArIDFdO1xuICB9XG5cbiAgY29uc3QgYnVmZmVyID0gYmFja2VuZC5idWZmZXIoXG4gICAgICBzaXplLnJlZHVjZSgoYSwgYikgPT4gYSAqIGIpLCBkdHlwZSk7XG4gIGNvbnN0IHZhbHMgPSBidWZmZXIudmFsdWVzKCk7XG5cbiAgZm9yIChsZXQgaSA9IDA7IGkgPCBudW1WYWxzOyBpKyspIHtcbiAgICBsZXQgbGVmdG92ZXIgPSBpO1xuICAgIGxldCBsb2MgPSAwO1xuICAgIGZvciAobGV0IGogPSAwOyBqIDwgc2hhcGUubGVuZ3RoOyBqKyspIHtcbiAgICAgIGNvbnN0IGNvb3JkID0gTWF0aC5mbG9vcihsZWZ0b3Zlci94U3RyaWRlc1tqXSk7XG4gICAgICBsZWZ0b3Zlci09Y29vcmQgKiB4U3RyaWRlc1tqXTtcbiAgICAgIGxvYyArPSBjb29yZCAqIHN0cmlkZXNbal07XG4gICAgfVxuICAgIHZhbHNbaV0gPSB2YWxzW2xvY107XG4gIH1cbiAgcmV0dXJuIGJ1ZmZlci50b1RlbnNvcigpO1xufVxuXG5leHBvcnQgY29uc3QgcmVzaGFwZUNvbmZpZyA9IHtcbiAgICBrZXJuZWxOYW1lOiBSZXNoYXBlLFxuICAgIGJhY2tlbmQ6ICdjcHUnLFxuICAgIGtlcm5lbEZ1bmM6IHJlc2hhcGVJbXBsXG59O1xuXG5leHBvcnQgY29uc3QgcmVzaGFwZUdyYWRDb25maWcgPSB7XG4gICAga2VybmVsTmFtZTogUmVzaGFwZSxcbiAgICBiYWNrZW5kOiAnY3B1JyxcbiAgICBncmFkRnVuYzogKGR5LCBpbnB1dHMpID0+IHtcbiAgICAgICAgY29uc3QgW3gsIF0gPSBpbnB1dHM7XG4gICAgICAgIGNvbnN0IGlucHV0U2hhcGUgPSB4LnNoYXBlO1xuICAgICAgICBjb25zdCBiYWNrZW5kID0gYmFja2VuZF91dGlsLmJhY2tlbmQoKTtcbiAgICAgICAgY29uc3QgeFZhbHVlcyA9IGJhY2tlbmQudGVuc29yTWFwLmdldCh4LmRhdGFJZCkudmFsdWVzO1xuICAgICAgICBjb25zdCBkeVZhbHVlcyA9IGJhY2tlbmQudGVuc29yTWFwLmdldChkeS5kYXRhSWQpLnZhbHVlcztcbiAgICAgICAgY29uc3QgeUJ1ZmZlciA9IHNlbGVjdF91dGlsLmJhY2tlbmQoKS5idWZmZXIoXG4gICAgICAgICAgICBpbnB1dFNoYXBlLCBkeS5kdHlwZSwgZHlWYWx1ZXMpO1xuICAgICAgICBjb25zdCB5VmFsdWVzID0geUJ1ZmZlci52YWx1ZXMoKTtcbiAgICAgICAgZm9yIChsZXQgaSA9IDA7IGkgPCB4VmFsdWVzLmxlbmd0aDsgaSsrKSB7XG4gICAgICAgICAgICB5VmFsdWVzW2ldID0gZHlWYWx1ZXNbaV07XG4gICAgICAgIH1cbiAgICAgICAgcmV0dXJuIHlCdWZmZXIudG9UZW5zb3IoKTtcbiAgICB9XG59O1xuXG5leHBvcnQgY29uc3QgcmVzaGFwZUdyYWRDb25maWcgPSB7XG4gICAga2VybmVsTmFtZTogUmVzaGFwZSxcbiAgICBiYWNrZW5kOiAnY3B1JyxcbiAgICBncmFkRnVuYzogKGR5LCBpbnB1dHMpID0+IHtcbiAgICAgICAgY29uc3QgW3gsIF0gPSBpbnB1dHM7

ICAgIGFyZ3M6IHtpbnB1dHM6IFNsaWNlSW5wdXRzLCBiYWNrZW5kOiBNYXRoQmFja2VuZENQVSwgYXR0cnM6IFNsaWNlQXR0cnN9KTpcbiAgICBUZW5zb3JJbmZvIHtcbiAgY29uc3Qge2lucHV0cywgYmFja2VuZCwgYXR0cnN9ID0gYXJncztcbiAgY29uc3Qge3h9ID0gaW5wdXRzO1xuICBjb25zdCB7YmVnaW4sIHNpemV9ID0gYXR0cnM7XG5cbiAgY29uc3QgYmFja2VuZCA9IHJlcXVpcmUoJy4vYmFja2VuZF9jcHUnKTtcbiAgY29uc3QgdXRpbCA9IHJlcXVpcmUoJy4uLy4uL3NyYy91dGlsJyk7XG4gIGNvbnN0IHNoYXJlZCA9IHJlcXVpcmUoJy4vc2hhcmVkJyk7XG5cbiAgY29uc3QgW2JlZ2luXywgc2l6ZV9dID0gc2xpY2VfdXRpbC5wYXJzZVNsaWNlUGFyYW1zKHgsIGJlZ2luLCBzaXplKTtcblxuICBjb25zdCBpc0NvbnRpbm91cyA9IHNsaWNlX3V0aWwuaXNTbGljZUNvbnRpbm91cyh4LnNoYXBlLCBiZWdpbl8sIHNpemVfKTtcbiAgY29uc3QgeFZhbHMgPSBiYWNrZW5kLnJlYWRTeW5jKHguZGF0YUlkKTtcbiAgY29uc3Qgb3V0ID0gYmFja2VuZC5tYWtlT3V0cHV0KHNpemVfLCB4LmR0eXBlKTtcbiAgY29uc3QgeFN0cmlkZXMgPSB1dGlsLmNvbXB1dGVTdHJpZGVzKHguc2hhcGUpO1xuICBjb25zdCBvdXREYXRhID0gYmFja2VuZC5kYXRhSWRNYXAuZ2V0KG91dC5kYXRhSWQpO1xuXG4gIGlmIChpc0NvbnRpbm91cykge1xuICAgIGNvbnN0IGZsYXRPZmZzZXQgPSBzbGljZV91dGlsLmNvbXB1dGVGbGF0T2Zmc2V0KGJlZ2luXywgeFN0cmlkZXMpO1xuXG4gICAgaWYgKHguZHR5cGUgPT09ICdzdHJpbmcnKSB7XG4gICAgICBvdXREYXRhLnN0cmluZ0J5dGVzID1cbiAgICAgICAgICAoeFZhbHMgYXMgVWludDhBcnJheVtdKVxuICAgICAgICAgICAgICAuc2xpY2UoZmxhdE9mZnNldCwgZmxhdE9mZnNldCArIHV0aWwuc2l6ZUZyb21TaGFwZShzaXplXykpO1xuICAgIH0gZWxzZSB7XG4gICAgICBjb25zdCBvdXRWYWxzID0gYmFja2VuZC50eXBlZEFycmF5RnJvbUhlYXAob3V0KTtcbiAgICAgIG91dFZhbHMuc2V0KFxuICAgICAgICAgICh4VmFscyBhcyBUeXBlZEFycmF5KVxuICAgICAgICAgICAgICAuc3ViYXJyYXkoZmxhdE9mZnNldCwgZmxhdE9mZnNldCArIHV0aWwuc2l6ZUZyb21TaGFwZShzaXplXykpKTtcbiAgICB9XG5cbiAgICByZXR1cm4gb3V0O1xuICB9XG5cbiAgaWYgKHguZHR5cGUgPT09ICdzdHJpbmcnKSB7XG4gICAgY29uc3QgcmVzID0gc2xpY2VJbXBsQ1BVKHhWYWxzLCBiZWdpbl8sIHNpemVfLCB4LnNoYXBlLCB4LmR0eXBlKTtcbiAgICBvdXREYXRhLnN0cmluZ0J5dGVzID0gcmVzIGFzIFVpbnQ4QXJyYXlbXTtcbiAgICByZXR1cm4gb3V0O1xuICB9XG5cbiAgY29uc3Qgb3V0VmFscyA9IGJhY2tlbmQudHlwZWRBcnJheUZyb21IZWFwKG91dCk7XG4gIGNvbnN0IHJhbmsgPSB4LnNoYXBlLmxlbmd0aDtcbiAgaWYgKHJhbmsgPT09IDIpIHtcbiAgICBzbGljZTJkKFxuICAgICAgICB4VmFscyBhcyBUeXBlZEFycmF5LCB4U3RyaWRlc1swXSwgb3V0VmFscywgYmVnaW5fIGFzIFtudW1iZXIsIG51bWJlcl0sXG4gICAgICAgIHNpemVfIGFzIFtudW1iZXIsIG51bWJlcl0pO1xuICB9IGVsc2UgaWYgKHJhbmsgPT09IDMpIHtcbiAgICBzbGljZTNkKFxuICAgICAgICB4VmFscyBhcyBUeXBlZEFycmF5LCB4U3RyaWRlc1swXSwgeFN0cmlkZXNbMV0sIG91dFZhbHMsXG4gICAgICAgIGJlZ2luXyBhcyBbbnVtYmVyLCBudW1iZXIsIG51bWJlcl0sIHNpemVfIGFzIFtudW1iZXIsIG51bWJlciwgbnVtYmVyXSk7XG4gIH0gZWxzZSBpZiAocmFuayA9PT0gNCkge1xuICAgIHNsaWNlNGQoXG4gICAgICAgIHhWYWxzIGFzIFR5cGVkQXJyYXksIHhTdHJpZGVzWzBdLCB4U3RyaWRlc1sxXSwgeFN0cmlkZXNbMl0sIG91dFZhbHMsXG4gICAgICAgIGJlZ2luXyBhcyBbbnVtYmVyLCBudW1iZXIsIG51bWJlciwgbnVtYmVyXSxcbiAgICAgICAgc2l6ZV8gYXMgW251bWJlciwgbnVtYmVyLCBudW1iZXIsIG51bWJlcl0pO1xuICB9IGVsc2Uge1xuICAgIGNvbnN0IHJlcyA9XG4gICAgICAgIHNsaWNlSW1wbENQVSh4VmFscywgYmVnaW5fLCBzaXplXywgeC5zaGFwZSwgeC5kdHlwZSkgYXMgVHlwZWRBcnJheTtcbiAgICBvdXRWYWxzLnNldChyZXMpO1xuICB9XG5cbiAgcmV0dXJuIG91dDtcbn1cblxuZnVuY3Rpb24gc2xpY2UyZChcbiAgICB4VmFsczogYmFja2VuZF91dGlsLlR5cGVkQXJyYXksIHhTdHJpZGU6IG51bWJlcixcbiAgICBvdXRWYWxzOiBiYWNrZW5kX3V0aWwuVHlwZWRBcnJheSwgYmVnaW46IFtudW1iZXIsIG51bWJlcl0sXG4gICAgc2l6ZTogW251bWJlciwgbnVtYmVyXSk6IHZvaWQge1xuICBsZXQgb3V0T2Zmc2V0ID0gMDtcbiAgY29uc3QgYmVnaW5JID0gYmVnaW5bMF07XG4gIGNvbnN0IGJlZ2luSiA9IGJlZ2luWzFdO1xuICBjb25zdCBlbmRJID0gYmVnaW5JICsgc2l6ZVswXTtcbiAgZm9yIChsZXQgaSA9IGJlZ2luSTsgaSA8IGVuZEk7IGkrKykge1xuICAgIGNvbnN0IHhPZmZzZXQgPSBpICogeFN0cmlkZSArIGJlZ2luSjtcbiAgICBvdXRWYWxzLnNldCh4VmFscy5zdWJhcnJheSh4T2Zmc2V0LCB4T2Zmc2V0ICsgc2l6ZVsxXSksIG91dE9mZnNldCk7XG4gICAgb3V0T2Zmc2V0ICs9IHNpemVbMV07XG4gIH1cbn1cblxuZnVuY3Rpb24gc2xpY2UzZChcbiAgICB4VmFsczogYmFja2VuZF91dGlsLlR5cGVkQXJyYXksIHhTdHJpZGUxOiBudW1iZXIsIHhTdHJpZGUyOiBudW1iZXIsXG4gICAgb3V0VmFsczogYmFja2VuZF91dGlsLlR5cGVkQXJyYXksIGJlZ2luOiBbbnVtYmVyLCBudW1iZXIsIG51bWJlcl0sXG4gICAgc2l6ZTogW251bWJlciwgbnVtYmVyLCBudW1iZXJdKTogdm9pZCB7XG4gIGxldCBvdXRPZmZzZXQgPSAwO1xuICBjb25zdCBiZWdpbkkgPSBiZWdpblswXTtcbiAgY29uc3QgYmVnaW5KID0gYmVnaW5bMV07XG4gIGNvbnN0IGJlZ2luSyA9IGJlZ2luWzJdO1xuICBjb25zdCBlbmRJID0gYmVnaW5JICsgc2l6ZVswXTtcbiAgY29uc3QgZW5kSiA9IGJlZ2luSiArIHNpemVbMV07XG4gIGZvciAobGV0IGkgPSBiZWdpbkk7IGkgPCBlbmRJOyBpKyspIHtcbiAgICBmb3IgKGxldCBqID0gYmVnaW5KOyBqIDwgZW5kSjsgaisrKSB7XG4gICAgICBjb25zdCB4T2Zmc2V0ID0gaSAqIHhTdHJpZGUxICsgaiAqIHhTdHJpZGUyICsgYmVnaW5LO1xuICAgICAgb3V0VmFscy5zZXQoeFZhbHMuc3ViYXJyYXkoeE9mZnNldCwgeE9mZnNldCArIHNpemVbMl0pLCBvdXRPZmZzZXQpO1xuICAgICAgb3V0T2Zmc2V0ICs9IHNpemVbMl07XG4gICAgfVxuICB9XG59XG5cbmV4cG9ydCBjb25zdCBzbGljZUNvbmZpZzogS2VybmVsQ29uZmlnID0ge1xuICBrZXJuZWxOYW1lOiBTbGljZSxcbiAgYmFja2VuZDogJ2NwdScsXG4gIGtlcm5lbEZ1bmM6IHNsaWNlLFxufTtcblxuLyogQGxpY2Vuc2VcbiAqIENvcHlyaWdodCAyMDE5IEdvb2dsZSBMTEMuIEFsbCBSaWdodHMgUmVzZXJ2ZWQuXG4gKiBMaWNlbnNlZCB1bmRlciB0aGUgQXBhY2hlIExpY2Vuc2UsIFZlcnNpb24gMi4wICh0aGUgXCJMaWNlbnNlXCIpO1xuICogeW91IG1heSBub3QgdXNlIHRoaXMgZmlsZSBleGNlcHQgaW4gY29tcGxpYW5jZSB3aXRoIHRoZSBMaWNlbnNlLlxuICogWW91IG1heSBvYnRhaW4gYSBjb3B5IG9mIHRoZSBMaWNlbnNlIGF0XG4gKlxuICogaHR0cDovL3d3dy5hcGFjaGUub3JnL2xpY2Vuc2VzL0xJQ0VOU0UtMi4wXG4gKlxuICogVW5sZXNzIHJlcXVpcmVkIGJ5IGFwcGxpY2FibGUgbGF3IG9yIGFncmVlZCB0byBpbiB3cml0aW5nLCBzb2Z0d2FyZVxuICogZGlzdHJpYnV0ZWQgdW5kZXIgdGhlIExpY2Vuc2UgaXMgZGlzdHJpYnV0ZWQgb24gYW4gXCJBUyBJU1wiIEJBU0lTLFxuICogV0lUSE9VVCBXQVJSQU5USUVTIE9SIENPTkRJVElPTlMgT0YgQU5ZIEtJTkQsIGVpdGhlciBleHByZXNzIG9yIGltcGxpZWQuXG4gKiBTZWUgdGhlIExpY2Vuc2UgZm9yIHRoZSBzcGVjaWZpYyBsYW5ndWFnZSBnb3Zlcm5pbmcgcGVybWlzc2lvbnMgYW5kXG4gKiBsaW1pdGF0aW9ucyB1bmRlciB0aGUgTGljZW5zZS5cbiAqXG4gKiA9PT09PT09PT09

xOffset + size[2]), outOffset);\n outOffset += size[2];\n }\n }\n}\n\nfunction slice4d(\n xVals: backend_util.TypedArray, xStride1: number, xStride2: number,\n xStride3: number, outVals: backend_util.TypedArray,\n
begin: [number, number, number, number],\n size: [number, number, number, number]): void {\n let outOffset = 0;\n const beginI = begin[0];\n const beginJ = begin[1];\n const beginK = begin[2];\n const endI = beginI + size[0];\n const endJ = beginJ + size[1];\n const endK = beginK + size[2];\n const beginL = begin[3];\n\n for (let i = beginI; i < endI; i++) {\n for (let j = beginJ; j < endJ; j++) {\n for (let k = beginK; k < endK; k++) {\n const xOffset = i * xStride1 + j * xStride2 + k * xStride3 + beginL;\n outVals.set(xVals.subarray(xOffset, xOffset + size[3]), outOffset);\n outOffset += size[3];\n }\n }\n }\n}\n\nexport const sliceConfig: KernelConfig = {\n kernelName: Slice,\n backendName: 'wasm',\n kernelFunc: slice as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2021 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {backend_util, BatchToSpaceND, BatchToSpaceNDAttrs, BatchToSpaceNDInputs, KernelConfig, KernelFunc} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {reshape} from './Reshape';\nimport {slice} from './Slice';\nimport {transpose} from './Transpose';\n\nfunction batchToSpaceND(args: {\n inputs: BatchToSpaceNDInputs,\n backend: BackendWasm,\n attrs: BatchToSpaceNDAttrs\n}) {\n const {inputs, backend, attrs} = args;\n const {x} = inputs;\n const {blockShape, crops} = attrs;\n\n const prod = blockShape.reduce((a, b) => a * b);\n\n const reshaped = backend_util.getReshaped(x.shape, blockShape, prod);\n const permuted = backend_util.getPermuted(reshaped.length, blockShape.length);\n const reshapedPermuted =\n backend_util.getReshapedPermuted(x.shape, blockShape, prod);\n const sliceBeginCoords =\n backend_util.getSliceBeginCoords(crops, blockShape.length);\n const sliceSize =\n backend_util.getSliceSize(reshapedPermuted, crops, blockShape.length);\n\n const xReshaped = reshape({inputs: {x}, backend, attrs: {shape: reshaped}});\n const xTransposed =\n transpose({inputs: {x: xReshaped}, backend, attrs: {perm: permuted}});\n const xTransposedReshaped = reshape({\n inputs: {x: xTransposed}, backend, attrs: {shape: reshapedPermuted}});\n const result = slice({\n inputs: {x: xTransposedReshaped},\n backend,\n attrs: {begin: sliceBeginCoords,
size: sliceSize}\n });\n\n backend.disposeData(xReshaped.dataId);\n backend.disposeData(xTransposed.dataId);\n backend.disposeData(xReshaped.dataId);\n\n return result;\n}\n\nexport const batchToSpaceNDConfig: KernelConfig = {\n kernelName: BatchToSpaceND,\n backendName: 'wasm',\n kernelFunc: batchToSpaceND as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {Cast, CastAttrs, CastInputs, KernelConfig, KernelFunc} from '@tensorflow/tfjs-core';\nimport {TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nexport function cast(\n args: {inputs: CastInputs, attrs: CastAttrs, backend: BackendWasm}):\n TensorInfo {\n const {inputs: {x}, attrs: {dtype}, backend} = args;\n const out = backend.makeOutput(x.shape, dtype);\n const inVals =

backend.typedArrayFromHeap(x);\n const outVals = backend.typedArrayFromHeap(out);\n outVals.set(inVals);\n return out;\n}\n\nexport const castConfig: KernelConfig = {\n kernelName: Cast,\n backendName: 'wasm',\n kernelFunc: cast as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2021 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may
 obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n
*/\nimport {KernelConfig, Ceil} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from
'./unary_kernel';\n\nexport const ceilConfig: KernelConfig = createUnaryKernelConfig(Ceil);\n","/**\n *
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distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either
express or implied.\n * See the License for the specific language governing permissions and\n * limitations under
the License.\n *
==========\n
*/\n\nimport {ClipByValue, ClipByValueAttrs, ClipByValueInputs, KernelConfig, KernelFunc} from
'@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmClip: (xId: number, min:
number, max: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmClip =
backend.wasm.cwrap(ClipByValue, null /* void */, [\n   'number', // x_id\n   'number', // min\n   'number', //
max\n   'number'   // out_id\n]);\n}\n\nfunction clip(args: {\n inputs: ClipByValueInputs,\n backend:
BackendWasm,\n attrs: ClipByValueAttrs\n}) {\n const
 {inputs, backend, attrs} = args;\n const {x} = inputs;\n const {clipValueMin, clipValueMax} = attrs;\n const xId
= backend.dataIdMap.get(x.dataId).id;\n const out = backend.makeOutput(x.shape, x.dtype);\n const outId =
backend.dataIdMap.get(out.dataId).id;\n wasmClip(xId, clipValueMin, clipValueMax, outId);\n return
out;\n}\n\nexport const clipByValueConfig: KernelConfig = {\n kernelName: ClipByValue,\n backendName:
'wasm',\n setupFunc: setup,\n kernelFunc: clip as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019
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OR CONDITIONS OF
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limitations under the License.\n *
==========\n
*/\n\nimport {backend_util, Concat, ConcatAttrs, ConcatInputs, KernelConfig, KernelFunc, util} from
'@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\nimport {concatImplCPU} from
'../kernel_utils/shared';\nimport {identity} from './Identity';\nimport {reshape} from './Reshape';\n\nexport function
concat(\n   args: {inputs: ConcatInputs, backend: BackendWasm, attrs: ConcatAttrs}) {\n const {inputs, backend}
= args;\n\n const axis = util.parseAxisParam(args.attrs.axis, inputs[0].shape)[0];\n\n let outShape =
backend_util.computeOutShape(inputs.map(t => t.shape), axis);\n\n // Keep only non-empty tensors (ignore tensors
with 0 in their shape).\n const $inputs = inputs.filter(t => util.sizeFromShape(t.shape) > 0);\n if ($inputs.length ===
 1) {\n   return identity({inputs: {x: $inputs[0]}, backend});\n }\n\n const out = backend.makeOutput(outShape,
inputs[0].dtype);\n\n if (util.sizeFromShape(outShape) === 0) {\n   return out;\n }\n\n const shapes =

$inputs.map(t => t.shape);\n backend_util.assertParamsConsistent(shapes, axis);\n\n if ($inputs[0].dtype === 'string') {\n   // Any concat of n-dimensional tensors across any axis can be reduced to\n   // a concatenation of two-dimensional tensors across the axis 1 by first\n   // partitioning the axes of the original tensors into those less than the\n   // axis to be concatenated and the rest. Then reshape the tensors\n   // into a two-dimensional tensor by collapsing these two sets of axes and\n   // concatenate the resulting matrices across the axis 1, finally reshaping\n   // the result to have the proper shape.\n   const inputs2D = $inputs.map(t => {\n   const innerSize = util.sizeFromShape(t.shape.slice(axis));\n   const shape = [-1, innerSize];\n   return reshape({inputs: {x: t}, backend, attrs: {shape}});\n   });\n\n   const inputsValShapes = inputs2D.map(t => {\n   return {vals: backend.readSync(t.dataId), shape: t.shape};\n   });\n\n   // Concats 2d tensors along axis=1.\n   outShape =\n   backend_util.computeOutShape(inputs2D.map(t => t.shape), 1 /* axis */);\n   const simplyConcat = inputs2D[0].shape[0] === 1;\n   const outVals = concatImplCPU(\n inputsValShapes, outShape, inputs[0].dtype,\n   simplyConcat) as string[];\n\n   const finalOutShape =\n   backend_util.computeOutShape($inputs.map(t => t.shape), axis);\n\n   out.shape = finalOutShape;\n   const outData = backend.dataIdMap.get(out.dataId);\n   outData.stringBytes = backend_util.fromStringArrayToUint8(outVals);\n\n   inputs2D.forEach(t => backend.disposeData(t.dataId));\n\n   return out;\n }\n\n const batchDim = util.sizeFromShape($inputs[0].shape.slice(0, axis));\n let sumInnerDims = 0;\n const innerDims = $inputs.map(input => {\n   const innerDim = util.sizeFromShape(input.shape.slice(axis));\n   sumInnerDims += innerDim;\n   return innerDim;\n });\n const inVals = $inputs.map(input => backend.typedArrayFromHeap(input));\n const outVals = backend.typedArrayFromHeap(out);\n for (let b = 0; b < batchDim; b++) {\n   let outOffset = b * sumInnerDims;\n   for (let i = 0; i < inVals.length; i++) {\n   const innerDim = innerDims[i];\n   const inOffset = b * innerDim;\n   const vals = inVals[i].subarray(inOffset, inOffset + innerDim);\n   outVals.set(vals, outOffset);\n   outOffset += innerDim;\n   }\n }\n return out;\n}\n\nexport const concatConfig: KernelConfig = {\n kernelName: Concat,\n backendName: 'wasm',\n kernelFunc: concat as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n * ===\n */\nimport { backend_util, util } from '@tensorflow/tfjs-core';\nexport function concatImpl(inputs, outShape, dtype, simplyConcat) {\n   const outVals = util.getArrayFromDType(dtype, util.sizeFromShape(outShape));\n   if (simplyConcat && dtype !== 'string') {\n   // Use built-in TypedArray.set() method for speed.\n   let offset = 0;\n   inputs.forEach(input => {\n   const size = util.sizeFromShape(input.shape);\n   outVals.set(input.vals, offset);\n   offset += size;\n   });\n   }\n   else {\n   let colOffset = 0;\n   inputs.forEach(input => {\n   const decodedData = dtype === 'string' ?\n   backend_util.fromUint8ToStringArray(input.vals) :\n   input.vals;\n   let tIdx = 0;\n   for (let row = 0; row < input.shape[0]; ++row) {\n   const resIdx = row * outShape[1] + colOffset;\n   for (let col = 0; col < input.shape[1]; ++col) {\n   outVals[resIdx + col] = decodedData[tIdx++];\n   }\n   }\n   colOffset += input.shape[1];\n   });\n   }\n   return outVals;\n}\n//# sourceMappingURL=data:application/json; base64,eyJ2ZXJzaW9uIjozLCJmaWxlIjoiQ29uY2F0X2ltcGwuanMiLCJzb3VyY2VSb290IjoiIiwic291cmNlcyI6WyIuLi8uLi8uLi8uLi8uLi8uLi90ZmpzLWJhY2tlbmQtY3B1L3NyYy9rZXJuZWxzL0NvbmNhdF9pbXBsLnRzIl0sIm5hbWVzIjpbXSwibWFwcGluZ3MiOiJBQUFBOzs7OztzOzs7OzsyOzs7OzsyOzs7Ozsy

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EVBQUUsSUFBSSxDQUFDLGFBQWEsQ0FBQyxRQUFRLENBQUMsQ0FBQyxDQUFDO0lBRTVFLElBQUk
sWUFBWSxJQUFJLEtBQUssS0FBSyxRQUFRLEVBQUU7UUFDdEMsa0RBQWtEO1FBQ2xELELElBQUksTUFB
TSxHQUFHLENBQUMsQ0FBQztRUNmLE1BQU0sQ0FBQyxPQUFDLFFBQUFNLFFBQUFBRTtZQUNyQixL
QUFLLEdBQUcsUUFBUSxDQUFDLENBQUM7Z0JBQ3BFLFlBQVksQ0FBQyxPQUFDLFFBQUFNLFFBQUFBRTtZ
ENBQUMsSUFBb0IsQ0FBQyxDQUFDLENBQUM7Z0JBQ2pFLFlBQVksQ0FBQyxPQUFDLFFBQUFNLFFBQUFBRTd
CLElBQUksSUFBSSxHQUFHLENBQUMsQ0FBQztZQUVViLEtBQUssSUFBSSxHLEdBQUcsQ0FBQyxQ0FBQyxxF
QUFFLEdBQUcsR0FBRyxxLQUFLLLENBQUMsS0FBSyxDQUFDLENBQUMsQ0FBQyxQ0FBQyxxFQUFFLEVBQUUsR0F
BRyxFQUFFO2dCQUM3QyxNLE1BQU0sR0FBRyxHQUFHLEdBQUcsUUFBUSxDQUFDLENBQUMsQ
0FBQyxHQUFHLFNBQVMsQ0FBQ0FDN0MsS0FBSyxJQUFJLEdBQUcsR0FBRyxDQUFDLEVBQUUsR0
FBRyxHQUFHLEtBQUssQ0FBQyxLQUFLLLENBQUMsQ0FBQyxDQUFDLEVBQUUsRUFBRSxRSxHQUFHLEVB
QUU7b0JBQzdDLE9BQU8sQ0FBQyxNQUFNLEdBQUcsR0FBRyxDQUFDLEdBQUcsQ0FBQyxV0FBVyxDQUFDLEVBQUUsDLElBQ
UksRUFBRSxDQUFDLENBQUMsQ0FBQyxDQUFDLENBQUM7aUJDO2FBQ0NBUFFCxTQUFTLElBQUksS0FBSyxDQUFDLEtBQUssLEtBQUssQ
QUssQ0FBQyxDQUFDLENBQUMsQ0FBQyxDQUFDLENBQUM5QixDQUFDLENBQUMsQ0FBQyxDQUFDLENBQUMsQ0FBQ0tO0lBRUQsT0F
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NlZCB1bmRlciB0aGUgQXBhY2hlIExpY2Vuc2UsIFZlcnNpb24gMi4wIChoaGUgXCJMaWNlbnNlXCIpO1xuICo
geW91IG1heSBub3QgdXNlIHRoaXMgZmlsZSBleGNlcHQgaW4gY29tcGxpYW5jZSB3aXRoIHRoZSBMaWNlb
nNlLlxuICogWW91IG1heSBvYnRhaW4gYSBjb3B5IG9mIHRoZSBMaWNlbnNlIGF0XG4gKlxuICogaHR0cDov
L3d3dy5hcGFjaGUub3JnL2xpY2Vuc2VzL0xJQ0VOU0UtMi4wXG4gKlxuICogVW5sZXNzIHJlcXVpcmVkIGJ5I
GFwcGxpY2FibGUgbGF3IG9yIGFncmVlZCB0byBpbiB3cml0aW5nLCBzb2Z0d2FyZVxuICogZGlzdHJpYnV0Z
WQgdW5kZXIgdGhlIExpY2Vuc2UgaXMgZGlzdHJpYnV0ZWQgb24gYW4gXCJBUyBJU1wiIEJBU0lTLFxuICo
gV0lUSE9VVCBXQVJSQU5USUVTIE9SIENPTkRJVElPTlMgT0YgQU5ZIEtJTkQsIGVpdGhlciBleHByZXNz
G9yIGltcGxpZWQuXG4gKiBTZWUgdGhlIExpY2Vuc2UgZm9yIHRoZSBzcGVjaWZpYyBsYW5ndWFnZSBnb3
Zlcm5pbmcgcGVybWlzc2lvbnMgYW5kXG4gKiBsaW1pdGF0aW9ucyB1bmRlciB0aGUgTGljZW5zZS5cbiAqID
09PT09PT09PT09PT09PT09PT09PT09PT09PT09PT09PT09PT09PT09PT09PT09PT09PT09PT09PT09PT09
PT09PT09PT09XG4gKi9cblxuaW1wb3J0IHtiYWNrZW5kX3V0aWwsIEJhY2tlbmRWYWx1ZXMsIERhdG
FUeXBlLCBUeXBlZEFycmF5LCB1dGlsfSBmcm9tICdAdGVuc29yZmxvdy90ZmpzLWNvcmUnO1xuXG5leHBv
cnQgZnVuY3Rpb24gY29uY2F0SW1wbChchcbiAgICBpbnB1dHM6IEFycmF5PHt2YWxzOiBCYWNrZW5kVmFsd
WVzLCBzaGFwZTogbnVtYmVyW119Piwgb3V0U2hhcGU6IG51bWJlcltdLFxuICAgIGR0eXBlOiBEYXRhVHl
wZSwgc2ltcGx5Q29uY2F0OiBib29sZWFuKTogVHlwZWRBcnJheXzdHJpbmdbXSB7XG4gIGNvbnN0IG91dF
ZhbHMgPSB1dGlsLmdldEFycmF5RnJvbURUeXBlKGR0eXBlLCB1dGlsLnNpemVGcm9tU2hhcGUob3V0U2hh
cGUpKTtcblxuICBpZiAoc2ltcGx5Q29uY2F0ICYmIGR0eXBlICE9PSAnc3RyaW5nJykge1xuICAgIC8vIFRlc
nNldCBpbiBUeXBlZEFycmF5LnNld

gICAgIGZvciAobGV0IGNvbCA9IDA7IGNvbCA8IGlucHV0LnNoYXBlWzFdOyArK2NvbCkge1xuICAgICAgICAgIC
AgIG91dFZhbHNbcmVzSWR4ICsgY29sXSA9IGRlY29kZWREYXRhW3RJZHgrK107XG4gICAgICAgIH1cbiA
gICAgIH1cblxuICAgICAgY29sT2Zmc2V0ICs9IGlucHV0LnNoYXBlWzFdO1xuICAgIH0pO1xuICB9XG5cbiAgc
mV0dXJuIG91dFZhbHM7XG59XG4iXX0=","/**\n
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 Conv2D, Conv2DAttrs, Conv2DInputs, KernelConfig, KernelFunc, Tensor4D} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmConv2d: (\n   xId: number, batchSize: number, inputHeight: number, inputWidth: number,\n   filterId: number, filterHeight: number, filterWidth: number, padTop: number,\n   padRight: number, padBottom: number, padLeft: number, isSamePad: number,\n   dilationHeight: number, dilationWidth: number, strideHeight: number,\n   strideWidth: number, inputChannels: number, outputChannels: number,\n   outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmConv2d = backend.wasm.cwrap(Conv2D, null /* void */, [\n   'number', // xId\n   'number', // batchSize\n   'number', // inputHeight\n   'number', // inputWidth\n   'number', // filterId\n   'number', // filterHeight\n   'number', // filterWidth\n   'number', // padTop\n   'number', // padRight\n   'number', // padBottom\n   'number', // padLeft\n
    'number', // isSamePad\n   'number', // dilationHeight\n   'number', // dilationWidth\n   'number', // strideHeight\n   'number', // strideWidth\n   'number', // inputChannels\n   'number', // outputChannels\n   'number', // outId\n]);\n}\n\nfunction conv2d(\n   args: {inputs: Conv2DInputs, backend: BackendWasm, attrs: Conv2DAttrs}) {\n const {inputs, attrs, backend} = args;\n\n const {x, filter} = inputs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n const filterId = backend.dataIdMap.get(filter.dataId).id;\n\n const {strides, dilations, pad, dimRoundingMode, dataFormat} = attrs;\n const $dataFormat = backend_util.convertConv2DDataFormat(dataFormat);\n const convInfo = backend_util.computeConv2DInfo(\n   (x as Tensor4D).shape, (filter as Tensor4D).shape, strides, dilations,\n   pad, dimRoundingMode, false, $dataFormat);\n\n const filterHeight = convInfo.filterHeight;\n const filterWidth = convInfo.filterWidth;\n const padTop = convInfo.padInfo.top;\n
  const padRight = convInfo.padInfo.right;\n const padBottom = convInfo.padInfo.bottom;\n const padLeft = convInfo.padInfo.left;\n const dilationHeight = convInfo.dilationHeight;\n const dilationWidth = convInfo.dilationWidth;\n const strideHeight = convInfo.strideHeight;\n const strideWidth = convInfo.strideWidth;\n const inputChannels = convInfo.inChannels;\n const outputChannels = convInfo.outChannels;\n const isSamePad = convInfo.padInfo.type === 'SAME' ? 1 : 0;\n\n if (convInfo.dataFormat !== 'channelsLast') {\n   throw new Error(\n   `wasm backend Conv2D does not support dataFormat:` +\n   `${convInfo.dataFormat}'. Please use 'channelsLast'.`);\n }\n\n const out = backend.makeOutput(convInfo.outShape, 'float32');\n const outId = backend.dataIdMap.get(out.dataId).id;\n wasmConv2d(\n   xId, x.shape[0], x.shape[1], x.shape[2], filterId, filterHeight,\n   filterWidth, padTop, padRight, padBottom, padLeft, isSamePad,\n   dilationHeight,
 dilationWidth, strideHeight, strideWidth, inputChannels,\n   outputChannels, outId);\n return out;\n}\n\nexport const conv2DConfig: KernelConfig = {\n kernelName: Conv2D,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: conv2d as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing,

software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport
{backend_util, Conv2DBackpropInput, Conv2DBackpropInputAttrs, Conv2DBackpropInputInputs, KernelConfig, KernelFunc, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmConv2DBackpropInput: (\n dyId: number, filterId: number, batchSize: number, filterHeight: number,\n filterWidth: number, inHeight: number, inWidth: number, inChannels: number,\n outHeight: number, outWidth: number, outChannels: number,\n strideHeight: number, strideWidth: number, topPad: number, leftPad: number,\n fltS0: number, fltS1: number, fltS2: number, xBatchStride: number,\n xRowStride: number, xColStride: number, xChannelStride: number,\n yBatchStride: number, yRowStride: number, yColStride: number,\n yChannelStride: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n wasmConv2DBackpropInput = backend.wasm.cwrap(Conv2DBackpropInput, null, [\n 'number', // dyId\n 'number', // filterId\n 'number',
// batchSize\n 'number', // filterHeight\n 'number', // filterWidth\n 'number', // inHeight\n 'number', // inWidth\n 'number', // inChannels\n 'number', // outHeight\n 'number', // outWidth\n 'number', // outChannels\n 'number', // strideHeight\n 'number', // strideWidth\n 'number', // topPad\n 'number', // leftPad\n 'number', // fltS0\n 'number', // fltS1\n 'number', // fltS2\n 'number', // xBatchStride\n 'number', // xRowStride\n 'number', // xColStride\n 'number', // xChannelStride\n 'number', // yBatchStride\n 'number', // yRowStride\n 'number', // yColStride\n 'number', // yChannelStride\n 'number', // outId\n]);\n}\n\nfunction conv2DBackpropInput(args: {\n backend: BackendWasm,\n inputs: Conv2DBackpropInputInputs,\n attrs: Conv2DBackpropInputAttrs\n}): TensorInfo {\n const {backend, inputs, attrs} = args;\n const {dy, filter} = inputs;\n const {strides, pad, dataFormat,
dimRoundingMode, inputShape} = attrs;\n\n const dilations = 1;\n\n const $dataFormat = backend_util.convertConv2DDataFormat(dataFormat);\n const convInfo = backend_util.computeConv2DInfo(\n inputShape, filter.shape as [number, number, number, number], strides,\n dilations, pad, dimRoundingMode, false /* depthwise */, $dataFormat);\n const {\n batchSize,\n filterHeight,\n filterWidth,\n inChannels,\n inHeight,\n inWidth,\n outChannels,\n outHeight,\n outWidth,\n strideHeight,\n strideWidth\n } = convInfo;\n\n const topPad = filterHeight - 1 - convInfo.padInfo.top;\n const leftPad = filterWidth - 1 - convInfo.padInfo.left;\n\n const isChannelsLast = convInfo.dataFormat === 'channelsLast';\n const dxStrides = util.computeStrides(convInfo.inShape);\n const dyStrides = util.computeStrides(dy.shape);\n const [fltS0, fltS1, fltS2] = util.computeStrides(filter.shape);\n const xBatchStride = dxStrides[0];\n const xRowStride = isChannelsLast
? dxStrides[1] : dxStrides[2];\n const xColStride = isChannelsLast ? dxStrides[2] : 1;\n const xChannelStride = isChannelsLast ? 1 : dxStrides[1];\n const yBatchStride = dyStrides[0];\n const yRowStride = isChannelsLast ? dyStrides[1] : dyStrides[2];\n const yColStride = isChannelsLast ? dyStrides[2] : 1;\n const yChannelStride = isChannelsLast ? 1 : dyStrides[1];\n\n const out = backend.makeOutput(convInfo.inShape, 'float32');\n const outId = backend.dataIdMap.get(out.dataId).id;\n const dyId = backend.dataIdMap.get(dy.dataId).id;\n const filterId = backend.dataIdMap.get(filter.dataId).id;\n\n wasmConv2DBackpropInput(\n dyId, filterId, batchSize,
filterHeight, filterWidth, inHeight, inWidth,\n inChannels, outHeight, outWidth, outChannels, strideHeight,
strideWidth,\n topPad, leftPad, fltS0, fltS1, fltS2, xBatchStride, xRowStride,\n xColStride, xChannelStride,
yBatchStride, yRowStride, yColStride,\n yChannelStride, outId);\n return out;\n}\n\nexport
const conv2DBackpropInputConfig: KernelConfig = {\n kernelName: Conv2DBackpropInput,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: conv2DBackpropInput as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or

agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {Cos, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\n\nexport const cosConfig: KernelConfig = createUnaryKernelConfig(Cos);\n","/**\n * @license\n * Copyright 2021 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\nimport {Cosh, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\n\nexport const coshConfig: KernelConfig = createUnaryKernelConfig(Cosh);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {CropAndResize, CropAndResizeAttrs, CropAndResizeInputs, KernelConfig, KernelFunc, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {cast} from './Cast';\n\n// Must match enum in CropAndResize.cc\nenum InterpolationMethod {\n bilinear = 0,\n nearest = 1\n}\n\nlet wasmCropAndResize: (\n imagesId: number, boxesId: number, boxIndId: number, numBoxes: number,\n imagesShape: Uint8Array, cropHeight: number, cropWidth: number,\n method: number, extrapolationValue: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n wasmCropAndResize = backend.wasm.cwrap(CropAndResize, null /*void*/, [\n 'number', // imagesId\n 'number', // boxesId\n 'number', // boxIndId\n 'number', // numBoxes\n 'array', // images shape\n 'number', // cropHeight\n 'number', // cropWidth\n 'number', // method\n 'number', // extrapolation value\n 'number' // out id\n]);\n}\n\nfunction cropAndResize(args: {\n backend: BackendWasm,\n inputs: CropAndResizeInputs,\n attrs: CropAndResizeAttrs\n}): TensorInfo {\n const {backend, inputs, attrs} = args;\n const {method, extrapolationValue, cropSize} = attrs;\n const {image, boxes, boxInd} = inputs;\n\n const numBoxes = boxes.shape[0];\n\n const [cropHeight, cropWidth] = cropSize as [number, number];\n const outShape = [numBoxes, cropHeight, cropWidth, image.shape[3]];\n\n let imagesData = backend.dataIdMap.get(image.dataId);\n let castedData;\n if (image.dtype !== 'float32') {\n castedData = cast({backend, inputs: {x: image}, attrs: {dtype: 'float32'}});\n imagesData = backend.dataIdMap.get(castedData.dataId);\n }\n\n const imagesId = imagesData.id;\n const boxesId = backend.dataIdMap.get(boxes.dataId).id;\n const boxIndId = backend.dataIdMap.get(boxInd.dataId).id;\n\n const out = backend.makeOutput(outShape, 'float32');\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n const imagesShapeBytes = new Uint8Array(new Int32Array(image.shape).buffer);\n\n wasmCropAndResize(\n imagesId, boxesId, boxIndId, numBoxes, imagesShapeBytes, cropHeight,\n cropWidth,\n InterpolationMethod[method as {} as keyof typeof InterpolationMethod],\n extrapolationValue, outId);\n\n if (castedData != null) {\n backend.disposeData(castedData.dataId);\n }\n\n return out;\n}\n\nexport const cropAndResizeConfig: KernelConfig = {\n kernelName: CropAndResize,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: cropAndResize as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version

2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {backend_util, KernelConfig, KernelFunc, Cumsum, CumsumAttrs, CumsumInputs, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {CppDType} from './types';\n\nimport {transpose} from './Transpose';\n\nlet wasmCumsum: (xId: number, exclusive: number, reverse: number,\n finalDim: number, outId: number, dtype: CppDType) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmCumsum = backend.wasm.cwrap(Cumsum, null /* void */, [\n 'number', // x_id\n 'number', // exclusive\n 'number', // reverse\n 'number', // final_dim\n 'number', // out_id\n 'number' // dtype\n]);\n}\n\nexport function cumsum(\n args: {inputs: CumsumInputs, backend: BackendWasm, attrs: CumsumAttrs}):\nTensorInfo {\n const {inputs, backend, attrs} = args;\n const {x} = inputs;\n const {axis, exclusive, reverse} = attrs;\n const xRank = x.shape.length;\n\n util.assert(x.dtype === 'float32' || x.dtype === 'int32',\n () => `cumsum does not support ${x.dtype} tensors in the WASM backend`);\n // permute required axis to inner most axis\n const permutation = backend_util.getAxesPermutation([axis], xRank);\n let permutedX = x;\n if (permutation !== null) {\n permutedX = transpose({inputs: {x}, attrs: {perm: permutation}, backend});\n }\n const permutedAxis = backend_util.getInnerMostAxes(1, xRank)[0];\n backend_util.assertAxesAreInnerMostDims('cumsum', [permutedAxis], xRank);\n\n const permutedOut = backend.makeOutput(permutedX.shape, permutedX.dtype);\n const finalDim = permutedX.shape[permutedAxis];\n const permutedXId = backend.dataIdMap.get(permutedX.dataId).id;\n const permutedOutId = backend.dataIdMap.get(permutedOut.dataId).id;\n wasmCumsum(permutedXId, exclusive ? 1 : 0, reverse ? 1 : 0, finalDim,\n permutedOutId, CppDType[x.dtype]);\n\n // transpose data back if permuted\n let out = permutedOut;\n if (permutation !== null) {\n const undoPermutation = backend_util.getUndoAxesPermutation(permutation);\n out = transpose(\n {inputs: {x: permutedOut}, attrs: {perm: undoPermutation}, backend});\n backend.disposeData(permutedX.dataId);\n backend.disposeData(permutedOut.dataId);\n }\n return out;\n}\n\nexport const cumsumConfig: KernelConfig = {\n kernelName: Cumsum,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: cumsum as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {DepthToSpace, DepthToSpaceAttrs, DepthToSpaceInputs, KernelConfig, KernelFunc, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmDepthToSpace: (\n xId: number, blockSize: number, channelsLast: number, xStrides: Uint8Array,\n xStridesLength: number, outputShape: Uint8Array, outputStrides: Uint8Array,\n outSize: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n wasmDepthToSpace = backend.wasm.cwrap(DepthToSpace, null /*void*/, [\n 'number', // xId\n 'number', // blockSize\n 'number', // channelsLast\n 'array', // xStrides\n 'number', // xStridesLength\n 'array', // outputShape\n 'array', // outputStrides\n 'number', // outSize\n 'number', // outId\n]);\n}\n\nexport function depthToSpace(args: {\n backend: BackendWasm,\n inputs: DepthToSpaceInputs,\n attrs: DepthToSpaceAttrs\n}): TensorInfo {\n const {backend, inputs, attrs} = args;\n const {x} = inputs;\n const

{blockSize, dataFormat} = attrs;\n\n const batchSize = x.shape[0];\n const inputHeight = (dataFormat === 'NHWC') ? x.shape[1] : x.shape[2];\n const inputWidth = (dataFormat === 'NHWC') ? x.shape[2] : x.shape[3];\n const inputDepth = (dataFormat === 'NHWC') ? x.shape[3] : x.shape[1];\n\n const outputHeight = inputHeight * blockSize;\n const outputWidth = inputWidth * blockSize;\n const outputDepth = inputDepth / (blockSize * blockSize);\n\n const outputShape = (dataFormat === 'NHWC') ?\n   [batchSize, outputHeight, outputWidth, outputDepth] :\n   [batchSize, outputDepth, outputHeight, outputWidth];\n\n const out = backend.makeOutput(outputShape, 'float32');\n\n const xData = backend.dataIdMap.get(x.dataId);\n const xId = xData.id;\n const xStridesBytes
 =\n   new Uint8Array(new Int32Array(util.computeStrides(x.shape)).buffer);\n\n const outputShapeBytes = new Uint8Array(new Int32Array(outputShape).buffer);\n const outStridesBytes =\n   new Uint8Array(new Int32Array(util.computeStrides(outputShape)).buffer);\n\n const outId = backend.dataIdMap.get(out.dataId).id;\n const channelsLast = dataFormat === 'NHWC' ? 1 : 0;\n wasmDepthToSpace(\n   xId, blockSize, channelsLast, xStridesBytes, x.shape.length - 1,\n   outputShapeBytes, outStridesBytes, outputShape.length, outId);\n\n return out;\n}\n\nexport const depthToSpaceConfig: KernelConfig = {\n kernelName: DepthToSpace,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: depthToSpace as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License
 at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n*/\n\nimport {backend_util, DepthwiseConv2dNative, DepthwiseConv2dNativeAttrs, DepthwiseConv2dNativeInputs, KernelConfig, KernelFunc, Tensor4D} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmDepthwiseConv2d: (\n   xId: number, batchSize: number, inputHeight: number, inputWidth: number,\n   filterId: number, filterHeight: number, filterWidth: number, padTop: number,\n   padRight: number, padBottom: number, padLeft: number, isSamePad: number,\n   dilationHeight: number, dilationWidth:
 number, strideHeight: number,\n   strideWidth: number, inputChannels: number, outputChannels: number,\n   outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmDepthwiseConv2d =\n   backend.wasm.cwrap(DepthwiseConv2dNative, null /* void */, [\n   'number', // xId\n   'number', // batchSize\n   'number', // inputHeight\n   'number', // inputWidth\n   'number', // filterId\n   'number', // filterHeight\n   'number', // filterWidth\n   'number', // padTop\n   'number', // padRight\n   'number', // padBottom\n   'number', // padLeft\n   'number', // isSamePad\n   'number', // dilationHeight\n   'number', // dilationWidth\n   'number', // strideHeight\n   'number', // strideWidth\n   'number', // inputChannels\n   'number', // outputChannels\n   'number', // outId\n   ]);\n}\n\nfunction depthwiseConv2d(args: {\n inputs: DepthwiseConv2dNativeInputs,\n
  backend: BackendWasm,\n attrs: DepthwiseConv2dNativeAttrs\n}) {\n const {inputs, attrs, backend} = args;\n\n const {x, filter} = inputs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n const filterId = backend.dataIdMap.get(filter.dataId).id;\n\n const {strides, dilations, pad, dimRoundingMode} = attrs;\n\n const $dilations = dilations == null ? [1, 1] : dilations;\n\n const convInfo = backend_util.computeConv2DInfo(\n   (x as Tensor4D).shape, (filter as Tensor4D).shape, strides,\n   ($dilations as number | [number, number]), pad, dimRoundingMode,\n   true /* depthwise */);\n\n const filterHeight = convInfo.filterHeight;\n const filterWidth = convInfo.filterWidth;\n const padTop = convInfo.padInfo.top;\n const padRight = convInfo.padInfo.right;\n const padBottom = convInfo.padInfo.bottom;\n const padLeft = convInfo.padInfo.left;\n const dilationHeight = convInfo.dilationHeight;\n const dilationWidth = convInfo.dilationWidth;\n const strideHeight = convInfo.strideHeight;\n

const strideWidth = convInfo.strideWidth;\n const inputChannels = convInfo.inChannels;\n const outputChannels = convInfo.outChannels;\n const isSamePad = convInfo.padInfo.type === 'SAME' ? 1 : 0;\n\n if (convInfo.dataFormat !== 'channelsLast') {\n   throw new Error(\n   `wasm backend DepthwiseConv2dNative does not support dataFormat:'` +\n   `${convInfo.dataFormat}'. Please use 'channelsLast'.`);\n }\n\n const out = backend.makeOutput(convInfo.outShape, 'float32');\n const outId = backend.dataIdMap.get(out.dataId).id;\n wasmDepthwiseConv2d(\n   xId, x.shape[0], x.shape[1], x.shape[2], filterId, filterHeight,\n   filterWidth, padTop, padRight, padBottom, padLeft, isSamePad,\n   dilationHeight, dilationWidth, strideHeight, strideWidth, inputChannels,\n   outputChannels, outId);\n return out;\n}\n\nexport const depthwiseConv2dNativeConfig: KernelConfig = {\n kernelName: DepthwiseConv2dNative,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: depthwiseConv2d as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2021 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\nimport {Elu, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\n\nexport const eluConfig: KernelConfig = createUnaryKernelConfig(Elu);\n","/**\n * @license\n * Copyright
 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\nimport {Equal, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from './binary_kernel';\n\nconst supportsFullBroadcast = false;\nexport const equalConfig: KernelConfig =\n createBinaryKernelConfig(Equal, supportsFullBroadcast, 'bool');\n","/**\n * @license\n * Copyright
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 License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {ExpandDims, ExpandDimsAttrs, ExpandDimsInputs, KernelConfig, KernelFunc, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\nimport {reshape} from

'./Reshape';\n\nexport function expandDims(args: {\n inputs: ExpandDimsInputs,\n attrs: ExpandDimsAttrs,\n backend: BackendWasm\n}) {\n const {inputs, attrs, backend} = args;\n const {input} = inputs;\n const {dim} = attrs;\n\n const inputRank = input.shape.length;\n const newShape = input.shape.slice();\n let $dim = dim;\n if (dim < 0) {\n   // Negative value is counted from the tail of rank.\n util.assert(\n   -(inputRank + 1) <= dim,\n   () => `Axis must be in the interval [${- (inputRank + 1)}, ${\n    inputRank}]`);\n $dim = inputRank + dim + 1;\n }\n newShape.splice($dim, 0, 1);\n\n return reshape({inputs: {x: input}, backend, attrs: {shape: newShape}});\n}\n\nexport const expandDimsConfig: KernelConfig = {\n kernelName: ExpandDims,\n backendName: 'wasm',\n kernelFunc: expandDims as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==\n */\n\nimport {KernelConfig, KernelFunc} from '@tensorflow/tfjs-core';\nimport {Fill, FillAttrs} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nexport function fill(args: {attrs: FillAttrs, backend: BackendWasm}) {\n const {attrs: {shape, value, dtype}, backend} = args;\n const out = backend.makeOutput(shape, dtype);\n const outVals = backend.typedArrayFromHeap(out);\n outVals.fill(value as number);\n return out;\n}\n\nexport const fillConfig: KernelConfig = {\n kernelName: Fill,\n backendName: 'wasm',\n kernelFunc: fill as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==\n */\n\nimport {FlipLeftRight, FlipLeftRightInputs, KernelConfig, KernelFunc, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmFlipLeftRight: (\n   xId: number, batch: number, imageHeight: number, imageWidth: number,\n   numChannels: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmFlipLeftRight = backend.wasm.cwrap(FlipLeftRight, null /* void */, [\n   'number', // xId\n   'number', // batch\n   'number', // imageHeight\n   'number', // imageWidth\n   'number', // numChannels\n   'number', // outId\n]);\n}\n\nexport function flipLeftRight(\n   args: {inputs: FlipLeftRightInputs, backend: BackendWasm}): TensorInfo {\n const {inputs, backend} = args;\n const {image} = inputs;\n\n const out = backend.makeOutput(image.shape, image.dtype);\n const imageId = backend.dataIdMap.get(image.dataId).id;\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n const [batch, imageHeight, imageWidth, numChannels] = image.shape;\n\n wasmFlipLeftRight(\n   imageId, batch, imageHeight, imageWidth, numChannels, outId);\n return out;\n}\n\nexport const flipLeftRightConfig: KernelConfig = {\n kernelName: FlipLeftRight,\n backendName: 'wasm',\n kernelFunc: flipLeftRight as {} as KernelFunc,\n setupFunc: setup\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *

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==========\n*/\nimport {Floor, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\nexport const floorConfig: KernelConfig = createUnaryKernelConfig(Floor);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n*/\n\nimport {FloorDiv, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from './binary_kernel';\n\nconst supportsFullBroadcast = false;\nexport const floorDivConfig: KernelConfig =\n createBinaryKernelConfig(FloorDiv, supportsFullBroadcast);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n*/\n\nimport {FusedBatchNorm, FusedBatchNormAttrs, FusedBatchNormInputs, KernelConfig, KernelFunc, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmBatchNorm: (\n    xId: number, meanId: number, varianceId: number, offsetId: number,\n    scaleId: number, varianceEpsilon: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n wasmBatchNorm = backend.wasm.cwrap(\n       FusedBatchNorm, null /* void */,\n       ['number', 'number', 'number', 'number', 'number', 'number', 'number']);\n}\n\nfunction fusedBatchNorm(args: {\n  backend: BackendWasm,\n  inputs: FusedBatchNormInputs,\n  attrs: FusedBatchNormAttrs\n}): TensorInfo {\n  const {backend, inputs, attrs} = args;\n  const {varianceEpsilon} = attrs;\n  const {x, mean, variance, offset, scale} = inputs;\n  const xId = backend.dataIdMap.get(x.dataId).id;\n  const meanId = backend.dataIdMap.get(mean.dataId).id;\n  const varianceId = backend.dataIdMap.get(variance.dataId).id;\n  const offsetId = offset != null ? backend.dataIdMap.get(offset.dataId).id : 0;\n  const scaleId = scale != null ? backend.dataIdMap.get(scale.dataId).id : 0;\n\n  const out = backend.makeOutput(x.shape, x.dtype);\n  // Short-circuit zero-sized tensors.\n  if (util.sizeFromShape(x.shape) ===
 0) {\n    return out;\n  }\n\n  const outId = backend.dataIdMap.get(out.dataId).id;\n\n  wasmBatchNorm(\n      xId, meanId, varianceId, offsetId, scaleId, varianceEpsilon, outId);\n  return out;\n}\n\nexport const fusedBatchNormConfig: KernelConfig = {\n  kernelName: FusedBatchNorm,\n  backendName: 'wasm',\n  setupFunc: setup,\n  kernelFunc: fusedBatchNorm as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations
 under the License.\n *
==========\n*/\n\nimport {backend_util, FusedConv2D, FusedConv2DAttrs, FusedConv2DInputs, KernelConfig, KernelFunc, Tensor4D} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport
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{FusableActivation} from './types';\n\nlet wasmFusedConv2d:\n (xId: number, batchSize: number, inputHeight: number, inputWidth: number,\n filterId: number, filterHeight: number, filterWidth: number,\n biasId: number, padTop: number, padRight: number, padBottom: number,\n padLeft: number, isSamePad: number, dilationHeight: number,\n dilationWidth: number, strideHeight: number, strideWidth: number,\n inputChannels: number, outputChannels: number, activation: number,\n preluActivationWeightsId: number, leakyreluAlpha: number, outId: number) =>\n void;\n\nfunction setup(backend: BackendWasm) {\n wasmFusedConv2d = backend.wasm.cwrap(FusedConv2D, null /*
void */, [\n 'number', // xId\n 'number', // batchSize\n 'number', // inputHeight\n 'number', // inputWidth\n 'number', // filterId\n 'number', // filterHeight\n 'number', // filterWidth\n 'number', // biasId\n 'number', // padTop\n 'number', // padRight\n 'number', // padBottom\n 'number', // padLeft\n 'number', // isSamePad\n 'number', // dilationHeight\n 'number', // dilationWidth\n 'number', // strideHeight\n 'number', // strideWidth\n 'number', // inputChannels\n 'number', // outputChannels\n 'number', // activation\n 'number', // preluActivationWeightsId\n 'number', // leakyreluAlpha\n 'number', // outId\n]);\n}\n\nfunction fusedConv2d(args: {\n inputs: FusedConv2DInputs,\n backend: BackendWasm,\n attrs: FusedConv2DAttrs\n}) {\n const {inputs, attrs, backend} = args;\n const {x, filter, bias, preluActivationWeights} = inputs;\n const {\n strides,\n pad,\n dilations,\n dataFormat,\n
dimRoundingMode,\n activation,\n leakyreluAlpha\n } = attrs;\n\n const convInfo = backend_util.computeConv2DInfo(\n (x as Tensor4D).shape, (filter as Tensor4D).shape, strides, dilations,\n pad, dimRoundingMode);\n\n const fusedActivation =\n FusableActivation[activation as {} as keyof typeof FusableActivation];\n if (fusedActivation == null) {\n throw new Error(\n `${activation} activation not yet supported for FusedConv2D ` +\n `in the wasm backend.`);\n }\n\n const xId = backend.dataIdMap.get(x.dataId).id;\n const filterId = backend.dataIdMap.get(filter.dataId).id;\n\n const outputChannels = convInfo.outChannels;\n\n let biasId = 0;\n if (bias != null) {\n const biasData = backend.dataIdMap.get(bias.dataId);\n if (biasData.shape.length !== 1) {\n throw new Error(\n `FusedConv2D only supports rank-1 bias but got ` +\n `rank ${biasData.shape.length}.`);\n }\n if (biasData.shape[0] !== outputChannels)
{\n throw new Error(\n `FusedConv2D bias shape (${biasData.shape}) does not ` +\n `match the number of output channels (${outputChannels})`);\n }\n biasId = biasData.id;\n }\n\n const filterHeight = convInfo.filterHeight;\n const filterWidth = convInfo.filterWidth;\n const padTop = convInfo.padInfo.top;\n const padRight = convInfo.padInfo.right;\n const padBottom = convInfo.padInfo.bottom;\n const padLeft = convInfo.padInfo.left;\n const dilationHeight = convInfo.dilationHeight;\n const dilationWidth = convInfo.dilationWidth;\n const strideHeight = convInfo.strideHeight;\n const strideWidth = convInfo.strideWidth;\n const inputChannels = convInfo.inChannels;\n const isSamePad = convInfo.padInfo.type === 'SAME' ? 1 : 0;\n const batchSize = convInfo.batchSize;\n const inHeight = convInfo.inHeight;\n const inWidth = convInfo.inWidth;\n\n if (dataFormat !== 'NHWC') {\n throw new Error(\n `wasm backend FusedConv2D does not
support dataFormat:'` +\n `${dataFormat}'. Please use 'NHWC'.`);\n }\n\n const out = backend.makeOutput(convInfo.outShape, 'float32');\n const outId = backend.dataIdMap.get(out.dataId).id;\n const preluActivationWeightsId = preluActivationWeights == null ?\n 0 :\n backend.dataIdMap.get(preluActivationWeights.dataId).id;\n\n wasmFusedConv2d(\n xId, batchSize, inHeight, inWidth, filterId, filterHeight, filterWidth,\n biasId, padTop, padRight, padBottom, padLeft, isSamePad, dilationHeight,\n dilationWidth, strideHeight, strideWidth, inputChannels, outputChannels,\n fusedActivation, preluActivationWeightsId, leakyreluAlpha || 0, outId);\n\n return out;\n}\n\nexport const fusedConv2DConfig: KernelConfig = {\n kernelName: FusedConv2D,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: fusedConv2d as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version
2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable

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law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========================================================================\n */\n\nimport {backend_util, FusedDepthwiseConv2D, FusedDepthwiseConv2DAttrs, FusedDepthwiseConv2DInputs, KernelConfig, KernelFunc, Tensor4D} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {FusableActivation} from './types';\n\nlet wasmFusedDepthwiseConv2d:\n    (xId: number, batchSize: number, inputHeight: number, inputWidth: number,\n filterId: number,
 filterHeight: number, filterWidth: number,\n     biasId: number, padTop: number, padRight: number, padBottom: number,\n     padLeft: number, isSamePad: number, dilationHeight: number,\n     dilationWidth: number, strideHeight: number, strideWidth: number,\n     inputChannels: number, outputChannels: number, activation: number,\n     preluActivationWeightsId: number, leakyreluAlpha: number, outId: number) =>\n void;\n\nfunction setup(backend: BackendWasm) {\n  wasmFusedDepthwiseConv2d =\n backend.wasm.cwrap(FusedDepthwiseConv2D, null /* void */, [\n        'number',  // xId\n        'number',  // batchSize\n        'number',  // inputHeight\n        'number',  // inputWidth\n        'number',  // filterId\n        'number',  // filterHeight\n        'number',  // filterWidth\n        'number',  // biasId\n        'number',  // padTop\n        'number',  // padRight\n        'number',  // padBottom\n        'number',  // padLeft\n        'number',  // isSamePad\n        'number',
  // dilationHeight\n        'number',  // dilationWidth\n        'number',  // strideHeight\n        'number',  // strideWidth\n
    'number',  // inputChannels\n        'number',  // outputChannels\n        'number',  // activation\n        'number',  // preluActivationWeightsId\n        'number',  // leakyreluAlpha\n        'number',  // outId\n    ]);\n}\n\nfunction fusedDepthwiseConv2d(args: {\n  inputs: FusedDepthwiseConv2DInputs,\n  backend: BackendWasm,\n  attrs: FusedDepthwiseConv2DAttrs\n}) {\n  const {inputs, attrs, backend} = args;\n  const {x, filter, bias, preluActivationWeights} = inputs;\n  const {\n    strides,\n    pad,\n    dilations,\n    dataFormat,\n dimRoundingMode,\n    activation,\n    leakyreluAlpha\n  } = attrs;\n\n  const convInfo = backend_util.computeConv2DInfo(\n      (x as Tensor4D).shape, (filter as Tensor4D).shape, strides, dilations,\n pad, dimRoundingMode, true /* depthwise */);\n\n  const fusedActivation =\n      FusableActivation[activation
  as {} as keyof typeof FusableActivation];\n  if (fusedActivation == null) {\n    throw new Error(\n `${activation} activation not yet supported for FusedDepthwiseConv2D ` +\n        `in the wasm backend.`);\n  }\n\n const xId = backend.dataIdMap.get(x.dataId).id;\n  const filterId = backend.dataIdMap.get(filter.dataId).id;\n\n const outputChannels = convInfo.outChannels;\n\n  let biasId = 0;\n  if (bias != null) {\n    const biasData = backend.dataIdMap.get(bias.dataId);\n    if (biasData.shape.length !== 1) {\n      throw new Error(\n `FusedDepthwiseConv2D only supports rank-1 bias but got ` +\n          `rank ${biasData.shape.length}.`);\n    }\n if (biasData.shape[0] !== outputChannels) {\n      throw new Error(\n          `FusedDepthwiseConv2D bias shape (${biasData.shape}) does not ` +\n          `match the number of output channels (${outputChannels})`);\n    }\n biasId = biasData.id;\n  }\n\n  const filterHeight = convInfo.filterHeight;\n  const
  filterWidth = convInfo.filterWidth;\n  const padTop = convInfo.padInfo.top;\n  const padRight = convInfo.padInfo.right;\n  const padBottom = convInfo.padInfo.bottom;\n  const padLeft = convInfo.padInfo.left;\n const dilationHeight = convInfo.dilationHeight;\n  const dilationWidth = convInfo.dilationWidth;\n  const strideHeight = convInfo.strideHeight;\n  const strideWidth = convInfo.strideWidth;\n  const inputChannels = convInfo.inChannels;\n  const isSamePad = convInfo.padInfo.type === 'SAME' ? 1 : 0;\n  const batchSize = convInfo.batchSize;\n  const inHeight = convInfo.inHeight;\n  const inWidth = convInfo.inWidth;\n\n  if (dataFormat !== 'NHWC') {\n    throw new Error(\n        `wasm backend FusedDepthwiseConv2D does not support dataFormat:'` +\n        `${dataFormat}'. Please use 'NHWC'.`);\n  }\n\n  const out = backend.makeOutput(convInfo.outShape, 'float32');\n  const outId = backend.dataIdMap.get(out.dataId).id;\n  const preluActivationWeightsId = preluActivationWeights ==
  null ?\n      0 :\n      backend.dataIdMap.get(preluActivationWeights.dataId).id;\n\n wasmFusedDepthwiseConv2d(\n      xId, batchSize, inHeight, inWidth, filterId, filterHeight, filterWidth,\n
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biasId, padTop, padRight, padBottom, padLeft, isSamePad, dilationHeight,\n dilationWidth, strideHeight, strideWidth, inputChannels, outputChannels,\n fusedActivation, preluActivationWeightsId, leakyreluAlpha || 0, outId);\n\n return out;\n}\n\nexport const fusedDepthwiseConv2DConfig: KernelConfig = {\n kernelName: FusedDepthwiseConv2D,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: fusedDepthwiseConv2d as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable
law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n */\n\nimport {gather_util, GatherNd, GatherNdInputs, KernelConfig, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {CppDType} from './types';\n\nlet wasmGatherNd: (\n xId: number, dtype: CppDType, indicesId: number, numSlices: number,\n sliceRank: number, sliceSize: number, strides: Uint8Array, outId: number) =>\n void;\n\nfunction setup(backend: BackendWasm): void {\n wasmGatherNd = backend.wasm.cwrap(GatherNd, null /*void*/, [\n 'number', // xId\n 'number', // dtype\n 'number', // indicesId\n 'number', // numSlices\n 'number', // sliceRank\n 'number', // sliceSize\n 'array', // strides\n 'number' // outId\n]);\n}\n\nfunction gatherNd(args: {backend: BackendWasm, inputs: GatherNdInputs}):\n TensorInfo {\n const {backend, inputs} = args;\n const {params, indices} = inputs;\n\n const [resultShape, numSlices, sliceSize, strides] =\n gather_util.prepareAndValidate(params, indices);\n\n const out = backend.makeOutput(resultShape, params.dtype);\n if (numSlices === 0) {\n return out;\n }\n\n const indicesShape = indices.shape;\n const sliceRank = indicesShape[indicesShape.length - 1];\n\n const xData = backend.dataIdMap.get(params.dataId);\n const xId = xData.id;\n const indicesData = backend.dataIdMap.get(indices.dataId);\n const indicesId = indicesData.id;\n\n const stridesBytes = new Uint8Array(new Int32Array(strides).buffer);\n\n const outId = backend.dataIdMap.get(out.dataId).id;\n wasmGatherNd(\n xId, CppDType[params.dtype], indicesId, numSlices, sliceRank, sliceSize,\n stridesBytes, outId);\n\n return out;\n}\n\nexport const gatherNdConfig: KernelConfig = {\n kernelName: GatherNd,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: gatherNd\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n */\n\nimport {backend_util, GatherV2, GatherV2Attrs, GatherV2Inputs, KernelConfig, KernelFunc, Tensor, TensorInfo, TypedArray, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {reshape} from './Reshape';\nimport {CppDType} from './types';\n\nlet wasmGather: (\n xId: number, dtype: CppDType, xStrides: Uint8Array, stridesSize: number,\n indicesId: number, batchSize: number, outStrides: Uint8Array,\n outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n wasmGather = backend.wasm.cwrap('Gather', null /*void*/, [\n 'number', // xId\n 'number', // dtype\n 'array', // xStrides\n 'number', // stridesSize\n 'number', // indicesId\n 'number', // batchSize\n 'array', // outStrides\n 'number' // outId\n]);\n}\n\nfunction gatherV2(\n args: {backend: BackendWasm, inputs: GatherV2Inputs, attrs: GatherV2Attrs}):\n TensorInfo {\n const {backend, inputs, attrs} = args;\n const {x, indices} = inputs;\n const {axis, batchDims} = attrs;\n\n // Throw error when any

index is out of bound.\n const parsedAxis = util.parseAxisParam(axis, x.shape)[0];\n const indicesVals = backend.readSync(indices.dataId) as TypedArray;\n const axisDim = x.shape[parsedAxis];\n for (let i = 0; i < indicesVals.length; ++i) {\n   const index = indicesVals[i];\n   util.assert(\n   index <= axisDim - 1 && index >= 0,\n   () =>\n   `GatherV2: the index value ${index} is not in [0, ${axisDim - 1}]`);\n }\n\n const shapeInfo = backend_util.segment_util.collectGatherOpShapeInfo(\n   x as Tensor, indices as Tensor, parsedAxis, batchDims);\n\n const flattenX = reshape({\n   inputs: {x},\n   attrs: {\n   shape: [\n   shapeInfo.batchSize, shapeInfo.outerSize, shapeInfo.dimSize,\n   shapeInfo.sliceSize\n   ]\n   },\n   backend\n });\n const indicesSize = util.sizeFromShape(indices.shape);\n const flattenIndex = reshape({\n   inputs: {x: indices},\n   attrs: {shape: [shapeInfo.batchSize, indicesSize / shapeInfo.batchSize]},\n   backend\n });\n const flattenOutputShape = [\n   shapeInfo.batchSize, shapeInfo.outerSize, indicesSize / shapeInfo.batchSize,\n   shapeInfo.sliceSize\n];\n\n const out = backend.makeOutput(flattenOutputShape, x.dtype);\n if (util.sizeFromShape(x.shape) === 0) {\n   return out;\n }\n const stridesSize = flattenX.shape.length - 1;\n\n const xData = backend.dataIdMap.get(flattenX.dataId);\n const xId = xData.id;\n\n const indicesData = backend.dataIdMap.get(flattenIndex.dataId);\n const indicesId = indicesData.id;\n\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n const xStridesBytes = new Uint8Array(\n   new Int32Array(util.computeStrides(flattenX.shape)).buffer);\n const outStridesBytes = new Uint8Array(\n   new Int32Array(util.computeStrides(flattenOutputShape)).buffer);\n\n wasmGather(\n   xId, CppDType[x.dtype], xStridesBytes, stridesSize, indicesId,\n   shapeInfo.batchSize, outStridesBytes, outId);\n\n backend.disposeData(flattenX.dataId);\n backend.disposeData(flattenIndex.dataId);\n\n // reshape\n out.shape = shapeInfo.outputShape;\n return out;\n}\n\nexport const gatherV2Config: KernelConfig = {\n kernelName: GatherV2,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: gatherV2 as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\nimport {Greater, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from './binary_kernel';\n\nconst supportsFullBroadcast = false;\nexport const greaterConfig: KernelConfig =\n createBinaryKernelConfig(Greater, supportsFullBroadcast, 'bool');\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\nimport {GreaterEqual, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from './binary_kernel';\n\nconst supportsFullBroadcast = false;\nexport const greaterEqualConfig: KernelConfig =\n createBinaryKernelConfig(GreaterEqual, supportsFullBroadcast, 'bool');\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *

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==========\n */\n\nimport {KernelConfig, KernelFunc, LeakyRelu, LeakyReluAttrs, LeakyReluInputs, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {CppDType} from './types';\n\nlet wasmFunc: (\n    xId: number, dtype: number, leakyreluAlpha: number, outId: number) => void;\n\nfunction setupFunc(backend: BackendWasm): void {\n  wasmFunc = backend.wasm.cwrap(LeakyRelu, null /* void */, [\n    'number',  // x_id\n    'number',  // dtype\n    'number',  // leakyrelu_alpha\n    'number',  // out_id\n  ]);\n}\n\nexport function leakyRelu(\n    args:\n        {inputs: LeakyReluInputs, attrs: LeakyReluAttrs, backend: BackendWasm}):\n    TensorInfo {\n  const {inputs: {x}, attrs: {alpha}, backend} = args;\n\n  const xId = backend.dataIdMap.get(x.dataId).id;\n  // According to TF API, LeakyRelu returns float32 when input is either float32\n  // or int32.\n  const out = backend.makeOutput(x.shape, 'float32');\n\n  if (util.sizeFromShape(x.shape) !== 0) {\n    const outId = backend.dataIdMap.get(out.dataId).id;\n    wasmFunc(xId, CppDType[x.dtype], alpha, outId);\n  }\n\n  return out;\n}\n\nexport const leakyReluConfig: KernelConfig = {\n  kernelName: LeakyRelu,\n  backendName: 'wasm',\n  setupFunc,\n  kernelFunc: leakyRelu as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\nimport {KernelConfig, Less} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from './binary_kernel';\nconst supportsFullBroadcast = false;\nexport const lessConfig: KernelConfig =\n createBinaryKernelConfig(Less, supportsFullBroadcast, 'bool');\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {KernelConfig, LessEqual} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from './binary_kernel';\nconst supportsFullBroadcast = false;\nexport const lessEqualConfig: KernelConfig =\n createBinaryKernelConfig(LessEqual, supportsFullBroadcast, 'bool');\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\nimport {KernelConfig, Log} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\nexport const logConfig: KernelConfig = createUnaryKernelConfig(Log);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
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==========\n
*/\nimport {KernelConfig, LogicalAnd}
from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from './binary_kernel';\nconst
supportsFullBroadcast = false;\nexport const logicalAndConfig: KernelConfig =\n
createBinaryKernelConfig(LogicalAnd, supportsFullBroadcast, 'bool');\n","/**\n * @license\n * Copyright 2019
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OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language
governing permissions and\n * limitations under the License.\n *
==========\n
*/\n\nimport {backend_util,
KernelConfig, KernelFunc, Max, MaxAttrs, MaxInputs, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport
{BackendWasm} from '../backend_wasm';\n\nimport {permuteAxesAndTranspose} from './kernel_utils';\nimport
{CppDType} from './types';\n\nlet wasmMax: (xId: number, dtype: number, reduceSize: number, outId: number)
=>\n void;\n\nfunction setup(backend: BackendWasm): void {\n wasmMax = backend.wasm.cwrap(Max, null
/*void*/, [\n 'number', // x_id\n 'number', // dtype\n 'number', // reduce_size\n 'number', // out_id\n
]);\n}\n\nfunction max(args: {backend: BackendWasm, inputs: MaxInputs, attrs: MaxAttrs}):\n TensorInfo {\n
const {backend, inputs, attrs} = args;\n const {reductionIndices: axis, keepDims} = attrs;\n const {x} = inputs;\n
const xId = backend.dataIdMap.get(x.dataId).id;\n let inputId = xId;\n let input = x;\n\n const {transposed, axes,
originalAxes, inputWasTransposed} =\n permuteAxesAndTranspose(x, axis, backend);\n\n if
(inputWasTransposed)
{\n const transposedId = backend.dataIdMap.get(transposed.dataId).id;\n input = transposed;\n inputId =
transposedId;\n }\n\n const inputRank = input.shape.length;\n backend_util.assertAxesAreInnerMostDims('max',
axes, inputRank);\n const [outShape, reduceShape] =\n
backend_util.computeOutAndReduceShapes(input.shape, axes);\n const reduceSize =
util.sizeFromShape(reduceShape);\n\n const out = backend.makeOutput(outShape, x.dtype);\n if
(util.sizeFromShape(input.shape) !== 0) {\n const outId = backend.dataIdMap.get(out.dataId).id;\n
wasmMax(inputId, CppDType[x.dtype], reduceSize, outId);\n }\n\n if (inputWasTransposed) {\n // dispose of the
transposed tensor.\n backend.disposeData(transposed.dataId);\n }\n\n if (keepDims) {\n // reshape\n const
newShape = backend_util.expandShapeToKeepDim(out.shape, originalAxes);\n out.shape = newShape;\n }\n\n
return out;\n}\n\nexport const maxConfig: KernelConfig = {\n kernelName: Max,\n
backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: max as {} as KernelFunc\n};\n","/**\n * @license\n *
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WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for
the specific language governing permissions and\n * limitations under the License.\n *
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*/\nimport {KernelConfig, Maximum} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from
'./binary_kernel';\nconst supportsFullBroadcast = false;\nexport const maximumConfig:
KernelConfig =\n createBinaryKernelConfig(Maximum, supportsFullBroadcast);\n","/**\n * @license\n *
Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the
\"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the
License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or
agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n *

WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {backend_util, KernelConfig, KernelFunc, MaxPool, MaxPoolAttrs, MaxPoolInputs, Tensor4D, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmMaxPool: (\n xId: number, batchSize: number, inputHeight: number, inputWidth: number,\n filterHeight: number, filterWidth: number, padTop: number, padRight: number,\n padBottom: number, padLeft: number, dilationHeight: number,\n dilationWidth: number, strideHeight: number, strideWidth: number,\n inputChannels: number, outputChannels: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmMaxPool = backend.wasm.cwrap(MaxPool, null /* void */, [\n 'number', // xId\n 'number', // batchSize\n 'number', // inputHeight\n 'number', // inputWidth\n 'number', // filterHeight\n 'number', // filterWidth\n 'number', // padTop\n 'number', // padRight\n 'number', // padBottom\n 'number', // padLeft\n 'number', // dilationHeight\n 'number', // dilationWidth\n 'number', // strideHeight\n 'number', // strideWidth\n 'number', // inputChannels\n 'number', // outputChannels\n 'number', // outId\n]);\n}\n\nfunction maxPool(\n args: {inputs: MaxPoolInputs, backend: BackendWasm, attrs: MaxPoolAttrs}) {\n const {inputs, attrs, backend} = args;\n\n const x = inputs.x as Tensor4D;\n const xId = backend.dataIdMap.get(x.dataId).id;\n\n // TF API supports int32 input. CPU and WebGL backend also support int32\n // input. WASM backend doesn't support it because it uses xnnpack which only\n // supports float32.\n //\n // Add the following assert only for the WASM backend instead of at core op\n // level.\n //\n // TODO: add support for int32 input.\n util.assert(\n x.dtype === 'float32',\n () =>\n `Error in MaxPool: only float32 input is supported. Got ${x.dtype}.`);\n\n const {filterSize, strides, pad, dimRoundingMode} = attrs;\n const convInfo = backend_util.computePool2DInfo(\n x.shape, filterSize, strides, 1 /* dilations */, pad, dimRoundingMode);\n\n const filterHeight = convInfo.filterHeight;\n const filterWidth = convInfo.filterWidth;\n const padTop = convInfo.padInfo.top;\n const padRight = convInfo.padInfo.right;\n const padBottom = convInfo.padInfo.bottom;\n const padLeft = convInfo.padInfo.left;\n const dilationHeight = convInfo.dilationHeight;\n const dilationWidth = convInfo.dilationWidth;\n const strideHeight = convInfo.strideHeight;\n const strideWidth = convInfo.strideWidth;\n const inputChannels = convInfo.inChannels;\n const outputChannels = convInfo.outChannels;\n\n if (convInfo.dataFormat !== 'channelsLast') {\n throw new Error(\n `wasm backend does not support dataFormat:'` +\n `${convInfo.dataFormat}'. Please use 'channelsLast'.`);\n }\n\n const out = backend.makeOutput(convInfo.outShape, 'float32');\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n wasmMaxPool(\n xId, x.shape[0], x.shape[1], x.shape[2], filterHeight, filterWidth,\n padTop, padRight, padBottom, padLeft, dilationHeight, dilationWidth,\n strideHeight, strideWidth, inputChannels, outputChannels, outId);\n return out;\n}\n\nexport const maxPoolConfig: KernelConfig = {\n kernelName: MaxPool,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: maxPool as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {backend_util, KernelConfig, KernelFunc, Mean, MeanAttrs, MeanInputs, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\nimport {cast} from './Cast';\n\nimport {permuteAxesAndTranspose} from './kernel_utils';\n\nlet wasmMean: (xId: number, reduceSize: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n wasmMean =\n backend.wasm.cwrap(Mean, null /*void*/, ['number, number, number']);\n}\n\nexport function mean(\n args: {backend: BackendWasm, inputs: MeanInputs, attrs: MeanAttrs}):\n TensorInfo {\n const {backend, inputs,

attrs} = args;\n const {axis, keepDims} = attrs;\n const {x} = inputs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n let inputId = xId;\n let input = x;\n\n const {transposed, axes, originalAxes, inputWasTransposed} =\n   permuteAxesAndTranspose(x, axis, backend);\n\n let reductionAxes = axes;\n if (inputWasTransposed) {\n   const transposedId = backend.dataIdMap.get(transposed.dataId).id;\n   if (transposedId !== xId) {\n
    // transpose was not a no-op. We will need to dispose of this\n   // once we are done.\n   input = transposed;\n
    inputId = transposedId;\n   reductionAxes = backend_util.getInnerMostAxes(\n   reductionAxes.length, input.shape.length);\n   }\n }\n\n backend_util.assertAxesAreInnerMostDims(\n   'mean', reductionAxes, input.shape.length);\n const [outShape, reduceShape] =\n backend_util.computeOutAndReduceShapes(input.shape, reductionAxes);\n const reduceSize = util.sizeFromShape(reduceShape);\n let castedInput = input;\n if (input.dtype !== 'float32') {\n   castedInput =\n cast({backend, inputs: {x: input}, attrs: {dtype: 'float32'}});\n   inputId = backend.dataIdMap.get(castedInput.dataId).id;\n }\n\n const out = backend.makeOutput(outShape, 'float32');\n if (util.sizeFromShape(input.shape) !== 0) {\n   const outId = backend.dataIdMap.get(out.dataId).id;\n wasmMean(inputId, reduceSize, outId);\n }\n\n if (inputWasTransposed) {\n
    // dispose of the transposed tensor.\n   backend.disposeData(transposed.dataId);\n }\n\n if (keepDims) {\n   // reshape\n   const newShape = backend_util.expandShapeToKeepDim(out.shape, originalAxes);\n   out.shape = newShape;\n }\n\n if (input.dtype !== 'float32') {\n   backend.disposeData(castedInput.dataId);\n }\n\n return out;\n}\n\nexport const meanConfig: KernelConfig = {\n kernelName: Mean,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: mean as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF
 ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n */\n\nimport {backend_util, KernelConfig, KernelFunc, Min, MinAttrs, MinInputs, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {permuteAxesAndTranspose} from './kernel_utils';\nimport {CppDType} from './types';\n\nlet wasmMin: (xId: number, dtype: number, reduceSize: number, outId: number) =>\n   void;\n\nfunction setup(backend: BackendWasm): void {\n wasmMin = backend.wasm.cwrap(Min, null /*void*/, [\n   'number', // x_id\n 'number', // dtype\n   'number', // reduce_size\n   'number', // out_id\n]);\n}\n\nfunction min(args: {backend: BackendWasm, inputs: MinInputs, attrs: MinAttrs}):\n   TensorInfo {\n const {backend, inputs, attrs} = args;\n const {axis, keepDims} = attrs;\n const {x}
 = inputs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n let inputId = xId;\n let input = x;\n\n const {transposed, axes, originalAxes, inputWasTransposed} =\n   permuteAxesAndTranspose(x, axis, backend);\n\n if (inputWasTransposed) {\n   const transposedId = backend.dataIdMap.get(transposed.dataId).id;\n   if (transposedId !== xId) {\n   // transpose was not a no-op. We will need to dispose of this\n   // once we are done.\n   input = transposed;\n   inputId = transposedId;\n   }\n }\n\n const inputRank = input.shape.length;\n\n backend_util.assertAxesAreInnerMostDims('min', axes, inputRank);\n const [outShape, reduceShape] =\n backend_util.computeOutAndReduceShapes(input.shape, axes);\n const reduceSize = util.sizeFromShape(reduceShape);\n\n const out = backend.makeOutput(outShape, input.dtype);\n if (util.sizeFromShape(input.shape) !== 0) {\n   const outId = backend.dataIdMap.get(out.dataId).id;\n wasmMin(inputId, CppDType[x.dtype], reduceSize,
 outId);\n }\n\n if (inputWasTransposed) {\n   // dispose of the transposed tensor.\n backend.disposeData(transposed.dataId);\n }\n\n if (keepDims) {\n   // reshape\n   const newShape =

backend_util.expandShapeToKeepDim(out.shape, originalAxes);\n out.shape = newShape;\n }\n\n return out;\n}\n\nexport const minConfig: KernelConfig = {\n kernelName: Min,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: min as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n
 * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n
*/\nimport {KernelConfig, Minimum} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from './binary_kernel';\nconst supportsFullBroadcast = false;\nexport const minimumConfig: KernelConfig =\n createBinaryKernelConfig(Minimum, supportsFullBroadcast);\n","/**\n * @license\n * Copyright 2021 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See
 the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n
/\n\nimport {KernelConfig, KernelFunc, MirrorPad, MirrorPadAttrs, MirrorPadInputs} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {CppDType} from './types';\n\n// Must match enum in MirrorPad.cc\nenum MirrorPaddingMode {\n reflect = 0,\n symmetric = 1\n}\n\nlet wasmMirrorPad: (\n xId: number, xShapeBytes: Uint8Array, xShapeLength: number, xDtype: number,\n prePaddingsBytes: Uint8Array, postPaddingsBytes: Uint8Array, mode: number,\n outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmMirrorPad = backend.wasm.cwrap(MirrorPad, null / void */, [\n 'number', // xId\n 'array', // x.shape\n 'number', // x.shape.length\n 'number', // x.dtype\n 'array', // pre-paddings\n 'array', // post-paddings\n 'number', //
 mode\n 'number', // outId\n]);\n}\n\nfunction mirrorPad(args: {\n inputs: MirrorPadInputs,\n backend: BackendWasm,\n attrs: MirrorPadAttrs\n}) {\n const {inputs: {x}, backend, attrs: {paddings, mode}} = args;\n\n const outShape = paddings.map(\n   (p, i) => p[0] /* beforePad */ + x.shape[i] + p[1] /* afterPad */);\n const xId = backend.dataIdMap.get(x.dataId).id;\n const out = backend.makeOutput(outShape, x.dtype);\n const outId = backend.dataIdMap.get(out.dataId).id;\n const xShapeBytes = new Uint8Array(new Int32Array(x.shape).buffer);\n\n const prePaddingsFlat = paddings.map(padTuple => padTuple[0]);\n const postPaddingsFlat = paddings.map(padTuple => padTuple[1]);\n const prePaddingsBytes =\n   new Uint8Array(new Int32Array(prePaddingsFlat).buffer);\n const postPaddingsBytes =\n   new Uint8Array(new Int32Array(postPaddingsFlat).buffer);\n\n wasmMirrorPad(\n   xId, xShapeBytes, x.shape.length, CppDType[x.dtype], prePaddingsBytes,\n   postPaddingsBytes,
 MirrorPaddingMode[mode], outId);\n return out;\n}\n\nexport const mirrorPadConfig: KernelConfig = {\n kernelName: MirrorPad,\n backendName: 'wasm',\n kernelFunc: mirrorPad as {} as KernelFunc,\n setupFunc: setup\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
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*/\n\nimport {KernelConfig, Multiply} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from './binary_kernel';\n\nconst supportsFullBroadcast = true;\nexport const multiplyConfig: KernelConfig =\n createBinaryKernelConfig(Multiply, supportsFullBroadcast);\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==========\n*/\nimport {KernelConfig, Neg} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\nexport const negConfig: KernelConfig = createUnaryKernelConfig(Neg);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==========\n*/\n\nimport {BackendWasm} from '../backend_wasm';\n\n// Analogous to `struct Result` in `non_max_suppression_impl.h`.\ninterface Result {\n pSelectedIndices: number;\n selectedSize: number;\n pSelectedScores: number;\n pValidOutputs: number;\n}\n\n/**\n * Parse the result of the c++ method, which has the shape equivalent to\n * `Result`.\n */\nexport function parseResultStruct(\n backend: BackendWasm, resOffset: number): Result {\n const result = new Int32Array(backend.wasm.HEAPU8.buffer, resOffset, 4);\n const pSelectedIndices = result[0];\n const selectedSize = result[1];\n const pSelectedScores = result[2];\n const pValidOutputs = result[3];\n // Since the result was allocated on the heap, we have to delete it.\n backend.wasm._free(resOffset);\n return {pSelectedIndices, selectedSize, pSelectedScores, pValidOutputs};\n}\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==========\n*/\n\nimport {KernelConfig, KernelFunc, NonMaxSuppressionV3, NonMaxSuppressionV3Attrs, NonMaxSuppressionV3Inputs, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {parseResultStruct} from './NonMaxSuppression_util';\n\nlet wasmFunc: (\n boxesId: number, scoresId: number, maxOutputSize: number,\n iouThreshold: number, scoreThreshold: number) => number;\n\nfunction setup(backend: BackendWasm): void {\n wasmFunc = backend.wasm.cwrap(\n NonMaxSuppressionV3,\n 'number', // Result*\n [\n 'number', // boxesId\n 'number', // scoresId\n 'number', // maxOutputSize\n 'number', // iouThreshold\n 'number', // scoreThreshold\n]);\n}\n\nfunction kernelFunc(args: {\n backend: BackendWasm,\n inputs: NonMaxSuppressionV3Inputs,\n attrs: NonMaxSuppressionV3Attrs\n}): TensorInfo {\n const {backend, inputs, attrs} = args;\n const {iouThreshold, maxOutputSize, scoreThreshold} = attrs;\n const {boxes, scores} = inputs;\n\n const boxesId = backend.dataIdMap.get(boxes.dataId).id;\n const scoresId =

backend.dataIdMap.get(scores.dataId).id;\n\n const resOffset =\n   wasmFunc(boxesId, scoresId, maxOutputSize, iouThreshold, scoreThreshold);\n\n const {pSelectedIndices, selectedSize, pSelectedScores, pValidOutputs} =\n parseResultStruct(backend, resOffset);\n\n // Since we are not using scores for V3, we have to delete it from the heap.\n backend.wasm._free(pSelectedScores);\n backend.wasm._free(pValidOutputs);\n\n const selectedIndicesTensor
 =\n   backend.makeOutput([selectedSize], 'int32', pSelectedIndices);\n\n return selectedIndicesTensor;\n}\n\nexport const nonMaxSuppressionV3Config: KernelConfig = {\n kernelName: NonMaxSuppressionV3,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: kernelFunc as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
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 /\n\nimport {KernelConfig, KernelFunc, NonMaxSuppressionV4, NonMaxSuppressionV4Attrs, NonMaxSuppressionV4Inputs, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {parseResultStruct} from './NonMaxSuppression_util';\n\nlet wasmFunc: (\n boxesId: number, scoresId: number, maxOutputSize: number,\n   iouThreshold: number, scoreThreshold: number,\n padToMaxOutputSize: boolean) => number;\n\nfunction setup(backend: BackendWasm): void {\n wasmFunc = backend.wasm.cwrap(\n   NonMaxSuppressionV4,\n   'number', // Result\n   [\n   'number', // boxesId\n 'number', // scoresId\n   'number', // maxOutputSize\n   'number', // iouThreshold\n   'number', // scoreThreshold\n   'bool',   // padToMaxOutputSize\n   ]);\n}\n\nfunction nonMaxSuppressionV4(args: {\n backend: BackendWasm,\n inputs: NonMaxSuppressionV4Inputs,\n attrs: NonMaxSuppressionV4Attrs\n}): TensorInfo[] {\n const {backend, inputs, attrs} = args;\n const {iouThreshold, maxOutputSize, scoreThreshold, padToMaxOutputSize} =\n   attrs;\n const {boxes, scores} = inputs;\n\n const boxesId = backend.dataIdMap.get(boxes.dataId).id;\n const scoresId = backend.dataIdMap.get(scores.dataId).id;\n\n const resOffset = wasmFunc(\n   boxesId, scoresId, maxOutputSize, iouThreshold, scoreThreshold,\n padToMaxOutputSize);\n\n const {pSelectedIndices, selectedSize, pSelectedScores, pValidOutputs} =\n parseResultStruct(backend, resOffset);\n\n // Since we are not using scores for V4, we have to delete it from the heap.\n backend.wasm._free(pSelectedScores);\n\n const selectedIndicesTensor =\n backend.makeOutput([selectedSize], 'int32', pSelectedIndices);\n\n const validOutputsTensor = backend.makeOutput([], 'int32', pValidOutputs);\n\n return [selectedIndicesTensor, validOutputsTensor];\n}\n\nexport const nonMaxSuppressionV4Config: KernelConfig = {\n kernelName: NonMaxSuppressionV4,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: nonMaxSuppressionV4 as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n
*/\n\nimport {KernelConfig, KernelFunc, NonMaxSuppressionV5, NonMaxSuppressionV5Attrs, NonMaxSuppressionV5Inputs, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {parseResultStruct} from './NonMaxSuppression_util';\n\nlet wasmFunc:\n   (boxesId: number, scoresId: number, maxOutputSize: number,\n   iouThreshold: number,

scoreThreshold: number, softNmsSigma: number) =>\n number;\n\nfunction setup(backend: BackendWasm): void {\n wasmFunc = backend.wasm.cwrap(\n NonMaxSuppressionV5,\n 'number', // Result*\n [\n 'number', // boxesId\n 'number', // scoresId\n 'number', // maxOutputSize\n 'number', // iouThreshold\n 'number', // scoreThreshold\n 'number', // softNmsSigma\n]);\n}\n\nfunction kernelFunc(args: {\n backend: BackendWasm,\n inputs: NonMaxSuppressionV5Inputs,\n attrs: NonMaxSuppressionV5Attrs\n}): TensorInfo[] {\n const {backend, inputs, attrs} = args;\n const {iouThreshold, maxOutputSize, scoreThreshold, softNmsSigma} = attrs;\n const {boxes, scores} = inputs;\n\n const boxesId = backend.dataIdMap.get(boxes.dataId).id;\n
const scoresId = backend.dataIdMap.get(scores.dataId).id;\n\n const resOffset = wasmFunc(\n boxesId, scoresId, maxOutputSize, iouThreshold, scoreThreshold,\n softNmsSigma);\n\n const {pSelectedIndices, selectedSize, pSelectedScores, pValidOutputs} =\n parseResultStruct(backend, resOffset);\n\n // Since we are not using validOutputs for V5, we have to delete it from the\n // heap.\n backend.wasm._free(pValidOutputs);\n\n const selectedIndicesTensor =\n backend.makeOutput([selectedSize], 'int32', pSelectedIndices);\n const selectedScoresTensor =\n backend.makeOutput([selectedSize], 'float32', pSelectedScores);\n\n return [selectedIndicesTensor, selectedScoresTensor];\n}\n\nexport const nonMaxSuppressionV5Config: KernelConfig = {\n kernelName: NonMaxSuppressionV5,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: kernelFunc as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights
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==\n */\nimport {KernelConfig, NotEqual} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from './binary_kernel';\nconst supportsFullBroadcast = false;\nexport const notEqualConfig: KernelConfig =\n createBinaryKernelConfig(NotEqual, supportsFullBroadcast, 'bool');\n","/**\n * @license\n * Copyright 2020 Google LLC. All
Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n */\n\nimport {KernelConfig, KernelFunc, OneHot, OneHotAttrs, OneHotInputs} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmOneHot: (\n indicesId: number, depth: number, onValue: number, offValue: number,\n outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmOneHot
= backend.wasm.cwrap(OneHot, null /* void */, [\n 'number', // indices_id\n 'number', // depth,\n 'number', // onValue\n 'number', // offValue\n 'number' // out_id\n]);\n}\n\nfunction oneHot(\n args: {inputs: OneHotInputs, attrs: OneHotAttrs, backend: BackendWasm}) {\n const {inputs, backend, attrs} = args;\n const {indices} = inputs;\n const {depth, onValue, offValue} = attrs;\n\n const out = backend.makeOutput([...indices.shape, depth], 'int32');\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n const indicesData = backend.dataIdMap.get(indices.dataId);\n const indicesId = indicesData.id;\n\n wasmOneHot(indicesId, depth, onValue, offValue, outId);\n\n return out;\n}\n\nexport const oneHotConfig: KernelConfig = {\n kernelName: OneHot,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: oneHot as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed

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2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {KernelConfig, KernelFunc, OnesLike, OnesLikeInputs} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nfunction onesLike(args: {inputs: OnesLikeInputs, backend: BackendWasm}) {\n const {inputs: {x}, backend} = args;\n const out = backend.makeOutput(x.shape, x.dtype);\n const outVals = backend.typedArrayFromHeap(out);\n outVals.fill(1);\n return
out;\n}\n\nexport const onesLikeConfig: KernelConfig = {\n kernelName: OnesLike,\n backendName: 'wasm',\n kernelFunc: onesLike as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {KernelConfig, KernelFunc, Pack, PackAttrs, PackInputs, TensorInfo, util} from '@tensorflow/tfjs-core';\nimport
{BackendWasm} from '../backend_wasm';\n\nimport {concat} from './Concat';\nimport {expandDims} from './ExpandDims';\n\nexport function pack(\n   args: {inputs: PackInputs, backend: BackendWasm, attrs: PackAttrs}):\n   TensorInfo {\n const {inputs, backend, attrs} = args;\n const {axis} = attrs;\n\n if (inputs.length === 1) {\n   return expandDims(\n   {inputs: {input: inputs[0]}, backend, attrs: {dim: axis}});\n }\n\n const shape = inputs[0].shape;\n const dtype = inputs[0].dtype;\n\n inputs.forEach(t => {\n   util.assertShapesMatch(\n   shape, t.shape,\n   'All tensors passed to stack must have matching shapes');\n   util.assert(\n   dtype === t.dtype,\n   () => 'All tensors passed to stack must have matching dtypes');\n });\n\n const intermediateTensorInfos: TensorInfo[] = [];\n const expandedTensors = inputs.map(t => {\n   const expandedT =\n   expandDims({inputs: {input: t}, backend, attrs: {dim: axis}});\n   intermediateTensorInfos.push(expandedT);\n   return expandedT;\n });\n\n const result = concat({inputs: expandedTensors, backend, attrs: {axis}});\n\n intermediateTensorInfos.forEach(t => backend.disposeData(t.dataId));\n\n return result;\n}\n\nexport const packConfig: KernelConfig = {\n kernelName: Pack,\n backendName: 'wasm',\n kernelFunc: pack as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n
* ==========\n */\n\nimport {KernelConfig, KernelFunc, PadV2, PadV2Attrs, PadV2Inputs, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {fill} from './Fill';\n\nimport {CppDType} from './types';\n\nlet wasmPadV2: (\n   xId: number, xShapeBytes: Uint8Array, xShapeLength: number, xDtype: number,\n   prePaddingsBytes: Uint8Array, postPaddingsBytes: Uint8Array,\n   constantValue: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmPadV2 = backend.wasm.cwrap(PadV2, null /* void */, [\n   'number', // xId\n   'array',   // x.shape\n   'number', // x.shape.length\n   'number', // x.dtype\n

'array', // pre-paddings\n 'array', // post-paddings\n 'number', // constantValue\n 'number', // outId\n]);\n}\n\nfunction pad(\n args: {inputs: PadV2Inputs, backend: BackendWasm, attrs: PadV2Attrs}) {\n const {inputs: {x}, backend, attrs:
 {paddings, constantValue}} = args;\n\n const outShape = paddings.map(\n   (p, i) => p[0] /* beforePad */ + x.shape[i] + p[1] /* afterPad */);\n\n if (util.sizeFromShape(x.shape) === 0) {\n   // Short-circuit the computation, since x doesn't have value, only\n   // the shape is used to compute output shape to pad.\n   return fill({\n backend,\n   attrs: {shape: outShape, value: constantValue, dtype: x.dtype}\n   });\n }\n\n const xId = backend.dataIdMap.get(x.dataId).id;\n const out = backend.makeOutput(outShape, x.dtype);\n const outTensorData = backend.dataIdMap.get(out.dataId);\n const outId = outTensorData.id;\n\n const xShapeBytes = new Uint8Array(new Int32Array(x.shape).buffer);\n\n const prePaddingsFlat = paddings.map(padTuple => padTuple[0]);\n const postPaddingsFlat = paddings.map(padTuple => padTuple[1]);\n const prePaddingsBytes =\n   new Uint8Array(new Int32Array(prePaddingsFlat).buffer);\n const postPaddingsBytes =\n   new Uint8Array(new
 Int32Array(postPaddingsFlat).buffer);\n\n wasmPadV2(\n   xId, xShapeBytes, x.shape.length, CppDType[x.dtype], prePaddingsBytes,\n   postPaddingsBytes, constantValue, outId);\n return out;\n}\n\nexport const padV2Config: KernelConfig = {\n kernelName: PadV2,\n backendName: 'wasm',\n kernelFunc: pad as {} as KernelFunc,\n setupFunc: setup\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
 ==\n */\nimport {KernelConfig, Pow} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from './binary_kernel';\nconst supportsFullBroadcast = false;\nexport const powConfig: KernelConfig =\n createBinaryKernelConfig(Pow, supportsFullBroadcast);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
 ==\n */\n\nimport {KernelConfig, KernelFunc, Prelu, PreluInputs} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {cast} from './Cast';\n\nlet wasmPrelu: (xId: number, weightsId: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmPrelu = backend.wasm.cwrap(Prelu, null /* void */, [\n   'number', // x_id\n   'number', // weights_id\n   'number'   // out_id\n]);\n}\n\nfunction prelu(args: {inputs: PreluInputs, backend: BackendWasm}) {\n const {inputs, backend} = args;\n const {x, alpha} = inputs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n const weightsId = backend.dataIdMap.get(alpha.dataId).id;\n\n let inputId = xId;\n const input = x;\n let castedInput = input;\n if (input.dtype !== 'float32') {\n   castedInput = cast({backend, inputs: {x}, attrs: {dtype: 'float32'}});\n   inputId = backend.dataIdMap.get(castedInput.dataId).id;\n }\n\n
  const out = backend.makeOutput(x.shape, 'float32');\n const outId = backend.dataIdMap.get(out.dataId).id;\n wasmPrelu(inputId, weightsId, outId);\n\n if (input.dtype !== 'float32') {\n backend.disposeData(castedInput.dataId);\n }\n return out;\n}\n\nexport const preluConfig: KernelConfig = {\n kernelName: Prelu,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: prelu as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the

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permissions and\n * limitations under the License.\n *
==========\n
*/\n\nimport {backend_util, KernelConfig, KernelFunc, Prod, ProdAttrs, ProdInputs, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {permuteAxesAndTranspose} from './kernel_utils';\n\nimport {CppDType} from './types';\n\nlet wasmProd: (\n xId: number, reduceSize: number,\n dtype: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n wasmProd = backend.wasm.cwrap(Prod, null /*void*/, [\n 'number',\n 'number',\n 'number',\n 'number'\n]);\n}\n\nfunction prod(args: {\n backend: BackendWasm,\n inputs: ProdInputs,\n attrs: ProdAttrs\n}): TensorInfo {\n const {backend, inputs, attrs} = args;\n const {axis, keepDims} = attrs;\n const {x} = inputs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n let inputId = xId;\n let input = x;\n\n const
{transposed, axes, originalAxes, inputWasTransposed} =\n permuteAxesAndTranspose(x, axis, backend);\n\n let reductionAxes = axes;\n if (inputWasTransposed) {\n const transposedId = backend.dataIdMap.get(transposed.dataId).id;\n if (transposedId !== xId) {\n // transpose was not a no-op. We will need to dispose of this\n // once we are done.\n input = transposed;\n inputId = transposedId;\n reductionAxes = backend_util.getInnerMostAxes(\n reductionAxes.length, input.shape.length);\n }\n }\n\n backend_util.assertAxesAreInnerMostDims(\n 'prod', reductionAxes, input.shape.length);\n const [outShape, reduceShape] =\n backend_util.computeOutAndReduceShapes(input.shape, reductionAxes);\n const reduceSize = util.sizeFromShape(reduceShape);\n\n const out = backend.makeOutput(outShape, input.dtype);\n if (util.sizeFromShape(input.shape) !== 0) {\n const outId = backend.dataIdMap.get(out.dataId).id;\n wasmProd(inputId, reduceSize,
CppDType[out.dtype], outId);\n }\n\n if (inputWasTransposed) {\n // dispose of the transposed tensor.\n backend.disposeData(transposed.dataId);\n }\n\n if (keepDims) {\n // reshape\n const newShape = backend_util.expandShapeToKeepDim(out.shape, originalAxes);\n out.shape = newShape;\n }\n\n return out;\n}\n\nexport const prodConfig: KernelConfig = {\n kernelName: Prod,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: prod as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either
express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n
*/\n\nimport {KernelConfig, KernelFunc, Range, RangeAttrs, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\nimport {rangeImplCPU} from '../kernel_utils/shared';\n\nexport const range =\n (args: {backend: BackendWasm, attrs: RangeAttrs}): TensorInfo => {\n const {backend, attrs} = args;\n const {start, stop, step, dtype} = attrs;\n const values = rangeImplCPU(start, stop, step, dtype);\n\n const out = backend.makeOutput([values.length], dtype);\n const outVals = backend.typedArrayFromHeap(out);\n outVals.set(values);\n return out;\n };\n\nexport const rangeConfig: KernelConfig = {\n kernelName: Range,\n backendName: 'wasm',\n kernelFunc: range as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright
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http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\nimport { util } from '@tensorflow/tfjs-core';\nexport function rangeImpl(start, stop, step, dtype) {\n   const sameStartStop = start === stop;\n   const increasingRangeNegativeStep = start < stop && step < 0;\n   const decreasingRangePositiveStep = stop < start && step > 1;\n   if (sameStartStop || increasingRangeNegativeStep ||\n   decreasingRangePositiveStep) {\n   return util.makeZerosTypedArray(0, dtype);\n   }\n   const numElements = Math.abs(Math.ceil((stop - start) / step));\n   const values = util.makeZerosTypedArray(numElements, dtype);\n   if (stop < start && step === 1) {\n   // Auto adjust the step's sign if it hasn't been set\n   // (or was set to 1)\n   step = -1;\n   }\n   values[0] = start;\n   for (let i = 1; i < values.length; i++) {\n   values[i] = values[i - 1] + step;\n   }\n   return values;\n}\n//# sourceMappingURL=data:application/json; base64,eyJ2ZXJzaW9uIjozLCJmaWxlIjoiUmFuZ2VfaW1wbC5qcyIsInNvdXJjZVJvb3QiOiIiLCJzb3VyY2VzIjpbIi4uLy4uLy4uLy4uLy4uLy4uL3RmanMtYmFja2VuZC1jcHUvc3JjL3tlcm5lbHMvUmFuZ2VfaW1wbC50cyJdLCJuYW1lcyI6W10sIm1hcHBpbmdzIjoiQUFBQTs7Ozs7Ozs7Ozs7O0dBZUc7QUFFSCxPQUFPLEVBQUUsSUFBSSxFQUFFLE1BQU0sc0JBQXNCLENBQUM7QUFFNUMsTUFBTSxVQUFVLFNBQVMsQ0FBQyxLQUFhLEVBQUUsSUFBWSxFQUFFLElBQVksRUFBRSxLQUFlO0lBQ3BFLE1BQU0sYUFBYSxHQUFHLEtBQUssS0FBSyxJQUFJLENBQUM7SUFDckMsTUFBTSwyQkFBMkIsR0FBRyxLQUFLLEdBQUcsSUFBSSxJQUFJLEdBQUcsQ0FBQyxDQUFDO0lBQ3pELE1BQU0sMkJBQTJCLEdBQUcsSUFBSSxHQUFHLEtBQUssSUFBSSxJQUFJLEdBQUcsQ0FBQyxDQUFDO0lBQzdELElBQUksQ0FBQyxhQUFhO1FBQUcsMkJBQTJCO1FBQUcsMkJBQTJCLEVBQUU7UUFDaEUsT0FBTyxJQUFJLENBQUMsb0JBQW9CLENBQUMsQ0FBQyxFQUFFLEtBQUssQ0FBQyxDQUFDO0tBQzlDO0lBQ0QsTUFBTSxZQUFZLEdBQUcsSUFBSSxDQUFDLEdBQUcsQ0FBQyxJQUFJLENBQUMsSUFBSSxDQUFDLENBQUMsSUFBSSxHQUFHLEtBQUssQ0FBQyxHQUFHLElBQUksQ0FBQyxDQUFDLENBQUM7SUFDMUUsTUFBTSxNQUFNLEdBQUcsSUFBSSxDQUFDLG9CQUFvQixDQUFDLFlBQVksRUFBRSxLQUFLLENBQUMsQ0FBQztJQUM5RCxJQUFJLElBQUksR0FBRyxLQUFLLElBQUksSUFBSSxLQUFLLENBQUMsRUFBRTtRQUM1QixnQ0FBZ0M7UUFDaEMsMkJBQTJCO1FBQzNCLElBQUksR0FBRyxDQUFDLENBQUMsQ0FBQztLQUNiO0lBQ0QsTUFBTSxDQUFDLENBQUMsQ0FBQyxHQUFHLEtBQUssQ0FBQztJQUNsQixLQUFLLElBQUksQ0FBQyxHQUFHLENBQUMsRUFBRSxDQUFDLEdBQUcsTUFBTSxDQUFDLE1BQU0sRUFBRSxDQUFDLEVBQUUsRUFBRTtRQUNwQyxNQUFNLENBQUMsQ0FBQyxDQUFDLEdBQUcsTUFBTSxDQUFDLENBQUMsR0FBRyxDQUFDLENBQUMsR0FBRyxJQUFJLENBQUM7S0FDckM7SUFDRCxPQUFPLE1BQU0sQ0FBQztBQUNsQixDQUFDIn0=

2luZ1JhbmdlTmVnYXRpdmVTdGVwID0gc3RhcnQgPCBzdG9wICYmIHN0ZXAgPCAwO1xuICBjb25zdCBkZWNyZWFzaW5nUmFuZ2VQb3NpdGl2ZVN0ZXAgPSBzdG9wIDwgc3RhcnQgJiYgc3RlcCA+IDE7XG5cbiAgaWYgKHNhbWVTdGFydFN0b3AgfHwgaW5jcmVhc2luZ1JhbmdlVnYXRpdmVTdGVwIHx8XG4gIGRlY3JlYXNpbmdSYW5nZVBvc2l0aXZlU3RlcCkge1xuICAgIHRcbiAgICByZXR1cm4gW107XG4gIH1cblxuICBjb25zdCBzaXplID0gTWF0aC5hYnMoTWF0aC5jZWlsKChzdG9wIC0gc3RhcnQpIC8gc3RlcCkpO1xuICBjb25zdCB2YWx1ZXMgPSBuZXcgRmxvYXQzMkFycmF5KHNpemUpO1xuXG4gIGZvciAobGV0IGkgPSAwOyBpIDwgc2l6ZTsgKytpKSB7XG4gICAgdmFsdWVzW2ldID0gc3RhcnQgKyBpICogc3RlcDtcbiAgfVxuXG4gIHJldHVybiB2YWx1ZXM7XG59XG4iLCIvKipcbiAqIEBsaWNlbnNlXG4gKiBDb3B5cmlnaHQgMjAxOSBHb29nbGUgTExDLiBBbGwgUmlnaHRzIFJlc2VydmVkLlxuICogTGljZW5zZWQgdW5kZXIgdGhlIEFwYWNoZSBMaWNlbnNlLCBWZXJzaW9uIDIuMCAodGhlIFwiTGljZW5zZVwiKTtcbiAqIHlvdSBtYXkgbm90IHVzZSB0aGlzIGZpbGUgZXhjZXB0IGluIGNvbXBsaWFuY2Ugd2l0aCB0aGUgTGljZW5zZS5cbiAqIFlvdSBtYXkgb2J0YWluIGEgY29weSBvZiB0aGUgTGljZW5zZSBhdFxuICpcbiAqIGh0dHA6Ly93d3cuYXBhY2hlLm9yZy9saWNlbnNlcy9MSUNFTlNFLTIuMFxuICpcbiAqIFVubGVzcyByZXF1aXJlZCBieSBhcHBsaWNhYmxlIGxhdyBvciBhZ3JlZWQgdG8gaW4gd3JpdGluZywgc29mdHdhcmVcbiAqIGRpc3RyaWJ1dGVkIHVuZGVyIHRoZSBMaWNlbnNlIGlzIGRpc3RyaWJ1dGVkIG9uIGFuIFwiQVMgSVNcIiBCQVNJUyxcbiAqIFdJVEhPVVQgV0FSUkFOVElFUyBPUiBDT05ESVRJT05TIE9GIEFOWSBLSU5ELCBlaXRoZXIgZXhwcmVzcyBvciBpbXBsaWVkLlxuICogU2VlIHRoZSBMaWNlbnNlIGZvciB0aGUgc3BlY2lmaWMgbGFuZ3VhZ2UgZ292ZXJuaW5nIHBlcm1pc3Npb25zIGFuZFxuICogbGltaXRhdGlvbnMgdW5kZXIgdGhlIExpY2Vuc2UuXG4gKlxuICA9PT09PT09PT09

*/\n\nimport {KernelConfig, KernelFunc, ResizeBilinear, ResizeBilinearAttrs, ResizeBilinearInputs, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {cast} from './Cast';\n\nlet wasmResizeBilinear: (\n xId: number, batch: number, oldHeight: number, oldWidth: number,\n numChannels: number, newHeight: number, newWidth: number,\n alignCorners: number, halfPixelCenters: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n wasmResizeBilinear = backend.wasm.cwrap(ResizeBilinear, null /*void*/, [\n 'number', // xId\n 'number', // batch\n 'number', // oldHeight\n 'number', // oldWidth\n 'number', // numChannels\n 'number', // newHeight\n 'number', // newWidth\n 'number', // alignCorners\n 'number', // halfPixelCenters\n 'number' // outId\n]);\n}\n\nfunction resizeBilinear(args: {\n backend: BackendWasm,\n inputs: ResizeBilinearInputs,\n attrs: ResizeBilinearAttrs\n}): TensorInfo {\n const {backend, inputs, attrs} = args;\n\n const {images} = inputs;\n const {alignCorners, halfPixelCenters, size} = attrs;\n const [newHeight, newWidth] = size;\n\n const [batch, oldHeight, oldWidth, numChannels] = images.shape;\n const outShape = [batch, newHeight, newWidth, numChannels];\n\n let xData = backend.dataIdMap.get(images.dataId);\n let castedData;\n if (xData.dtype !== 'float32') {\n castedData =\n cast({backend, inputs: {x: images}, attrs: {dtype: 'float32'}});\n xData = backend.dataIdMap.get(castedData.dataId);\n }\n const xId = xData.id;\n\n const out = backend.makeOutput(outShape, 'float32');\n if (util.sizeFromShape(images.shape) === 0) {\n return out;\n }\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n wasmResizeBilinear(\n xId, batch, oldHeight, oldWidth, numChannels, newHeight, newWidth,\n alignCorners ? 1 : 0, halfPixelCenters ? 1 : 0, outId);\n\n if (castedData != null) {\n backend.disposeData(castedData.dataId);\n }\n\n return out;\n}\n\nexport const resizeBilinearConfig: KernelConfig = {\n kernelName: ResizeBilinear,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: resizeBilinear as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==\n */\n\nimport {KernelConfig, KernelFunc, Reverse, ReverseAttrs, ReverseInputs, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {identity} from './Identity';\nimport {reshape} from './Reshape';\n\nlet wasmReverse: (\n xId: number, axes: Uint8Array, axesLength: number, outShape: Uint8Array,\n outShapeLength: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmReverse = backend.wasm.cwrap(Reverse, null, [\n 'number', // x_id\n 'array', // axes\n 'number', // axes_length\n 'array', // out_shape\n 'number', // out_shape_length\n 'number' // out_id\n]);\n}\n\nexport function reverse(\n args: {inputs: ReverseInputs, backend: BackendWasm, attrs: ReverseAttrs}):\n TensorInfo {\n const {inputs, backend, attrs} = args;\n const {x} = inputs;\n const {dims} = attrs;\n\n const axes = util.parseAxisParam(dims, x.shape);\n\n if (x.shape.length === 0) {\n return identity({inputs: {x}, backend});\n }\n\n const out = backend.makeOutput(x.shape, x.dtype);\n const xId = backend.dataIdMap.get(x.dataId).id;\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n const axesBytes = new Uint8Array(new Int32Array(axes).buffer);\n const outShapeBytes = new Uint8Array(new Int32Array(x.shape).buffer);\n\n wasmReverse(\n xId, axesBytes, axes.length, outShapeBytes, x.shape.length, outId);\n\n const reshaped =\n reshape({inputs: {x: out}, attrs: {shape: x.shape}, backend});\n\n backend.disposeData(out.dataId);\n return reshaped;\n}\n\nexport const reverseConfig: KernelConfig = {\n kernelName: Reverse,\n backendName: 'wasm',\n kernelFunc: reverse as {} as KernelFunc,\n setupFunc: setup\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n *

Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==========\n */\n\nimport {KernelConfig, KernelFunc, RotateWithOffset, RotateWithOffsetAttrs, RotateWithOffsetInputs, TensorInfo} from '@tensorflow/tfjs-core';\nimport {backend_util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmRotate: (\n xId: number, batch: number, imageHeight: number, imageWidth: number,\n numChannels: number, radians: number, centerX: number, centerY: number,\n fillBytes: Uint8Array, fillLength: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmRotate = backend.wasm.cwrap(RotateWithOffset, null /* void */, [\n 'number', // xId\n 'number', // batch\n 'number', // imageHeight\n 'number', // imageWidth\n 'number', // numChannels\n 'number', // radians\n 'number', // centerX\n 'number', // centerY\n 'array', // fillBytes\n 'number', // fillLength\n 'number', // outId\n]);\n}\n\nexport function rotateWithOffset(args: {\n inputs: RotateWithOffsetInputs,\n backend: BackendWasm,\n attrs: RotateWithOffsetAttrs\n}): TensorInfo {\n const {inputs, backend, attrs} = args;\n const {image} = inputs;\n const {radians, fillValue, center} = attrs;\n\n const out = backend.makeOutput(image.shape, image.dtype);\n const imageId = backend.dataIdMap.get(image.dataId).id;\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n const [batch, imageHeight, imageWidth, numChannels] = image.shape;\n\n const [centerX, centerY] =\n backend_util.getImageCenter(center, imageHeight, imageWidth);\n\n const fillIsBlack = fillValue === 0;\n const fullOpacityValue = 255;\n\n const fillValues = typeof fillValue === 'number' ?\n [fillValue, fillValue, fillValue, fillIsBlack ? 0 : fullOpacityValue] :\n [...fillValue, fullOpacityValue];\n const fillBytes = new Uint8Array(new Int32Array(fillValues).buffer);\n\n wasmRotate(\n imageId, batch, imageHeight, imageWidth, numChannels, radians, centerX,\n centerY, fillBytes, fillValues.length, outId);\n return out;\n}\n\nexport const rotateWithOffsetConfig: KernelConfig = {\n kernelName: RotateWithOffset,\n backendName: 'wasm',\n kernelFunc: rotateWithOffset as {} as KernelFunc,\n setupFunc: setup\n};\n","/**\n * @license\n * Copyright 2021 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR
CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==========\n */\nimport {KernelConfig, Round} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\n\nexport const roundConfig: KernelConfig = createUnaryKernelConfig(Round);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the
specific language governing permissions and\n * limitations under the License.\n *\n ==========\n */\nimport {KernelConfig, Rsqrt} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\nexport const rsqrtConfig: KernelConfig = createUnaryKernelConfig(Rsqrt);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a

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 * ==\n
*/\n\nimport {KernelConfig, KernelFunc, scatter_util, ScatterNd, ScatterNdAttrs, ScatterNdInputs, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {CppDType} from './types';\n\nlet wasmScatterNd: (\n indicesId: number, updatesId: number, dtype: CppDType, sliceRank: number,\n numUpdates: number, sliceSize: number, strides: Uint8Array,\n outputSize: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n wasmScatterNd = backend.wasm.cwrap(ScatterNd, null /*void*/, [\n 'number', // indicesId\n 'number', // updatesId\n 'number', // dtype\n 'number', // sliceRank\n 'number', // numUpdates\n 'number', // sliceSize\n 'array', // strides\n 'number', // outputSize\n 'number' // outId\n]);\n}\n\nfunction scatterNd(\n args:\n   {backend: BackendWasm, inputs: ScatterNdInputs, attrs:
 ScatterNdAttrs}):\n TensorInfo {\n const {backend, inputs, attrs} = args;\n const {indices, updates} = inputs;\n const {shape} = attrs;\n\n const out = backend.makeOutput(shape, updates.dtype);\n if (util.sizeFromShape(shape) === 0) {\n return out;\n }\n\n const {sliceRank, numUpdates, sliceSize, strides, outputSize} =\n scatter_util.calculateShapes(updates, indices, shape);\n\n const indicesData = backend.dataIdMap.get(indices.dataId);\n const indicesId = indicesData.id;\n\n const updatesData = backend.dataIdMap.get(updates.dataId);\n const updatesId = updatesData.id;\n\n const stridesBytes = new Uint8Array(new Int32Array(strides).buffer);\n\n const outId = backend.dataIdMap.get(out.dataId).id;\n wasmScatterNd(\n indicesId, updatesId, CppDType[updates.dtype], sliceRank, numUpdates,\n sliceSize, stridesBytes, outputSize, outId);\n\n return out;\n}\n\nexport const scatterNdConfig: KernelConfig = {\n kernelName: ScatterNd,\n backendName: 'wasm',\n
  setupFunc: setup,\n kernelFunc: scatterNd as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n
*/\n\nimport {KernelConfig, KernelFunc, Select, SelectInputs, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmSelect: (\n conditionId: number, tId: number,
 eId: number, offset: number,\n outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmSelect = backend.wasm.cwrap('SelectV2', null, [\n 'number', // conditionId\n 'number', // tId\n 'number', // eId\n 'number', // offset\n 'number', // outId\n]);\n}\n\nfunction select(args: {inputs: SelectInputs, backend: BackendWasm}) {\n const {inputs, backend} = args;\n const {condition, t, e} = inputs;\n\n const conditionId = backend.dataIdMap.get(condition.dataId).id;\n const tId = backend.dataIdMap.get(t.dataId).id;\n const eId = backend.dataIdMap.get(e.dataId).id;\n const out = backend.makeOutput(t.shape, t.dtype);\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n const cRank = condition.shape.length;\n const tRank = t.shape.length;\n\n const offset = cRank === 0 || cRank > 1 || tRank === 1 ?\n 1 :\n util.sizeFromShape(t.shape.slice(1));\n\n wasmSelect(conditionId, tId, eId, offset, outId);\n return out;\n}\n\nexport const
 selectConfig: KernelConfig = {\n kernelName: Select,\n backendName: 'wasm',\n kernelFunc: select as {} as KernelFunc,\n setupFunc: setup\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n *

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==========\n */\n\nimport {KernelConfig, KernelFunc, Sigmoid, SigmoidInputs, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm}
from '../backend_wasm';\n\nlet wasmFunc: (xId: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n wasmFunc = backend.wasm.cwrap(Sigmoid, null /* void */, ['number', 'number']);\n}\n\nfunction sigmoid(args: {backend: BackendWasm, inputs: SigmoidInputs}):\n TensorInfo {\n const {backend, inputs: {x}} = args;\n const xId = backend.dataIdMap.get(x.dataId).id;\n const out = backend.makeOutput(x.shape, x.dtype);\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n // Short-circuit zero-sized tensors.\n if (util.sizeFromShape(out.shape) === 0) {\n return out;\n }\n\n wasmFunc(xId, outId);\n return out;\n}\n\nexport const sigmoidConfig: KernelConfig = {\n kernelName: 'Sigmoid',\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: sigmoid as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file
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==========\n */\nimport {KernelConfig, Sin} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\nexport const sinConfig: KernelConfig = createUnaryKernelConfig(Sin);\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n
* http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {KernelConfig, KernelFunc, Softmax, SoftmaxAttrs, SoftmaxInputs, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmFunc: (xId: number, outId: number, channels: number, batch: number) =>\n void;\n\nfunction setup(backend: BackendWasm): void {\n wasmFunc = backend.wasm.cwrap(Softmax, null /* void */, [\n 'number', // xId\n 'number', // outId\n 'number', // channels\n 'number' // batch\n]);\n}\n\nfunction softmax(\n args: {backend: BackendWasm,
inputs: SoftmaxInputs, attrs: SoftmaxAttrs}):\n TensorInfo {\n const {backend, inputs: {logits}, attrs: {dim}} = args;\n const xId = backend.dataIdMap.get(logits.dataId).id;\n const out = backend.makeOutput(logits.shape, logits.dtype);\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n const channels = logits.shape[dim];\n const batch = util.sizeFromShape(logits.shape) / channels;\n\n // Short-circuit zero-sized tensors.\n if (util.sizeFromShape(out.shape) === 0) {\n return out;\n }\n\n wasmFunc(xId, outId, channels, batch);\n return out;\n}\n\nexport const softmaxConfig: KernelConfig = {\n kernelName: Softmax,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: softmax as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2021 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n

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==========\n */\n\nimport {backend_util, KernelConfig, KernelFunc, ReshapeAttrs, ReshapeInputs, SpaceToBatchND, SpaceToBatchNDAttrs, SpaceToBatchNDInputs, TensorInfo, TransposeAttrs, TransposeInputs, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {padV2Config} from './PadV2';\nimport {reshape} from './Reshape';\nimport {transpose} from './Transpose';\n\nfunction spaceToBatchND(args: {\n inputs: SpaceToBatchNDInputs,\n backend: BackendWasm,\n attrs: SpaceToBatchNDAttrs\n}) {\n const {inputs, backend,
  attrs} = args;\n const {x} = inputs;\n const {blockShape, paddings} = attrs;\n\n const prod = util.sizeFromShape(blockShape);\n\n const completePaddings: Array<[number, number]> = [[0, 0]];\n completePaddings.push(...(paddings as Array<[number, number]>));\n\n for (let i = 1 + blockShape.length; i < x.shape.length; ++i) {\n   completePaddings.push([0, 0]);\n }\n\n const paddedX = padV2Config.kernelFunc({\n inputs: {x},\n   backend,\n   attrs: {paddings: completePaddings, constantValue: 0}\n }) as TensorInfo;\n\n const reshapedPaddedShape =\n   backend_util.getReshaped(paddedX.shape, blockShape, prod, false);\n\n const permutedReshapedPaddedPermutation = backend_util.getPermuted(\n   reshapedPaddedShape.length, blockShape.length, false);\n\n const flattenShape =\n   backend_util.getReshapedPermuted(paddedX.shape, blockShape, prod, false);\n\n const reshapeInputs: ReshapeInputs = {x: paddedX};\n const reshapeAttrs: ReshapeAttrs = {shape: reshapedPaddedShape};\n
  const paddedXReshaped =\n   reshape({inputs: reshapeInputs, backend, attrs: reshapeAttrs});\n\n const transposeInputs: TransposeInputs = {x: paddedXReshaped};\n const transposeAttrs:\n   TransposeAttrs = {perm: permutedReshapedPaddedPermutation};\n const paddedXT =\n   transpose({inputs: transposeInputs, backend, attrs: transposeAttrs});\n\n const resultReshapeInputs: ReshapeInputs = {x: paddedXT};\n const resultReshapeAttrs: ReshapeAttrs = {shape: flattenShape};\n const result = reshape(\n   {inputs: resultReshapeInputs, backend, attrs: resultReshapeAttrs});\n\n backend.disposeData(paddedX.dataId);\n backend.disposeData(paddedXReshaped.dataId);\n backend.disposeData(paddedXT.dataId);\n\n return result;\n}\n\nexport const spaceToBatchNDConfig: KernelConfig = {\n kernelName: SpaceToBatchND,\n backendName: 'wasm',\n kernelFunc: spaceToBatchND as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed
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==========\n */\n\nimport {KernelConfig, KernelFunc, SplitV, SplitVAttrs, SplitVInputs, util} from '@tensorflow/tfjs-core';\nimport {backend_util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {slice} from './Slice';\n\nexport function splitV(\n   args: {inputs: SplitVInputs, attrs: SplitVAttrs, backend: BackendWasm}) {\n const {inputs,
  attrs, backend} = args;\n const {x} = inputs;\n const {numOrSizeSplits, axis} = attrs;\n\n const $axis = util.parseAxisParam(axis, x.shape)[0];\n\n const splitSizes = backend_util.prepareSplitSize(x, numOrSizeSplits, $axis);\n const begin = new Array(x.shape.length).fill(0);\n const size = x.shape.slice();\n return splitSizes.map(s => {\n   const xSliceSize = [...size];\n   xSliceSize[$axis] = s;\n   const xSlice =\n   slice({inputs: {x}, attrs: {begin, size: xSliceSize}, backend});\n   begin[$axis] += s;\n   return xSlice;\n });\n}\n\nexport const splitVConfig: KernelConfig = {\n kernelName: SplitV,\n backendName: 'wasm',\n kernelFunc: splitV as {} as

KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n==========\n*/\n\nimport {KernelConfig, Sqrt} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\nexport const sqrtConfig: KernelConfig = createUnaryKernelConfig(Sqrt);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n==========\n*/\nimport {KernelConfig, Square} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\nexport const squareConfig: KernelConfig = createUnaryKernelConfig(Square);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n==========\n*/\nimport {KernelConfig, SquaredDifference} from '@tensorflow/tfjs-core';\nimport {createBinaryKernelConfig} from './binary_kernel';\nconst supportsFullBroadcast = true;\nexport const squaredDifferenceConfig: KernelConfig =\n   createBinaryKernelConfig(SquaredDifference, supportsFullBroadcast);\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n==========\n*/\n\nimport {KernelConfig, KernelFunc, Step, StepAttrs, StepInputs, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {CppDType} from './types';\n\nlet wasmStep: (xId: number, alpha: number, dtype: number, outId: number) =>\n   void;\n\nfunction setup(backend: BackendWasm): void {\n wasmStep = backend.wasm.cwrap(Step, null /*void*/, [\n   'number', // x_id\n   'number', // alpha\n   'number', // dtype\n   'number', // out_id\n]);\n}\n\nfunction step(\n   args: {backend: BackendWasm, inputs: StepInputs, attrs: StepAttrs}):\n   TensorInfo {\n const {backend, inputs, attrs} = args;\n const {alpha} = attrs;\n const {x} = inputs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n\n const out = backend.makeOutput(x.shape, x.dtype);\n const outId = backend.dataIdMap.get(out.dataId).id;\n wasmStep(xId, alpha, CppDType[x.dtype], outId);\n return out;\n}\n\nexport const stepConfig: KernelConfig = {\n kernelName: Step,\n backendName: 'wasm',\n setupFunc:

setup,\n kernelFunc: step as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2021 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under
 the License.\n *
==========\n */\n\nimport {KernelConfig, KernelFunc, slice_util, StridedSlice, StridedSliceAttrs, StridedSliceInputs, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\nimport {reshape} from './Reshape';\nimport {slice} from './Slice';\n\nlet wasmStridedSlice: (\n   xId: number, xStridesBytes: Uint8Array, xRank: number,\n   beginBytes: Uint8Array, endBytes: Uint8Array, stridesBytes: Uint8Array,\n   outShapeBytes: Uint8Array, outStridesBytes: Uint8Array,\n   outShapeLength: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n wasmStridedSlice = backend.wasm.cwrap(StridedSlice, null /*void*/, [\n   'number', // xId\n   'array',   // xStrides\n   'number', // xRank\n   'array',   // beginBytes\n   'array',   // endBytes\n   'array',   // stridesBytes\n   'array',   // outShapeBytes\n   'array',   // outStridesBytes\n
    'number', // outShapeLength\n   'number', // outId\n]);\n}\n\nexport function stridedSlice(args: {\n backend: BackendWasm,\n inputs: StridedSliceInputs,\n attrs: StridedSliceAttrs\n}): TensorInfo {\n const {backend, inputs, attrs} = args;\n const {x} = inputs;\n\n const {\n   begin,\n   end,\n   strides,\n   beginMask,\n   endMask,\n   ellipsisMask,\n   newAxisMask,\n   shrinkAxisMask\n } = attrs;\n\n const {\n   finalShapeSparse,\n   finalShape,\n   isIdentity,\n   sliceDim0,\n   isSimpleSlice,\n   begin: $begin,\n   end: $end,\n   strides: $strides\n } =\n   slice_util.sliceInfo(\n   x.shape, begin, end, strides, beginMask, endMask, ellipsisMask,\n   newAxisMask, shrinkAxisMask);\n\n let result;\n\n if (isIdentity) {\n   // Optimization #1, slice is a no-op plus reshape\n   result = reshape({inputs: {x}, backend, attrs: {shape: finalShape}});\n } else if (sliceDim0 || isSimpleSlice) {\n   // Optimization #2, slice is memory contiguous
 (only occurs in dim 0)\n   util.assert(\n   x.shape.length >= 1,\n   () => `Input must have rank at least 1, got: ${x.shape.length}`);\n\n   const size = slice_util.computeOutShape($begin, $end, $strides);\n   // To tolerate begin[0] > end[0] (a 0-output slice), we min(begin, end).\n   const sliced = slice({inputs: {x}, backend, attrs: {begin: $begin, size}});\n   result =\n   reshape({inputs: {x: sliced}, backend, attrs: {shape: finalShape}});\n   backend.disposeData(sliced.dataId);\n } else {\n   const out = backend.makeOutput(finalShapeSparse, 'float32');\n\n   const xId = backend.dataIdMap.get(x.dataId).id;\n   const xStridesBytes =\n   new Uint8Array(new Int32Array(util.computeStrides(x.shape)).buffer);\n   const beginBytes = new Uint8Array(new Int32Array($begin).buffer);\n   const endBytes = new Uint8Array(new Int32Array($end).buffer);\n   const stridesBytes = new Uint8Array(new Int32Array($strides).buffer);\n\n   const outputShapeBytes =\n
        new Uint8Array(new Int32Array(finalShapeSparse).buffer);\n   const outStridesBytes = new Uint8Array(\n
 new Int32Array(util.computeStrides(finalShapeSparse)).buffer);\n   const outId =
 backend.dataIdMap.get(out.dataId).id;\n\n   wasmStridedSlice(\n   xId, xStridesBytes, x.shape.length,
 beginBytes, endBytes, stridesBytes,\n   outputShapeBytes, outStridesBytes, finalShapeSparse.length, outId);\n\n   result = reshape({inputs: {x: out}, backend, attrs: {shape: finalShape}});\n\n   backend.disposeData(out.dataId);\n }\n\n return result;\n}\n\nexport const stridedSliceConfig: KernelConfig = {\n kernelName: StridedSlice,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: stridedSlice as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License
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language governing permissions and\n * limitations under the License.\n *
==========\n
*/\nimport {KernelConfig, Sub} from '@tensorflow/tfjs-core';\nimport {createBinaryKernelConfig} from
'./binary_kernel';\nconst supportsFullBroadcast = true;\nexport const subConfig: KernelConfig =\n
createBinaryKernelConfig(Sub, supportsFullBroadcast);\n","/**\n * @license\n * Copyright 2019 Google LLC. All
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the License.\n *
==========\n
*/\n\nimport {backend_util, KernelConfig, KernelFunc, Sum, SumAttrs, SumInputs, TensorInfo, util} from
'@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport
{permuteAxesAndTranspose} from './kernel_utils';\nimport {CppDType} from './types';\n\nlet wasmSum: (xId:
number, reduceSize: number, dtype: number, outId: number) =>\n void;\n\nfunction setup(backend:
BackendWasm): void {\n wasmSum = backend.wasm.cwrap(Sum, null /*void*/, [\n 'number', // input_id\n
'number', // reduce_size\n 'number', // dtype\n
  'number', // out_id\n]);\n}\n\nfunction sum(args: {backend: BackendWasm, inputs: SumInputs, attrs:
SumAttrs}):\n TensorInfo {\n const {backend, inputs, attrs} = args;\n const {axis, keepDims} = attrs;\n const
{x} = inputs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n let inputId = xId;\n let input = x;\n\n const
{transposed, axes, originalAxes, inputWasTransposed} =\n permuteAxesAndTranspose(x, axis, backend);\n\n
let reductionAxes = axes;\n if (inputWasTransposed) {\n const transposedId =
backend.dataIdMap.get(transposed.dataId).id;\n if (transposedId !== xId) {\n // transpose was not a no-op. We
will need to dispose of this\n // once we are done.\n input = transposed;\n inputId = transposedId;\n
reductionAxes = backend_util.getInnerMostAxes(\n reductionAxes.length, input.shape.length);\n }\n }\n\n
backend_util.assertAxesAreInnerMostDims(\n 'sum', reductionAxes, input.shape.length);\n const [outShape,
reduceShape] =\n backend_util.computeOutAndReduceShapes(input.shape, reductionAxes);\n const reduceSize
= util.sizeFromShape(reduceShape);\n\n const out = backend.makeOutput(outShape, input.dtype);\n if
(util.sizeFromShape(input.shape) !== 0) {\n const outId = backend.dataIdMap.get(out.dataId).id;\n
wasmSum(inputId, reduceSize, CppDType[out.dtype], outId);\n }\n\n if (inputWasTransposed) {\n // dispose of
the transposed tensor.\n backend.disposeData(transposed.dataId);\n }\n\n if (keepDims) {\n // reshape\n const
newShape = backend_util.expandShapeToKeepDim(out.shape, originalAxes);\n out.shape = newShape;\n }\n\n
return out;\n}\n\nexport const sumConfig: KernelConfig = {\n kernelName: Sum,\n backendName: 'wasm',\n
setupFunc: setup,\n kernelFunc: sum as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2021 Google
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OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language
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==========\n
*/\nimport {KernelConfig, Tan} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from
'./unary_kernel';\nexport const tanConfig: KernelConfig = createUnaryKernelConfig(Tan);\n","/**\n * @license\n *
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==========\n
*/\nimport {KernelConfig, Tanh} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\nexport const tanhConfig: KernelConfig = createUnaryKernelConfig(Tanh);\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable
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==========\n
/\n\nimport {KernelConfig, KernelFunc, Tile, TileAttrs, TileInputs} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {CppDType} from './types';\n\nlet wasmTile: (\n xId: number, xShape: Uint8Array, xShapeSize: number, newShape: Uint8Array,\n newShapeSize: number, dtype: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmTile = backend.wasm.cwrap(Tile, null / void */, [\n 'number', // x_id\n 'array', // x_shape\n 'number', // x_shape.length\n 'array', // new_shape\n 'number', // new_shape.length\n 'number' // out_id\n]);\n}\n\nfunction tile(\n args: {inputs: TileInputs, backend: BackendWasm, attrs: TileAttrs}) {\n const {inputs, backend, attrs} = args;\n const {x} = inputs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n const {reps} = attrs;\n\n const newShape: number[] = new Array(x.shape.length);\n for (let i = 0; i < newShape.length; i++) {\n newShape[i] = x.shape[i] * reps[i];\n }\n const xShapeBytes = new Uint8Array(new Int32Array(x.shape).buffer);\n const newShapeBytes = new Uint8Array(new Int32Array(newShape).buffer);\n\n const out = backend.makeOutput(newShape, x.dtype);\n const outId = backend.dataIdMap.get(out.dataId).id;\n wasmTile(\n xId, xShapeBytes, x.shape.length, newShapeBytes, newShape.length,\n CppDType[out.dtype], outId);\n return out;\n}\n\nexport const tileConfig: KernelConfig = {\n kernelName: Tile,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: tile as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC.
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==========\n
*/\n\nimport {KernelConfig, KernelFunc, TensorInfo, TopK, TopKAttrs, TopKInputs} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\nimport {CppDType} from './types';\n\nlet wasmTopK: (\n xId: number, xShapeBytes: Uint8Array, xShapeLength: number,\n xDtype: CppDType, k: number, sorted: boolean,
outValuesId: number,\n outIndicesId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmTopK = backend.wasm.cwrap(TopK, null /* void */, [\n 'number', // xId\n 'array', // x.shape\n 'number', // x.shape.length\n 'number', // x.dtype\n 'number', // k\n 'bool', // sorted\n 'number', // outValuesId\n 'number', // outIndicesId\n]);\n}\n\nexport const topk:\n (args: {inputs: TopKInputs, backend: BackendWasm, attrs: TopKAttrs}) =>\n TensorInfo[] | TensorInfo = ({inputs, backend, attrs}) => {\n const {x} = inputs;\n const {k, sorted} = attrs;\n\n const xId = backend.dataIdMap.get(x.dataId).id;\n const xShapeBytes = new Uint8Array(new Int32Array(x.shape).buffer);\n const outputShape = x.shape.slice();\n

outputShape[outputShape.length - 1] = k;\n const outValues = backend.makeOutput(outputShape, x.dtype);\n const outValuesId = backend.dataIdMap.get(outValues.dataId).id;\n const outIndices = backend.makeOutput(outputShape, 'int32');\n const outIndicesId = backend.dataIdMap.get(outIndices.dataId).id;\n\n wasmTopK(\n xId, xShapeBytes, x.shape.length, CppDType[x.dtype], k, sorted,\n outValuesId, outIndicesId);\n\n return [outValues, outIndices];\n };\n\nexport const topKConfig: KernelConfig = {\n kernelName: TopK,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: topk as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2021 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR
CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {KernelConfig, KernelFunc, TensorInfo, Transform, TransformAttrs, TransformInputs, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmTransform: (\n imageId: number, transformsId: number, isBatchTransform: boolean,\n batch: number, outHeight: number, outWidth: number, numChannels: number,\n imageWidth: number, imageHeight: number, strides: Uint8Array,\n stridesLength: number, interpolationModeId: number, fillModeId: number,\n fillValue: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n wasmTransform = backend.wasm.cwrap(Transform, null /*void*/, [\n 'number', // imageId\n 'number', // transformsId\n 'bool', // isBatchTransform\n 'number', // batch\n 'number', // outHeight\n 'number', // outWidth\n 'number', // numChannels\n 'number', // imageWidth\n 'number', // imageHeight\n 'array', // strides\n 'number', // stridesLength\n 'number', // interpolationModeId\n 'number', // fillModeId\n 'number', // fillValue\n 'number' // outId\n]);\n}\n\nfunction transform(\n args:\n {backend: BackendWasm, inputs: TransformInputs, attrs: TransformAttrs}):\n TensorInfo {\n const {backend, inputs, attrs} = args;\n const {image, transforms} = inputs;\n const {interpolation, fillMode, fillValue, outputShape} = attrs;\n\n const [batch, imageHeight, imageWidth, numChannels] = image.shape;\n const [outHeight, outWidth] =\n outputShape != null ? outputShape : [imageHeight, imageWidth];\n const outShape =\n [batch, outHeight, outWidth,\n numChannels] as [number, number, number, number];\n const strides =\n new Uint8Array(new Int32Array(util.computeStrides(image.shape)).buffer);\n\n const out = backend.makeOutput(outShape, image.dtype);\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n const imageData = backend.dataIdMap.get(image.dataId);\n const imageId = imageData.id;\n\n const transformsData = backend.dataIdMap.get(transforms.dataId);\n const transformsId = transformsData.id;\n\n const interpolationModeId = interpolation === 'nearest' ? 1 : 2;\n let fillModeId;\n switch (fillMode) {\n case 'constant':\n fillModeId = 1;\n break;\n case 'reflect':\n fillModeId = 2;\n break;\n case 'wrap':\n fillModeId = 3;\n break;\n case 'nearest':\n fillModeId = 4;\n break;\n default:\n fillModeId = 1;\n break;\n }\n\n wasmTransform(\n imageId, transformsId, (transforms.shape[0] > 1), batch, outHeight,\n outWidth, numChannels, imageWidth, imageHeight, strides,\n image.shape.length - 1, interpolationModeId, fillModeId, fillValue,\n outId);\n\n return out;\n}\n\nexport const transformConfig: KernelConfig = {\n kernelName: Transform,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: transform as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language

governing permissions and\n * limitations under the License.\n *
==========\n
*/\n\nimport {KernelConfig, KernelFunc, ZerosLike, ZerosLikeInputs} from '@tensorflow/tfjs-core';\n\nimport
{BackendWasm} from '../backend_wasm';\n\nfunction zerosLike(args: {inputs: ZerosLikeInputs, backend:
BackendWasm}) {\n const {inputs: {x}, backend} = args;\n const out = backend.makeOutput(x.shape, x.dtype);\n
const outVals = backend.typedArrayFromHeap(out);\n outVals.fill(0);\n return out;\n}\n\nexport const
zerosLikeConfig: KernelConfig = {\n kernelName: ZerosLike,\n backendName: 'wasm',\n kernelFunc: zerosLike
as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed
under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the
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Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed
on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or
implied.\n
 * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n//
We explicitly import the modular kernels so they get registered in the\n// global registry when we compile the
library. A modular build would replace\n// the contents of this file and import only the kernels that are
needed.\nimport {KernelConfig, registerKernel} from '@tensorflow/tfjs-core';\n\nimport {fusedMatMulConfig}
from './kernels/_FusedMatMul';\nimport {absConfig} from './kernels/Abs';\nimport {addConfig} from
'./kernels/Add';\nimport {addNConfig} from './kernels/AddN';\nimport {allConfig} from './kernels/All';\nimport
{anyConfig} from './kernels/Any';\nimport {argMaxConfig} from './kernels/ArgMax';\nimport {avgPoolConfig}
from './kernels/AvgPool';\nimport {batchMatMulConfig} from './kernels/BatchMatMul';\nimport
{batchToSpaceNDConfig} from './kernels/BatchToSpaceND';\nimport
{castConfig} from './kernels/Cast';\nimport {ceilConfig} from './kernels/Ceil';\nimport {clipByValueConfig} from
'./kernels/ClipByValue';\nimport {concatConfig} from './kernels/Concat';\nimport {conv2DConfig} from
'./kernels/Conv2D';\nimport {conv2DBackpropInputConfig} from './kernels/Conv2DBackpropInput';\nimport
{cosConfig} from './kernels/Cos';\nimport {coshConfig} from './kernels/Cosh';\nimport {cropAndResizeConfig}
from './kernels/CropAndResize';\nimport {cumsumConfig} from './kernels/Cumsum';\nimport
{depthToSpaceConfig} from './kernels/DepthToSpace';\nimport {depthwiseConv2dNativeConfig} from
'./kernels/DepthwiseConv2dNative';\nimport {eluConfig} from './kernels/Elu';\nimport {equalConfig} from
'./kernels/Equal';\nimport {expConfig} from './kernels/Exp';\nimport {expandDimsConfig} from
'./kernels/ExpandDims';\nimport {fillConfig} from './kernels/Fill';\nimport {flipLeftRightConfig} from
'./kernels/FlipLeftRight';\nimport {floorConfig} from './kernels/Floor';\nimport {floorDivConfig}
from './kernels/FloorDiv';\nimport {fusedBatchNormConfig} from './kernels/FusedBatchNorm';\nimport
{fusedConv2DConfig} from './kernels/FusedConv2D';\nimport {fusedDepthwiseConv2DConfig} from
'./kernels/FusedDepthwiseConv2D';\nimport {gatherNdConfig} from './kernels/GatherNd';\nimport
{gatherV2Config} from './kernels/GatherV2';\nimport {greaterConfig} from './kernels/Greater';\nimport
{greaterEqualConfig} from './kernels/GreaterEqual';\nimport {identityConfig} from './kernels/Identity';\nimport
{leakyReluConfig} from './kernels/LeakyRelu';\nimport {lessConfig} from './kernels/Less';\nimport
{lessEqualConfig} from './kernels/LessEqual';\nimport {logConfig} from './kernels/Log';\nimport
{logicalAndConfig} from './kernels/LogicalAnd';\nimport {maxConfig} from './kernels/Max';\nimport
{maximumConfig} from './kernels/Maximum';\nimport {maxPoolConfig} from './kernels/MaxPool';\nimport
{meanConfig} from './kernels/Mean';\nimport {minConfig} from './kernels/Min';\nimport {minimumConfig} from
'./kernels/Minimum';\nimport {mirrorPadConfig} from './kernels/MirrorPad';\nimport {multiplyConfig} from
'./kernels/Multiply';\nimport {negConfig} from './kernels/Neg';\nimport {nonMaxSuppressionV3Config} from
'./kernels/NonMaxSuppressionV3';\nimport {nonMaxSuppressionV4Config} from
'./kernels/NonMaxSuppressionV4';\nimport {nonMaxSuppressionV5Config} from
'./kernels/NonMaxSuppressionV5';\nimport {notEqualConfig} from './kernels/NotEqual';\nimport {oneHotConfig}

from './kernels/OneHot';\nimport {onesLikeConfig} from './kernels/OnesLike';\nimport {packConfig} from './kernels/Pack';\nimport {padV2Config} from './kernels/PadV2';\nimport {powConfig} from './kernels/Pow';\nimport {preluConfig} from './kernels/Prelu';\nimport {prodConfig} from './kernels/Prod';\nimport {rangeConfig} from './kernels/Range';\nimport {realDivConfig} from './kernels/RealDiv';\nimport {reluConfig} from './kernels/Relu';\nimport {relu6Config} from './kernels/Relu6';\nimport {reshapeConfig} from './kernels/Reshape';\nimport
{resizeBilinearConfig} from './kernels/ResizeBilinear';\nimport {reverseConfig} from './kernels/Reverse';\nimport {rotateWithOffsetConfig} from './kernels/RotateWithOffset';\nimport {roundConfig} from './kernels/Round';\nimport {rsqrtConfig} from './kernels/Rsqrt';\nimport {scatterNdConfig} from './kernels/ScatterNd';\nimport {selectConfig} from './kernels/Select';\nimport {sigmoidConfig} from './kernels/Sigmoid';\nimport {sinConfig} from './kernels/Sin';\nimport {sliceConfig} from './kernels/Slice';\nimport {softmaxConfig} from './kernels/Softmax';\nimport {spaceToBatchNDConfig} from './kernels/SpaceToBatchND';\nimport {splitVConfig} from './kernels/SplitV';\nimport {sqrtConfig} from './kernels/Sqrt';\nimport {squareConfig} from './kernels/Square';\nimport {squaredDifferenceConfig} from './kernels/SquaredDifference';\nimport {stepConfig} from './kernels/Step';\nimport {stridedSliceConfig} from './kernels/StridedSlice';\nimport {subConfig} from './kernels/Sub';\nimport {sumConfig}
from './kernels/Sum';\nimport {tanConfig} from './kernels/Tan';\nimport {tanhConfig} from './kernels/Tanh';\nimport {tileConfig} from './kernels/Tile';\nimport {topKConfig} from './kernels/TopK';\nimport {transformConfig} from './kernels/Transform';\nimport {transposeConfig} from './kernels/Transpose';\nimport {unpackConfig} from './kernels/Unpack';\nimport {zerosLikeConfig} from './kernels/ZerosLike';\n\n// List all kernel configs here\nconst kernelConfigs: KernelConfig[] = [\n absConfig,\n addConfig,\n addNConfig,\n allConfig,\n anyConfig,\n argMaxConfig,\n avgPoolConfig,\n batchMatMulConfig,\n batchToSpaceNDConfig,\n castConfig,\n ceilConfig,\n clipByValueConfig,\n concatConfig,\n conv2DConfig,\n conv2DBackpropInputConfig,\n cosConfig,\n coshConfig,\n cropAndResizeConfig,\n cumsumConfig,\n depthToSpaceConfig,\n depthwiseConv2dNativeConfig,\n eluConfig,\n equalConfig,\n expConfig,\n expandDimsConfig,\n fillConfig,\n flipLeftRightConfig,\n floorConfig,\n
floorDivConfig,\n fusedMatMulConfig,\n fusedBatchNormConfig,\n fusedConv2DConfig,\n fusedDepthwiseConv2DConfig,\n gatherNdConfig,\n gatherV2Config,\n greaterConfig,\n greaterEqualConfig,\n identityConfig,\n leakyReluConfig,\n lessConfig,\n lessEqualConfig,\n logConfig,\n logicalAndConfig,\n maxConfig,\n maximumConfig,\n maxPoolConfig,\n meanConfig,\n minConfig,\n minimumConfig,\n mirrorPadConfig,\n multiplyConfig,\n negConfig,\n nonMaxSuppressionV3Config,\n nonMaxSuppressionV4Config,\n nonMaxSuppressionV5Config,\n notEqualConfig,\n oneHotConfig,\n onesLikeConfig,\n packConfig,\n padV2Config,\n powConfig,\n preluConfig,\n prodConfig,\n rangeConfig,\n realDivConfig,\n reluConfig,\n relu6Config,\n reshapeConfig,\n resizeBilinearConfig,\n reverseConfig,\n rotateWithOffsetConfig,\n rsqrtConfig,\n roundConfig,\n scatterNdConfig,\n selectConfig,\n sigmoidConfig,\n sinConfig,\n sliceConfig,\n softmaxConfig,\n spaceToBatchNDConfig,\n splitVConfig,\n
sqrtConfig,\n squareConfig,\n squaredDifferenceConfig,\n stepConfig,\n stridedSliceConfig,\n subConfig,\n sumConfig,\n tanConfig,\n tanhConfig,\n tileConfig,\n topKConfig,\n transformConfig,\n transposeConfig,\n unpackConfig,\n zerosLikeConfig\n];\n\nfor (const kernelConfig of kernelConfigs) {\n registerKernel(kernelConfig);\n}\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n
* ===\n */\n\nimport {KernelConfig, KernelFunc, TensorInfo, Unpack, UnpackAttrs, UnpackInputs} from

'@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {slice} from './Slice';\n\nfunction unpack(\n args: {inputs: UnpackInputs, backend: BackendWasm, attrs: UnpackAttrs}):\n TensorInfo[] {\n const {inputs, backend, attrs} = args;\n const {value} = inputs;\n let {axis} = attrs;\n\n if (axis < 0) {\n axis += value.shape.length;\n }\n\n const numOutputs = value.shape[axis];\n const rank = value.shape.length;\n const outShape: number[] = new Array(rank - 1);\n let outIndex = 0;\n for (let i = 0; i < rank; i++) {\n if (i !== axis) {\n outShape[outIndex++] = value.shape[i];\n }\n }\n const outs: TensorInfo[] = new Array(numOutputs);\n const begin = new Array(rank).fill(0);\n const size = value.shape.slice();\n size[axis] = 1;\n for (let i = 0; i < outs.length; i++) {\n begin[axis] = i;\n outs[i] = slice({inputs: {x: value}, attrs: {begin, size}, backend});\n }\n return outs.map(({dataId, dtype}) => ({dataId, dtype, shape: outShape}));\n}\n\nexport const unpackConfig: KernelConfig = {\n kernelName: Unpack,\n backendName: 'wasm',\n kernelFunc: unpack as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==\n */\n\nimport {env} from '@tensorflow/tfjs-core';\n\nconst ENV = env();\n\n/**\n * True if SIMD is supported.\n */\n// From: https://github.com/GoogleChromeLabs/wasm-feature-detect\nENV.registerFlag(\n // This typed array passed in to WebAssembly.validate is WebAssembly binary\n // code. In this case it is a small program that contains SIMD\n // instructions.\n 'WASM_HAS_SIMD_SUPPORT', async () => WebAssembly.validate(new Uint8Array([\n 0, 97, 115, 109, 1, 0, 0, 0, 1, 4, 1, 96, 0, 0, 3,\n 2, 1, 0, 10, 9, 1, 7, 0, 65, 0, 253, 15, 26, 11\n])));\n\n/**\n * True if threads are supported.\n */\n// From: https://github.com/GoogleChromeLabs/wasm-feature-detect\nENV.registerFlag('WASM_HAS_MULTITHREAD_SUPPORT', async () => {\n // TODO(annxingyuan): Enable node support once this is resolved:\n // https://github.com/tensorflow/tfjs/issues/3830\n if (ENV.get('IS_NODE')) {\n return false;\n }\n\n try {\n // Test for transferability of SABs (needed for Firefox)\n // https://groups.google.com/forum/#!msg/mozilla.dev.platform/IHkBZlHETpA/dwsMNchWEQAJ\n new MessageChannel().port1.postMessage(new SharedArrayBuffer(1));\n // This typed array is a WebAssembly program containing threaded\n // instructions.\n return WebAssembly.validate(new Uint8Array([\n 0, 97, 115, 109, 1, 0, 0, 0, 1, 4, 1, 96, 0, 0, 3, 2, 1, 0, 5,\n 4, 1, 3, 1, 1, 10, 11, 1, 9, 0, 65, 0, 254, 16, 2, 0, 26, 11\n]));\n } catch (e) {\n return false;\n }\n});\n","\nvar WasmBackendModuleThreadedSimd = (function() {\n var _scriptDir = typeof document !== 'undefined' && document.currentScript ? document.currentScript.src : undefined;\n if (typeof __filename !== 'undefined') _scriptDir = _scriptDir || __filename;\n return (\nfunction(WasmBackendModuleThreadedSimd) {\n WasmBackendModuleThreadedSimd = WasmBackendModuleThreadedSimd || {};\n\nfunction GROWABLE_HEAP_I8(){if(wasmMemory.buffer!=buffer){updateGlobalBufferAndViews(wasmMemory.buffer)}return HEAP8}function GROWABLE_HEAP_U8(){if(wasmMemory.buffer!=buffer){updateGlobalBufferAndViews(wasmMemory.buffer)}return HEAPU8}function GROWABLE_HEAP_I32(){if(wasmMemory.buffer!=buffer){updateGlobalBufferAndViews(wasmMemory.buffer)}return HEAP32}function GROWABLE_HEAP_U32(){if(wasmMemory.buffer!=buffer){updateGlobalBufferAndViews(wasmMemory.buffer)}return HEAPU32}function GROWABLE_HEAP_F64(){if(wasmMemory.buffer!=buffer){updateGlobalBufferAndViews(wasmMemory.buffer)}return HEAPF64}var Module=typeof

WasmBackendModuleThreadedSimd!==\"undefined\"?WasmBackendModuleThreadedSimd:{};var readyPromiseResolve,readyPromiseReject;Module[\"ready\"]=new Promise(function(resolve,reject){readyPromiseResolve=resolve;readyPromiseReject=reject});var moduleOverrides={};var key;for(key in Module){if(Module.hasOwnProperty(key)){moduleOverrides[key]=Module[key]}}var arguments_=[];var thisProgram=\"./this.program\";var quit_=function(status,toThrow){throw toThrow};var ENVIRONMENT_IS_WEB=false;var ENVIRONMENT_IS_WORKER=false;var ENVIRONMENT_IS_NODE=false;var ENVIRONMENT_IS_SHELL=false;ENVIRONMENT_IS_WEB=typeof window===\"object\";ENVIRONMENT_IS_WORKER=typeof importScripts===\"function\";ENVIRONMENT_IS_NODE=typeof process===\"object\"&&typeof process.versions===\"object\"&&typeof process.versions.node===\"string\";ENVIRONMENT_IS_SHELL=!ENVIRONMENT_IS_WEB&&!ENVIRONMENT_IS_NODE&&!ENVIRONMENT_IS_WORKER;var ENVIRONMENT_IS_PTHREAD=Module[\"ENVIRONMENT_IS_PTHREAD\"]||false;if(ENVIRONMENT_IS_PTHREAD){buffer=Module[\"buffer\"]}var scriptDirectory=\"\";function locateFile(path){if(Module[\"locateFile\"]){return Module[\"locateFile\"](path,scriptDirectory)}return scriptDirectory+path}var read_,readAsync,readBinary,setWindowTitle;var nodeFS;var nodePath;if(ENVIRONMENT_IS_NODE){if(ENVIRONMENT_IS_WORKER){scriptDirectory=require(\"path\").dirname(scriptDirectory)+\"/\"}else{scriptDirectory=__dirname+\"/\"}read_=function shell_read(filename,binary){if(!nodeFS)nodeFS=require(\"fs\");if(!nodePath)nodePath=require(\"path\");filename=nodePath[\"normalize\"](filename);return nodeFS[\"readFileSync\"](filename,binary?null:\"utf8\")};readBinary=function readBinary(filename){var ret=read_(filename,true);if(!ret.buffer){ret=new Uint8Array(ret)}assert(ret.buffer);return ret};if(process[\"argv\"].length>1){thisProgram=process[\"argv\"][1].replace(/\\\\/g,\"/\")}arguments_=process[\"argv\"].slice(2);process[\"on\"](\"uncaughtException\",function(ex){if(!(ex instanceof ExitStatus)){throw ex}});process[\"on\"](\"unhandledRejection\",abort);quit_=function(status){process[\"exit\"](status)};Module[\"inspect\"]=function(){return\"[Emscripten Module object]\"};var nodeWorkerThreads;try{nodeWorkerThreads=require(\"worker_threads\")}catch(e){console.error('The \"worker_threads\" module is not supported in this node.js build - perhaps a newer version is needed?');throw e}global.Worker=nodeWorkerThreads.Worker}else if(ENVIRONMENT_IS_SHELL){if(typeof read!=\"undefined\"){read_=function shell_read(f){return read(f)}}readBinary=function readBinary(f){var data;if(typeof readbuffer===\"function\"){return new Uint8Array(readbuffer(f))}data=read(f,\"binary\");assert(typeof data===\"object\");return data};if(typeof scriptArgs!=\"undefined\"){arguments_=scriptArgs}else if(typeof arguments!=\"undefined\"){arguments_=arguments}if(typeof quit===\"function\"){quit_=function(status){quit(status)}}if(typeof print!==\"undefined\"){if(typeof console===\"undefined\")console={};console.log=print;console.warn=console.error=typeof printErr!==\"undefined\"?printErr:print}}else if(ENVIRONMENT_IS_WEB||ENVIRONMENT_IS_WORKER){if(ENVIRONMENT_IS_WORKER){scriptDirectory=self.location.href}else if(typeof document!==\"undefined\"&&document.currentScript){scriptDirectory=document.currentScript.src}if(typeof _scriptDir !== \"undefined\" && _scriptDir){scriptDirectory=_scriptDir}if(scriptDirectory.indexOf(\"blob:\")!==0){scriptDirectory=scriptDirectory.substr(0,scriptDirectory.lastIndexOf(\"/\")+1)}else{scriptDirectory=\"\"}if(ENVIRONMENT_IS_NODE){read_=function shell_read(filename,binary){if(!nodeFS)nodeFS=require(\"fs\");if(!nodePath)nodePath=require(\"path\");filename=nodePath[\"normalize\"](filename);return nodeFS[\"readFileSync\"](filename,binary?null:\"utf8\")};readBinary=function readBinary(filename){var

ret=read_(filename,true);if(!ret.buffer){ret=new Uint8Array(ret)}assert(ret.buffer);return ret}}else{read_=function(url){var xhr=new XMLHttpRequest;xhr.open(\"GET\",url,false);xhr.send(null);return xhr.responseText};if(ENVIRONMENT_IS_WORKER){readBinary=function(url){var xhr=new XMLHttpRequest;xhr.open(\"GET\",url,false);xhr.responseType=\"arraybuffer\";xhr.send(null);return new Uint8Array(xhr.response)}}readAsync=function(url,onload,onerror){var xhr=new XMLHttpRequest;xhr.open(\"GET\",url,true);xhr.responseType=\"arraybuffer\";xhr.onload=function(){if(xhr.status==200||xhr.status==0&&xhr.response){onload(xhr.response);return}onerror()};xhr.onerror=onerror;xhr.send(null)}}setWindowTitle=function(title){document.title=title}}else{}if(ENVIRONMENT_IS_NODE){if(typeof performance===\"undefined\"){global.performance=require(\"perf_hooks\").performance}}var out=Module[\"print\"]||console.log.bind(console);var err=Module[\"printErr\"]||console.warn.bind(console);for(key in moduleOverrides){if(moduleOverrides.hasOwnProperty(key)){Module[key]=moduleOverrides[key]}}moduleOverrides=null;if(Module[\"arguments\"])arguments_=Module[\"arguments\"];if(Module[\"thisProgram\"])thisProgram=Module[\"thisProgram\"];if(Module[\"quit\"])quit_=Module[\"quit\"];function warnOnce(text){if(!warnOnce.shown)warnOnce.shown={};if(!warnOnce.shown[text]){warnOnce.shown[text]=1;err(text)}}var Atomics_load=Atomics.load;var Atomics_store=Atomics.store;var Atomics_compareExchange=Atomics.compareExchange;var wasmBinary;if(Module[\"wasmBinary\"])wasmBinary=Module[\"wasmBinary\"];var noExitRuntime=Module[\"noExitRuntime\"]||true;if(typeof WebAssembly!==\"object\"){abort(\"no native wasm support detected\")}var wasmMemory;var wasmModule;var ABORT=false;var EXITSTATUS;function assert(condition,text){if(!condition){abort(\"Assertion failed: \"+text)}}function getCFunc(ident){var func=Module[\"_\"+ident];assert(func,\"Cannot call unknown function \"+ident+\", make sure it is exported\");return func}function ccall(ident,returnType,argTypes,args,opts){var toC={\"string\":function(str){var ret=0;if(str!==null&&str!==undefined&&str!==0){var len=(str.length<<2)+1;ret=stackAlloc(len);stringToUTF8(str,ret,len)}return ret},\"array\":function(arr){var ret=stackAlloc(arr.length);writeArrayToMemory(arr,ret);return ret}};function convertReturnValue(ret){if(returnType===\"string\")return UTF8ToString(ret);if(returnType===\"boolean\")return Boolean(ret);return ret}var func=getCFunc(ident);var cArgs=[];var stack=0;if(args){for(var i=0;i<args.length;i++){var converter=toC[argTypes[i]];if(converter){if(stack===0)stack=stackSave();cArgs[i]=converter(args[i])}else{cArgs[i]=args[i]}}}var ret=func.apply(null,cArgs);ret=convertReturnValue(ret);if(stack!==0)stackRestore(stack);return ret}function cwrap(ident,returnType,argTypes,opts){argTypes=argTypes||[];var numericArgs=argTypes.every(function(type){return type===\"number\"});var numericRet=returnType!==\"string\";if(numericRet&&numericArgs&&!opts){return getCFunc(ident)}return function(){return ccall(ident,returnType,argTypes,arguments,opts)}}function UTF8ArrayToString(heap,idx,maxBytesToRead){var endIdx=idx+maxBytesToRead;var str=\"\";while(!(idx>=endIdx)){var u0=heap[idx++];if(!u0)return str;if(!(u0&128)){str+=String.fromCharCode(u0);continue}var u1=heap[idx++]&63;if((u0&224)==192){str+=String.fromCharCode((u0&31)<<6|u1);continue}var u2=heap[idx++]&63;if((u0&240)==224){u0=(u0&15)<<12|u1<<6|u2}else{u0=(u0&7)<<18|u1<<12|u2<<6|heap[idx++]&63}if(u0<65536){str+=String.fromCharCode(u0)}else{var ch=u0-65536;str+=String.fromCharCode(55296|ch>>10,56320|ch&1023)}}return str}function UTF8ToString(ptr,maxBytesToRead){return ptr?UTF8ArrayToString(GROWABLE_HEAP_U8(),ptr,maxBytesToRead):\"\"}function stringToUTF8Array(str,heap,outIdx,maxBytesToWrite){if(!(maxBytesToWrite>0))return 0;var startIdx=outIdx;var endIdx=outIdx+maxBytesToWrite-1;for(var i=0;i<str.length;++i){var u=str.charCodeAt(i);if(u>=55296&&u<=57343){var

u1=str.charCodeAt(++i);u=65536+((u&1023)<<10)|u1&1023}if(u<=127){if(outIdx>=endIdx)break;heap[outIdx++]=u}else if(u<=2047){if(outIdx+1>=endIdx)break;heap[outIdx++]=192|u>>6;heap[outIdx++]=128|u&63}else if(u<=65535){if(outIdx+2>=endIdx)break;heap[outIdx++]=224|u>>12;heap[outIdx++]=128|u>>6&63;heap[outIdx++]=128|u&63}else{if(outIdx+3>=endIdx)break;heap[outIdx++]=240|u>>18;heap[outIdx++]=128|u>>12&63;heap[outIdx++]=128|u>>6&63;heap[outIdx++]=128|u&63}}heap[outIdx]=0;return outIdx-startIdx}function stringToUTF8(str,outPtr,maxBytesToWrite){return stringToUTF8Array(str,GROWABLE_HEAP_U8(),outPtr,maxBytesToWrite)}function lengthBytesUTF8(str){var len=0;for(var i=0;i<str.length;++i){var u=str.charCodeAt(i);if(u>=55296&&u<=57343)u=65536+((u&1023)<<10)|str.charCodeAt(++i)&1023;if(u<=127)++len;else if(u<=2047)len+=2;else if(u<=65535)len+=3;else len+=4}return len}function writeArrayToMemory(array,buffer){GROWABLE_HEAP_I8().set(array,buffer)}function alignUp(x,multiple){if(x%multiple>0){x+=multiple-x%multiple}return x}var buffer,HEAP8,HEAPU8,HEAP16,HEAPU16,HEAP32,HEAPU32,HEAPF32,HEAPF64;function updateGlobalBufferAndViews(buf){buffer=buf;Module[\"HEAP8\"]=HEAP8=new Int8Array(buf);Module[\"HEAP16\"]=HEAP16=new Int16Array(buf);Module[\"HEAP32\"]=HEAP32=new Int32Array(buf);Module[\"HEAPU8\"]=HEAPU8=new Uint8Array(buf);Module[\"HEAPU16\"]=HEAPU16=new Uint16Array(buf);Module[\"HEAPU32\"]=HEAPU32=new Uint32Array(buf);Module[\"HEAPF32\"]=HEAPF32=new Float32Array(buf);Module[\"HEAPF64\"]=HEAPF64=new Float64Array(buf)}var INITIAL_MEMORY=Module[\"INITIAL_MEMORY\"]||16777216;if(ENVIRONMENT_IS_PTHREAD){wasmMemory=Module[\"wasmMemory\"];buffer=Module[\"buffer\"]}else{if(Module[\"wasmMemory\"]){wasmMemory=Module[\"wasmMemory\"]}else{wasmMemory=new WebAssembly.Memory({\"initial\":INITIAL_MEMORY/65536,\"maximum\":2147483648/65536,\"shared\":true});if(!(wasmMemory.buffer instanceof SharedArrayBuffer)){err(\"requested a shared WebAssembly.Memory but the returned buffer is not a SharedArrayBuffer, indicating that while the browser has SharedArrayBuffer it does not have WebAssembly threads support - you may need to set a flag\");if(ENVIRONMENT_IS_NODE){console.log(\"(on node you may need: --experimental-wasm-threads --experimental-wasm-bulk-memory and also use a recent version)\")}throw Error(\"bad memory\")}}}if(wasmMemory){buffer=wasmMemory.buffer}INITIAL_MEMORY=buffer.byteLength;updateGlobalBufferAndViews(buffer);var wasmTable;var __ATPRERUN__=[];var __ATINIT__=[];var __ATMAIN__=[];var __ATEXIT__=[];var __ATPOSTRUN__=[];var runtimeInitialized=false;var runtimeExited=false;if(!ENVIRONMENT_IS_PTHREAD)__ATINIT__.push({func:function(){___wasm_call_ctors()}});function preRun(){if(ENVIRONMENT_IS_PTHREAD)return;if(Module[\"preRun\"]){if(typeof Module[\"preRun\"]==\"function\")Module[\"preRun\"]=[Module[\"preRun\"]];while(Module[\"preRun\"].length){addOnPreRun(Module[\"preRun\"].shift())}}callRuntimeCallbacks(__ATPRERUN__)}function initRuntime(){runtimeInitialized=true;if(ENVIRONMENT_IS_PTHREAD)return;callRuntimeCallbacks(__ATINIT__)}function preMain(){if(ENVIRONMENT_IS_PTHREAD)return;callRuntimeCallbacks(__ATMAIN__)}function exitRuntime(){if(ENVIRONMENT_IS_PTHREAD)return;runtimeExited=true}function postRun(){if(ENVIRONMENT_IS_PTHREAD)return;if(Module[\"postRun\"]){if(typeof Module[\"postRun\"]==\"function\")Module[\"postRun\"]=[Module[\"postRun\"]];while(Module[\"postRun\"].length){addOnPostRun(Module[\"postRun\"].shift())}}callRuntimeCallbacks(__ATPOSTRUN__)}function addOnPreRun(cb){__ATPRERUN__.unshift(cb)}function addOnPostRun(cb){__ATPOSTRUN__.unshift(cb)}var runDependencies=0;var runDependencyWatcher=null;var dependenciesFulfilled=null;function addRunDependency(id){assert(!ENVIRONMENT_IS_PTHREAD,\"addRunDependency cannot be used in a pthread worker\");runDependencies++;if(Module[\"monitorRunDependencies\"]){Module[\"monitorRunDependencies\"](ru

nDependencies)}}function removeRunDependency(id){runDependencies--
;if(Module[\"monitorRunDependencies\"]){Module[\"monitorRunDependencies\"](runDependencies)}if(runDependencies==0){if(runDependencyWatcher!==null){clearInterval(runDependencyWatcher);runDependencyWatcher=null}if(dependenciesFulfilled){var
callback=dependenciesFulfilled;dependenciesFulfilled=null;callback()}}}Module[\"preloadedImages\"]={};Module[\"preloadedAudios\"]={};function
abort(what){if(Module[\"onAbort\"]){Module[\"onAbort\"](what)}if(ENVIRONMENT_IS_PTHREAD)console.error(\"Pthread aborting at \"+(new
Error).stack);what+=\"\";err(what);ABORT=true;EXITSTATUS=1;what=\"abort(\"+what+\"). Build with -s ASSERTIONS=1 for more info.\";var e=new WebAssembly.RuntimeError(what);readyPromiseReject(e);throw e}function hasPrefix(str,prefix){return
String.prototype.startsWith?str.startsWith(prefix):str.indexOf(prefix)===0}var
dataURIPrefix=\"data:application/octet-stream; base64,\";function isDataURI(filename){return hasPrefix(filename,dataURIPrefix)}var fileURIPrefix=\"file://\";function isFileURI(filename){return hasPrefix(filename,fileURIPrefix)}var wasmBinaryFile=\"tfjs-backend-wasm-threaded-simd.wasm\";if(!isDataURI(wasmBinaryFile)){wasmBinaryFile=locateFile(wasmBinaryFile)}function getBinary(file){try{if(file==wasmBinaryFile&&wasmBinary){return new Uint8Array(wasmBinary)}if(readBinary){return readBinary(file)}else{throw\"both async and sync fetching of the wasm failed\"}}catch(err){abort(err)}}function
getBinaryPromise(){if(!wasmBinary&&(ENVIRONMENT_IS_WEB||ENVIRONMENT_IS_WORKER)){if(typeof fetch===\"function\"&&!isFileURI(wasmBinaryFile)){return fetch(wasmBinaryFile,{credentials:\"same-origin\"}).then(function(response){if(!response[\"ok\"]){throw\"failed to load wasm binary file at '\"+wasmBinaryFile+\"'\"}return
response[\"arrayBuffer\"]()}).catch(function(){return getBinary(wasmBinaryFile)})}else{if(readAsync){return new Promise(function(resolve,reject){readAsync(wasmBinaryFile,function(response){resolve(new Uint8Array(response))},reject)})}}}return Promise.resolve().then(function(){return getBinary(wasmBinaryFile)})}function createWasm(){var info={\"a\":asmLibraryArg};function receiveInstance(instance,module){var
exports=instance.exports;Module[\"asm\"]=exports;wasmTable=Module[\"asm\"][\"I\"];wasmModule=module;if(!ENVIRONMENT_IS_PTHREAD){var
numWorkersToLoad=PThread.unusedWorkers.length;PThread.unusedWorkers.forEach(function(w){PThread.loadWasmModuleToWorker(w,function(){if(!--numWorkersToLoad)removeRunDependency(\"wasm-instantiate\")})})}if(!ENVIRONMENT_IS_PTHREAD){addRunDependency(\"wasm-instantiate\")}function receiveInstantiatedSource(output){receiveInstance(output[\"instance\"],output[\"module\"])}function instantiateArrayBuffer(receiver){return getBinaryPromise().then(function(binary){return
WebAssembly.instantiate(binary,info)}).then(receiver,function(reason){err(\"failed to asynchronously prepare wasm: \"+reason);abort(reason)})}function instantiateAsync(){if(!wasmBinary&&typeof WebAssembly.instantiateStreaming===\"function\"&&!isDataURI(wasmBinaryFile)&&!isFileURI(wasmBinaryFile)&&typeof fetch===\"function\"){return fetch(wasmBinaryFile,{credentials:\"same-origin\"}).then(function(response){var result=WebAssembly.instantiateStreaming(response,info);return result.then(receiveInstantiatedSource,function(reason){err(\"wasm streaming compile failed: \"+reason);err(\"falling back to ArrayBuffer instantiation\");return instantiateArrayBuffer(receiveInstantiatedSource)})})}else{return instantiateArrayBuffer(receiveInstantiatedSource)}}if(Module[\"instantiateWasm\"]){try{var exports=Module[\"instantiateWasm\"](info,receiveInstance);return exports}catch(e){err(\"Module.instantiateWasm callback failed with error: \"+e);return false}}instantiateAsync().catch(readyPromiseReject);return{}}var ASM_CONSTS={10520:function(){throw\"Canceled!\"},10538:function($0,$1){setTimeout(function(){__emscripten_do_dispatch_to_thread($0,$1)},0)}};function initPthreadsJS(){PThread.initRuntime()}function callRuntimeCallbacks(callbacks){while(callbacks.length>0){var callback=callbacks.shift();if(typeof

callback==\"function\"){callback(Module);continue}var func=callback.func;if(typeof
func===\"number\"){if(callback.arg===undefined){wasmTable.get(func)()}else{wasmTable.get(func)(callback.arg)
}}else{func(callback.arg===undefined?null:callback.arg)}}}var
ERRNO_CODES={EPERM:63,ENOENT:44,ESRCH:71,EINTR:27,EIO:29,ENXIO:60,E2BIG:1,ENOEXEC:45,E
BADF:8,ECHILD:12,EAGAIN:6,EWOULDBLOCK:6,ENOMEM:48,EACCES:2,EFAULT:21,ENOTBLK:105,EB
USY:10,EEXIST:20,EXDEV:75,ENODEV:43,ENOTDIR:54,EISDIR:31,EINVAL:28,ENFILE:41,EMFILE:33,EN
OTTY:59,ETXTBSY:74,EFBIG:22,ENOSPC:51,ESPIPE:70,EROFS:69,EMLINK:34,EPIPE:64,EDOM:18,ERAN
GE:68,ENOMSG:49,EIDRM:24,ECHRNG:106,EL2NSYNC:156,EL3HLT:107,EL3RST:108,ELNRNG:109,EUNA
TCH:110,ENOCSI:111,EL2HLT:112,EDEADLK:16,ENOLCK:46,EBADE:113,EBADR:114,EXFULL:115,ENOA
NO:104,EBADRQC:103,EBADSLT:102,EDEADLOCK:16,EBFONT:101,ENOSTR:100,ENODATA:116,ETIME:
117,ENOSR:118,ENONET:119,ENOPKG:120,EREMOTE:121,ENOLINK:47,EADV:122,ESRMNT:123,ECOMM
:124,EPROTO:65,EMULTIHOP:36,EDOTDOT:125,EBADMSG:9,ENOTUNIQ:126,EBADFD:127,EREMCHG:1
28,ELIBACC:129,ELIBBAD:130,ELIBSCN:131,ELIBMAX:132,ELIBEXEC:133,ENOSYS:52,ENOTEMPTY:55,
ENAMETOOLONG:37,ELOOP:32,EOPNOTSUPP:138,EPFNOSUPPORT:139,ECONNRESET:15,ENOBUFS:42,
EAFNOSUPPORT:5,EPROTOTYPE:67,ENOTSOCK:57,ENOPROTOOPT:50,ESHUTDOWN:140,ECONNREFU
SED:14,EADDRINUSE:3,ECONNABORTED:13,ENETUNREACH:40,ENETDOWN:38,ETIMEDOUT:73,EHOS
TDOWN:142,EHOSTUNREACH:23,EINPROGRESS:26,EALREADY:7,EDESTADDRREQ:17,EMSGSIZE:35,E
PROTONOSUPPORT:66,ESOCKTNOSUPPORT:137,EADDRNOTAVAIL:4,ENETRESET:39,EISCONN:30,EN
OTCONN:53,ETOOMANYREFS:141,EUSERS:136,EDQUOT:19,ESTALE:72,ENOTSUP:138,ENOMEDIUM:14
8,EILSEQ:25,EOVERFLOW:61,ECANCELED:11,ENOTRECOVERABLE:56,EOWNERDEAD:62,ESTRPIPE:13
5};function
_emscripten_futex_wake(addr,count){if(addr<=0||addr>GROWABLE_HEAP_I8().length||addr&3!=0||count<0)retu
rn-28;if(count==0)return 0;if(count>=2147483647)count=Infinity;var
mainThreadWaitAddress=Atomics.load(GROWABLE_HEAP_I32(),__emscripten_main_thread_futex>>2);var
mainThreadWoken=0;if(mainThreadWaitAddress==addr){var
loadedAddr=Atomics.compareExchange(GROWABLE_HEAP_I32(),__emscripten_main_thread_futex>>2,mainTh
readWaitAddress,0);if(loadedAddr==mainThreadWaitAddress){--count;mainThreadWoken=1;if(count<=0)return
1}}var ret=Atomics.notify(GROWABLE_HEAP_I32(),addr>>2,count);if(ret>=0)return
ret+mainThreadWoken;throw\"Atomics.notify returned an unexpected value
\"+ret}Module[\"_emscripten_futex_wake\"]=_emscripten_futex_wake;function
killThread(pthread_ptr){if(ENVIRONMENT_IS_PTHREAD)throw\"Internal Error! killThread() can only ever be
called from main application thread!\";if(!pthread_ptr)throw\"Internal Error! Null pthread_ptr in
killThread!\";GROWABLE_HEAP_I32()[pthread_ptr+12>>2]=0;var
pthread=PThread.pthreads[pthread_ptr];pthread.worker.terminate();PThread.freeThreadData(pthread);PThread.runni
ngWorkers.splice(PThread.runningWorkers.indexOf(pthread.worker),1);pthread.worker.pthread=undefined}functio
n cancelThread(pthread_ptr){if(ENVIRONMENT_IS_PTHREAD)throw\"Internal Error! cancelThread() can only
ever be called from main application thread!\";if(!pthread_ptr)throw\"Internal Error! Null pthread_ptr in
cancelThread!\";var
pthread=PThread.pthreads[pthread_ptr];pthread.worker.postMessage({\"cmd\":\"cancel\"})}function
cleanupThread(pthread_ptr){if(ENVIRONMENT_IS_PTHREAD)throw\"Internal Error! cleanupThread() can only
ever be called from main application thread!\";if(!pthread_ptr)throw\"Internal Error! Null pthread_ptr in
cleanupThread!\";var
pthread=PThread.pthreads[pthread_ptr];if(pthread){GROWABLE_HEAP_I32()[pthread_ptr+12>>2]=0;var
worker=pthread.worker;PThread.returnWorkerToPool(worker)}}var
PThread={unusedWorkers:[],runningWorkers:[],initMainThreadBlock:function(){var
pthreadPoolSize=8;for(var
i=0;i<pthreadPoolSize;++i){PThread.allocateUnusedWorker()}},initRuntime:function(){var
tb=_malloc(228);for(var

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i=0;i<228/4;++i)GROWABLE_HEAP_U32()[tb/4+i]=0;GROWABLE_HEAP_I32()[tb+12>>2]=tb;var
headPtr=tb+152;GROWABLE_HEAP_I32()[headPtr>>2]=headPtr;var tlsMemory=_malloc(512);for(var
i=0;i<128;++i)GROWABLE_HEAP_U32()[tlsMemory/4+i]=0;Atomics.store(GROWABLE_HEAP_U32(),tb+100
>>2,tlsMemory);Atomics.store(GROWABLE_HEAP_U32(),tb+40>>2,tb);__emscripten_thread_init(tb,!ENVIRON
MENT_IS_WORKER,1);_emscripten_register_main_browser_thread_id(tb)},initWorker:function(){},pthreads:{},t
hreadExitHandlers:[],setThreadStatus:function(){},runExitHandlers:function(){while(PThread.threadExitHandlers.l
ength>0){PThread.threadExitHandlers.pop()()}if(ENVIRONMENT_IS_PTHREAD&&_pthread_self())___pthread
_tsd_run_dtors()},runExitHandlersAndDeinitThread:function(tb,exitCode){Atomics.store(GROWABLE_HEAP_U
32(),tb+56>>2,1);Atomics.store(GROWABLE_HEAP_U32(),tb+60>>2,0);PThread.runExitHandlers();Atomics.stor
e(GROWABLE_HEAP_U32(),tb+4>>2,exitCode);Atomics.store(GROWABLE_HEAP_U32(),tb+0>>2,1);_emscri
pten_futex_wake(tb+0,2147483647);__emscripten_thread_init(0,0,0)},threadExit:function(exitCode){var
tb=_pthread_self();if(tb){PThread.runExitHandlersAndDeinitThread(tb,exitCode);if(ENVIRONMENT_IS_PTHRE
AD){postMessage({\"cmd\":\"exit\"})}}},threadCancel:function(){PThread.runExitHandlersAndDeinitThread(_pthr
ead_self(),-1);postMessage({\"cmd\":\"cancelDone\"})},terminateAllThreads:function(){for(var t in
PThread.pthreads){var
pthread=PThread.pthreads[t];if(pthread&&pthread.worker){PThread.returnWorkerToPool(pthread.worker)}}PThre
ad.pthreads={};for(var i=0;i<PThread.unusedWorkers.length;++i){var
worker=PThread.unusedWorkers[i];worker.terminate()}PThread.unusedWorkers=[];for(var
i=0;i<PThread.runningWorkers.length;++i){var worker=PThread.runningWorkers[i];var
pthread=worker.pthread;PThread.freeThreadData(pthread);worker.terminate()}PThread.runningWorkers=[]},freeTh
readData:function(pthread){if(!pthread)return;if(pthread.threadInfoStruct){var
tlsMemory=GROWABLE_HEAP_I32()[pthread.threadInfoStruct+100>>2];GROWABLE_HEAP_I32()[pthread.thr
eadInfoStruct+100>>2]=0;_free(tlsMemory);_free(pthread.threadInfoStruct)}pthread.threadInfoStruct=0;if(pthread.
allocatedOwnStack&&pthread.stackBase)_free(pthread.stackBase);pthread.stackBase=0;if(pthread.worker)pthread.
worker.pthread=null},returnWorkerToPool:function(worker){PThread.runWithoutMainThreadQueuedCalls(functio
n(){delete
PThread.pthreads[worker.pthread.threadInfoStruct];PThread.unusedWorkers.push(worker);PThread.runningWorker
s.splice(PThread.runningWorkers.indexOf(worker),1);PThread.freeThreadData(worker.pthread);worker.pthread=un
defined})},runWithoutMainThreadQueuedCalls:function(func){GROWABLE_HEAP_I32()[__emscripten_allow_m
ain_runtime_queued_calls>>2]=0;try{func()}finally{GROWABLE_HEAP_I32()[__emscripten_allow_main_runti
me_queued_calls>>2]=1}},receiveObjectTransfer:function(data){},loadWasmModuleToWorker:function(worker,o
nFinishedLoading){worker.onmessage=function(e){var
 d=e[\"data\"];var
cmd=d[\"cmd\"];if(worker.pthread)PThread.currentProxiedOperationCallerThread=worker.pthread.threadInfoStruct;
if(d[\"targetThread\"]&&d[\"targetThread\"]!=_pthread_self()){var
thread=PThread.pthreads[d.targetThread];if(thread){thread.worker.postMessage(e.data,d[\"transferList\"])}else{con
sole.error('Internal error! Worker sent a message \"'+cmd+'\" to target pthread '+d[\"targetThread\"]+\", but that
thread no longer
exists!\")}PThread.currentProxiedOperationCallerThread=undefined;return}if(cmd===\"processQueuedMainThread
Work\"){_emscripten_main_thread_process_queued_calls()}else
if(cmd===\"spawnThread\"){spawnThread(e.data)}else
if(cmd===\"cleanupThread\"){cleanupThread(d[\"thread\"])}else
if(cmd===\"killThread\"){killThread(d[\"thread\"])}else
if(cmd===\"cancelThread\"){cancelThread(d[\"thread\"])}else
if(cmd===\"loaded\"){worker.loaded=true;if(onFinishedLoading)onFinishedLoading(worker);if(worker.runPthread)
{worker.runPthread();delete
 worker.runPthread}}else if(cmd===\"print\"){out(\"Thread \"+d[\"threadId\"]+\": \"+d[\"text\"])}else
if(cmd===\"printErr\"){err(\"Thread \"+d[\"threadId\"]+\": \"+d[\"text\"])}else if(cmd===\"alert\"){alert(\"Thread
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\"+d[\"threadId\"]+\": \"+d[\"text\"])}else if(cmd===\"exit\"){var
detached=worker.pthread&&Atomics.load(GROWABLE_HEAP_U32(),worker.pthread.threadInfoStruct+64>>2);if
(detached){PThread.returnWorkerToPool(worker)}}else
if(cmd===\"exitProcess\"){try{exit(d[\"returnCode\"])}catch(e){if(e instanceof ExitStatus)return;throw e}}else
if(cmd===\"cancelDone\"){PThread.returnWorkerToPool(worker)}else
if(cmd===\"objectTransfer\"){PThread.receiveObjectTransfer(e.data)}else
if(e.data.target===\"setimmediate\"){worker.postMessage(e.data)}else{err(\"worker sent an unknown command
\"+cmd)}PThread.currentProxiedOperationCallerThread=undefined};worker.onerror=function(e){err(\"pthread sent
an error! \"+e.filename+\":\"+e.lineno+\":
\"+e.message)};if(ENVIRONMENT_IS_NODE){worker.on(\"message\",function(data){worker.onmessage({data:d
ata})});worker.on(\"error\",function(data){worker.onerror(data)});worker.on(\"exit\",function(data){})}worker.post
Message({\"cmd\":\"load\",\"urlOrBlob\":Module[\"mainScriptUrlOrBlob\"]||_scriptDir,\"wasmMemory\":wasmMe
mory,\"wasmModule\":wasmModule})},allocateUnusedWorker:function(){var
pthreadMainJs=locateFile(\"tfjs-backend-wasm-threaded-simd.worker.js\");PThread.unusedWorkers.push(new
Worker(pthreadMainJs))},getNewWorker:function(){if(PThread.unusedWorkers.length==0){PThread.allocateUnus
edWorker();PThread.loadWasmModuleToWorker(PThread.unusedWorkers[0])}if(PThread.unusedWorkers.length>
0)return PThread.unusedWorkers.pop();else return null},busySpinWait:function(msecs){var
t=performance.now()+msecs;while(performance.now()<t){}}};function
establishStackSpace(stackTop,stackMax){_emscripten_stack_set_limits(stackTop,stackMax);stackRestore(stackTop
)}Module[\"establishStackSpace\"]=establishStackSpace;function
getNoExitRuntime(){return noExitRuntime}Module[\"getNoExitRuntime\"]=getNoExitRuntime;function
invokeEntryPoint(ptr,arg){return
wasmTable.get(ptr)(arg)}Module[\"invokeEntryPoint\"]=invokeEntryPoint;function
___assert_fail(condition,filename,line,func){abort(\"Assertion failed: \"+UTF8ToString(condition)+\", at:
\"+[filename?UTF8ToString(filename):\"unknown filename\",line,func?UTF8ToString(func):\"unknown
function\"])}function ___call_main(argc,argv){var returnCode=_main(argc,argv)}var
_emscripten_get_now;if(ENVIRONMENT_IS_NODE){_emscripten_get_now=function(){var
t=process[\"hrtime\"]();return t[0]*1e3+t[1]/1e6}}else
if(ENVIRONMENT_IS_PTHREAD){_emscripten_get_now=function(){return performance.now()-
Module[\"__performance_now_clock_drift\"]}}else if(typeof
dateNow!==\"undefined\"){_emscripten_get_now=dateNow}else _emscripten_get_now=function(){return
performance.now()};function setErrNo(value){GROWABLE_HEAP_I32()[___errno_location()>>2]=value;return
value}function _atexit(func,arg){if(ENVIRONMENT_IS_PTHREAD)return
_emscripten_proxy_to_main_thread_js(1,1,func,arg)}function
__emscripten_notify_thread_queue(targetThreadId,mainThreadId){if(targetThreadId==mainThreadId){postMessag
e({\"cmd\":\"processQueuedMainThreadWork\"})}else
if(ENVIRONMENT_IS_PTHREAD){postMessage({\"targetThread\":targetThreadId,\"cmd\":\"processThreadQueu
e\"})}else{var pthread=PThread.pthreads[targetThreadId];var
worker=pthread&&pthread.worker;if(!worker){return}worker.postMessage({\"cmd\":\"processThreadQueue\"})}ret
urn 1}function _abort(){abort()}function _emscripten_asm_const_int(code,sigPtr,argbuf){var
args=readAsmConstArgs(sigPtr,argbuf);return ASM_CONSTS[code].apply(null,args)}function
_emscripten_conditional_set_current_thread_status(expectedStatus,newStatus){}function
_emscripten_futex_wait(addr,val,timeout){if(addr<=0||addr>GROWABLE_HEAP_I8().length||addr&3!=0)return-
28;if(!ENVIRONMENT_IS_WEB){var
ret=Atomics.wait(GROWABLE_HEAP_I32(),addr>>2,val,timeout);if(ret===\"timed-out\")return-
73;if(ret===\"not-equal\")return-6;if(ret===\"ok\")return
0;throw\"Atomics.wait returned an unexpected value
\"+ret}else{if(Atomics.load(GROWABLE_HEAP_I32(),addr>>2)!=val){return-6}var

tNow=performance.now();var tEnd=tNow+timeout;var
lastAddr=Atomics.exchange(GROWABLE_HEAP_I32(),__emscripten_main_thread_futex>>2,addr);while(1){tNo
w=performance.now();if(tNow>tEnd){lastAddr=Atomics.exchange(GROWABLE_HEAP_I32(),__emscripten_mai
n_thread_futex>>2,0);return-
73}lastAddr=Atomics.exchange(GROWABLE_HEAP_I32(),__emscripten_main_thread_futex>>2,0);if(lastAddr==
0){break}_emscripten_main_thread_process_queued_calls();if(Atomics.load(GROWABLE_HEAP_I32(),addr>>2)!
=val){return-
6}lastAddr=Atomics.exchange(GROWABLE_HEAP_I32(),__emscripten_main_thread_futex>>2,addr)}return
0}}function
_emscripten_memcpy_big(dest,src,num){GROWABLE_HEAP_U8().copyWithin(dest,src,src+num)}function
_emscripten_num_logical_cores(){if(ENVIRONMENT_IS_NODE)return require(\"os\").cpus().length;return
navigator[\"hardwareConcurrency\"]}function
_emscripten_proxy_to_main_thread_js(index,sync){var numCallArgs=arguments.length-2;var
stack=stackSave();var serializedNumCallArgs=numCallArgs;var args=stackAlloc(serializedNumCallArgs*8);var
b=args>>3;for(var i=0;i<numCallArgs;i++){var arg=arguments[2+i];GROWABLE_HEAP_F64()[b+i]=arg}var
ret=_emscripten_run_in_main_runtime_thread_js(index,serializedNumCallArgs,args,sync);stackRestore(stack);retur
n ret}var _emscripten_receive_on_main_thread_js_callArgs=[];var readAsmConstArgsArray=[];function
readAsmConstArgs(sigPtr,buf){readAsmConstArgsArray.length=0;var
ch;buf>>=2;while(ch=GROWABLE_HEAP_U8()[sigPtr++]){var
double=ch<105;if(double&&buf&1)buf++;readAsmConstArgsArray.push(double?GROWABLE_HEAP_F64()[buf
++>>1]:GROWABLE_HEAP_I32()[buf]);++buf}return readAsmConstArgsArray}function
_emscripten_receive_on_main_thread_js(index,numCallArgs,args){_emscripten_receive_on_main_thread_js_callA
rgs.length=numCallArgs;var b=args>>3;for(var
i=0;i<numCallArgs;i++){_emscripten_receive_on_main_thread_js_callArgs[i]=GROWABLE_HEAP_F64()[b+i]}v
ar
isEmAsmConst=index<0;var func=!isEmAsmConst?proxiedFunctionTable[index]:ASM_CONSTS[-index-
1];return func.apply(null,_emscripten_receive_on_main_thread_js_callArgs)}function
_emscripten_get_heap_size(){return GROWABLE_HEAP_U8().length}function
emscripten_realloc_buffer(size){try{wasmMemory.grow(size-
buffer.byteLength+65535>>>16);updateGlobalBufferAndViews(wasmMemory.buffer);return
1}catch(e){}}function _emscripten_resize_heap(requestedSize){var
oldSize=_emscripten_get_heap_size();if(requestedSize<=oldSize){return false}var
maxHeapSize=2147483648;if(requestedSize>maxHeapSize){return false}for(var
cutDown=1;cutDown<=4;cutDown*=2){var
overGrownHeapSize=oldSize*(1+.2/cutDown);overGrownHeapSize=Math.min(overGrownHeapSize,requestedSize
+100663296);var
newSize=Math.min(maxHeapSize,alignUp(Math.max(requestedSize,overGrownHeapSize),65536));var
replacement=emscripten_realloc_buffer(newSize);if(replacement){return true}}return false}var
JSEvents={inEventHandler:0,removeAllEventListeners:function(){for(var
i=JSEvents.eventHandlers.length-1;i>=0;--
i){JSEvents._removeHandler(i)}JSEvents.eventHandlers=[];JSEvents.deferredCalls=[]},registerRemoveEventListen
ers:function(){if(!JSEvents.removeEventListenersRegistered){__ATEXIT__.push(JSEvents.removeAllEventListene
rs);JSEvents.removeEventListenersRegistered=true}},deferredCalls:[],deferCall:function(targetFunction,precedence
,argsList){function arraysHaveEqualContent(arrA,arrB){if(arrA.length!=arrB.length)return false;for(var i in
arrA){if(arrA[i]!=arrB[i])return false}return true}for(var i in JSEvents.deferredCalls){var
call=JSEvents.deferredCalls[i];if(call.targetFunction==targetFunction&&arraysHaveEqualContent(call.argsList,args
List)){return}}JSEvents.deferredCalls.push({targetFunction:targetFunction,precedence:precedence,argsList:argsList
});JSEvents.deferredCalls.sort(function(x,y){return

x.precedence<y.precedence})},removeDeferredCalls:function(targetFunction){for(var i=0;i<JSEvents.deferredCalls.length;++i){if(JSEvents.deferredCalls[i].targetFunction==targetFunction){JSEvents.deferredCalls.splice(i,1);--i}}},canPerformEventHandlerRequests:function(){return JSEvents.inEventHandler&&JSEvents.currentEventHandler.allowsDeferredCalls},runDeferredCalls:function(){if(!JSEvents.canPerformEventHandlerRequests()){return}for(var i=0;i<JSEvents.deferredCalls.length;++i){var call=JSEvents.deferredCalls[i];JSEvents.deferredCalls.splice(i,1);--i;call.targetFunction.apply(null,call.argsList)}},eventHandlers:[],removeAllHandlersOnTarget:function(target,eventTypeString){for(var i=0;i<JSEvents.eventHandlers.length;++i){if(JSEvents.eventHandlers[i].target==target&&(!eventTypeString||eventTypeString==JSEvents.eventHandlers[i].eventTypeString)){JSEvents._removeHandler(i--)}}},_removeHandler:function(i){var h=JSEvents.eventHandlers[i];h.target.removeEventListener(h.eventTypeString,h.eventListenerFunc,h.useCapture);JSEvents.eventHandlers.splice(i,1)},registerOrRemoveHandler:function(eventHandler){var jsEventHandler=function jsEventHandler(event){++JSEvents.inEventHandler;JSEvents.currentEventHandler=eventHandler;JSEvents.runDeferredCalls();eventHandler.handlerFunc(event);JSEvents.runDeferredCalls();--JSEvents.inEventHandler};if(eventHandler.callbackfunc){eventHandler.eventListenerFunc=jsEventHandler;eventHandler.target.addEventListener(eventHandler.eventTypeString,jsEventHandler,eventHandler.useCapture);JSEvents.eventHandlers.push(eventHandler);JSEvents.registerRemoveEventListeners()}else{for(var i=0;i<JSEvents.eventHandlers.length;++i){if(JSEvents.eventHandlers[i].target==eventHandler.target&&JSEvents.eventHandlers[i].eventTypeString==eventHandler.eventTypeString){JSEvents._removeHandler(i--)}}}},queueEventHandlerOnThread_iiii:function(targetThread,eventHandlerFunc,eventTypeId,eventData,userData){var stackTop=stackSave();var varargs=stackAlloc(12);GROWABLE_HEAP_I32()[varargs>>2]=eventTypeId;GROWABLE_HEAP_I32()[varargs+4>>2]=eventData;GROWABLE_HEAP_I32()[varargs+8>>2]=userData;__emscripten_call_on_thread(0,targetThread,637534208,eventHandlerFunc,eventData,varargs);stackRestore(stackTop)},getTargetThreadForEventCallback:function(targetThread){switch(targetThread){case 1:return 0;case 2:return PThread.currentProxiedOperationCallerThread;default:return targetThread}},getNodeNameForTarget:function(target){if(!target)return\"\";if(target==window)return\"#window\";if(target==screen)return\"#screen\";return target&&target.nodeName?target.nodeName:\"\"},fullscreenEnabled:function(){return document.fullscreenEnabled||document.webkitFullscreenEnabled}};function stringToNewUTF8(jsString){var length=lengthBytesUTF8(jsString)+1;var cString=_malloc(length);stringToUTF8(jsString,cString,length);return cString}function _emscripten_set_offscreencanvas_size_on_target_thread_js(targetThread,targetCanvas,width,height){var stackTop=stackSave();var varargs=stackAlloc(12);var targetCanvasPtr=0;if(targetCanvas){targetCanvasPtr=stringToNewUTF8(targetCanvas)}GROWABLE_HEAP_I32()[varargs>>2]=targetCanvasPtr;GROWABLE_HEAP_I32()[varargs+4>>2]=width;GROWABLE_HEAP_I32()[varargs+8>>2]=height;__emscripten_call_on_thread(0,targetThread,657457152,0,targetCanvasPtr,varargs);stackRestore(stackTop)}function _emscripten_set_offscreencanvas_size_on_target_thread(targetThread,targetCanvas,width,height){targetCanvas=targetCanvas?UTF8ToString(targetCanvas):\"\";_emscripten_set_offscreencanvas_size_on_target_thread_js(targetThread,targetCanvas,width,height)}function maybeCStringToJsString(cString){return cString>2?UTF8ToString(cString):cString}var specialHTMLTargets=[0,typeof document!==\"undefined\"?document:0,typeof window!==\"undefined\"?window:0];function findEventTarget(target){target=maybeCStringToJsString(target);var domElement=specialHTMLTargets[target]||(typeof document!==\"undefined\"?document.querySelector(target):undefined);return domElement}function

findCanvasEventTarget(target){return findEventTarget(target)}function
_emscripten_set_canvas_element_size_calling_thread(target,width,height){var
canvas=findCanvasEventTarget(target);if(!canvas)return-
4;if(canvas.canvasSharedPtr){GROWABLE_HEAP_I32()[canvas.canvasSharedPtr>>2]=width;GROWABLE_HEAP_I32()[canvas.canvasSharedPtr+4>>2]=height}if(canvas.offscreenCanvas||!canvas.controlTransferredOffscreen){if(canvas.offscreenCanvas)canvas=canvas.offscreenCanvas;var
autoResizeViewport=false;if(canvas.GLctxObject&&canvas.GLctxObject.GLctx){var
prevViewport=canvas.GLctxObject.GLctx.getParameter(2978);autoResizeViewport=prevViewport[0]===0&&prevViewport[1]===0&&prevViewport[2]===canvas.width&&prevViewport[3]===canvas.height}canvas.width=width;canvas.height=height;if(autoResizeViewport){canvas.GLctxObject.GLctx.viewport(0,0,width,height)}}else
if(canvas.canvasSharedPtr){var
targetThread=GROWABLE_HEAP_I32()[canvas.canvasSharedPtr+8>>2];_emscripten_set_offscreencanvas_size_on_target_thread(targetThread,target,width,height);return 1}else{return-4}return 0}function
_emscripten_set_canvas_element_size_main_thread(target,width,height){if(ENVIRONMENT_IS_PTHREAD)return
_emscripten_proxy_to_main_thread_js(2,1,target,width,height);return
_emscripten_set_canvas_element_size_calling_thread(target,width,height)}function
_emscripten_set_canvas_element_size(target,width,height){var
canvas=findCanvasEventTarget(target);if(canvas){return
_emscripten_set_canvas_element_size_calling_thread(target,width,height)}else{return
_emscripten_set_canvas_element_size_main_thread(target,width,height)}}function
_emscripten_set_current_thread_status(newStatus){}function
_emscripten_set_thread_name(threadId,name){}function __webgl_enable_ANGLE_instanced_arrays(ctx){var
ext=ctx.getExtension(\"ANGLE_instanced_arrays\");if(ext){ctx[\"vertexAttribDivisor\"]=function(index,divisor){ext[\"vertexAttribDivisorANGLE\"](index,divisor)};ctx[\"drawArraysInstanced\"]=function(mode,first,count,primcount){ext[\"drawArraysInstancedANGLE\"](mode,first,count,primcount)};ctx[\"drawElementsInstanced\"]=function(mode,count,type,indices,primcount){ext[\"drawElementsInstancedANGLE\"](mode,count,type,indices,primcount)};return
1}}function __webgl_enable_OES_vertex_array_object(ctx){var
ext=ctx.getExtension(\"OES_vertex_array_object\");if(ext){ctx[\"createVertexArray\"]=function(){return
ext[\"createVertexArrayOES\"]()};ctx[\"deleteVertexArray\"]=function(vao){ext[\"deleteVertexArrayOES\"](vao)};ctx[\"bindVertexArray\"]=function(vao){ext[\"bindVertexArrayOES\"](vao)};ctx[\"isVertexArray\"]=function(vao){return ext[\"isVertexArrayOES\"](vao)};return 1}}function __webgl_enable_WEBGL_draw_buffers(ctx){var
ext=ctx.getExtension(\"WEBGL_draw_buffers\");if(ext){ctx[\"drawBuffers\"]=function(n,bufs){ext[\"drawBuffersWEBGL\"](n,bufs)};return 1}}function
__webgl_enable_WEBGL_multi_draw(ctx){return!!(ctx.multiDrawWebgl=ctx.getExtension(\"WEBGL_multi_draw\"))}var
GL={counter:1,buffers:[],programs:[],framebuffers:[],renderbuffers:[],textures:[],uniforms:[],shaders:[],vaos:[],contexts:{},offscreenCanvases:{},timerQueriesEXT:[],programInfos:{},stringCache:{},unpackAlignment:4,recordError:function
recordError(errorCode){if(!GL.lastError){GL.lastError=errorCode}},getNewId:function(table){var
ret=GL.counter++;for(var i=table.length;i<ret;i++){table[i]=null}return
ret},getSource:function(shader,count,string,length){var source=\"\";for(var i=0;i<count;++i){var
len=length?GROWABLE_HEAP_I32()[length+i*4>>2]:-
1;source+=UTF8ToString(GROWABLE_HEAP_I32()[string+i*4>>2],len<0?undefined:len)}return
source},createContext:function(canvas,webGLContextAttributes){var
ctx=canvas.getContext(\"webgl\",webGLContextAttributes);if(!ctx)return 0;var
handle=GL.registerContext(ctx,webGLContextAttributes);return

handle},registerContext:function(ctx,webGLContextAttributes){var
handle=_malloc(8);GROWABLE_HEAP_I32()[handle+4>>2]=_pthread_self();var
context={handle:handle,attributes:webGLContextAttributes,version:webGLContextAttributes.majorVersion,GLctx:
ctx};if(ctx.canvas)ctx.canvas.GLctxObject=context;GL.contexts[handle]=context;if(typeof
webGLContextAttributes.enableExtensionsByDefault===\"undefined\"||webGLContextAttributes.enableExtensions
ByDefault){GL.initExtensions(context)}return
handle},makeContextCurrent:function(contextHandle){GL.currentContext=GL.contexts[contextHandle];Module.ctx
=GLctx=GL.currentContext&&GL.currentContext.GLctx;return!(contextHandle&&!GLctx)},getContext:function(c
ontextHandle){return
GL.contexts[contextHandle]},deleteContext:function(contextHandle){if(GL.currentContext===GL.contexts[context
Handle])GL.currentContext=null;if(typeof
JSEvents===\"object\")JSEvents.removeAllHandlersOnTarget(GL.contexts[contextHandle].GLctx.canvas);if(GL.co
ntexts[contextHandle]&&GL.contexts[contextHandle].GLctx.canvas)GL.contexts[contextHandle].GLctx.canvas.GL
ctxObject=undefined;_free(GL.contexts[contextHandle].handle);GL.contexts[contextHandle]=null},initExtensions:f
unction(context){if(!context)context=GL.currentContext;if(context.initExtensionsDone)return;context.initExtension
sDone=true;var
GLctx=context.GLctx;__webgl_enable_ANGLE_instanced_arrays(GLctx);__webgl_enable_OES_vertex_array_obj
ect(GLctx);__webgl_enable_WEBGL_draw_buffers(GLctx);GLctx.disjointTimerQueryExt=GLctx.getExtension(\"
EXT_disjoint_timer_query\");__webgl_enable_WEBGL_multi_draw(GLctx);var
exts=GLctx.getSupportedExtensions()||[];exts.forEach(function(ext){if(ext.indexOf(\"lose_context\")<0&&ext.inde
xOf(\"debug\")<0){GLctx.getExtension(ext)}})},populateUniformTable:function(program){var
p=GL.programs[program];var
ptable=GL.programInfos[program]={uniforms:{},maxUniformLength:0,maxAttributeLength:-
1,maxUniformBlockNameLength:-1};var utable=ptable.uniforms;var
numUniforms=GLctx.getProgramParameter(p,35718);for(var i=0;i<numUniforms;++i){var
u=GLctx.getActiveUniform(p,i);var
name=u.name;ptable.maxUniformLength=Math.max(ptable.maxUniformLength,name.length+1);if(name.slice(-
1)==\"]\"){name=name.slice(0,name.lastIndexOf(\"[\"))}var loc=GLctx.getUniformLocation(p,name);if(loc){var
id=GL.getNewId(GL.uniforms);utable[name]=[u.size,id];GL.uniforms[id]=loc;for(var
j=1;j<u.size;++j){var
n=name+\"[\"+j+\"]\";loc=GLctx.getUniformLocation(p,n);id=GL.getNewId(GL.uniforms);GL.uniforms[id]=loc}}
}};var __emscripten_webgl_power_preferences=[\"default\",\"low-power\",\"high-performance\"];function
_emscripten_webgl_do_create_context(target,attributes){var a=attributes>>2;var
powerPreference=GROWABLE_HEAP_I32()[a+(24>>2)];var
contextAttributes={\"alpha\":!!GROWABLE_HEAP_I32()[a+(0>>2)],\"depth\":!!GROWABLE_HEAP_I32()[a+(4
>>2)],\"stencil\":!!GROWABLE_HEAP_I32()[a+(8>>2)],\"antialias\":!!GROWABLE_HEAP_I32()[a+(12>>2)],\"p
remultipliedAlpha\":!!GROWABLE_HEAP_I32()[a+(16>>2)],\"preserveDrawingBuffer\":!!GROWABLE_HEAP_
I32()[a+(20>>2)],\"powerPreference\":__emscripten_webgl_power_preferences[powerPreference],\"failIfMajorPerf
ormanceCaveat\":!!GROWABLE_HEAP_I32()[a+(28>>2)],majorVersion:GROWABLE_HEAP_I32()[a+(32>>2)],
minorVersion:GROWABLE_HEAP_I32()[a+(36>>2)],enableExtensionsByDefault:GROWABLE_HEAP_I32()[a+(
40>>2)],explicitSwapControl:GROWABLE_HEAP_I32()[a+(44>>2)],proxyContextToMainThread:GROWABLE_
HEAP_I32()[a+(48>>2)],renderViaOffscreenBackBuffer:GROWABLE_HEAP_I32()[a+(52>>2)]};var
canvas=findCanvasEventTarget(target);if(!canvas){return 0}if(contextAttributes.explicitSwapControl){return
0}var contextHandle=GL.createContext(canvas,contextAttributes);return contextHandle}function
_emscripten_webgl_create_context(a0,a1){return _emscripten_webgl_do_create_context(a0,a1)}var
SYSCALLS={mappings:{},buffers:[null,[],[]],printChar:function(stream,curr){var
buffer=SYSCALLS.buffers[stream];if(curr===0||curr===10){(stream===1?out:err)(UTF8ArrayToString(buffer,0));
buffer.length=0}else{buffer.push(curr)}},varargs:undefined,get:function(){SYSCALLS.varargs+=4;var

ret=GROWABLE_HEAP_I32()[SYSCALLS.varargs-4>>2];return ret},getStr:function(ptr){var ret=UTF8ToString(ptr);return ret},get64:function(low,high){return low}};function _fd_close(fd){if(ENVIRONMENT_IS_PTHREAD)return _emscripten_proxy_to_main_thread_js(3,1,fd);return 0}function _fd_seek(fd,offset_low,offset_high,whence,newOffset){if(ENVIRONMENT_IS_PTHREAD)return _emscripten_proxy_to_main_thread_js(4,1,fd,offset_low,offset_high,whence,newOffset)}function _fd_write(fd,iov,iovcnt,pnum){if(ENVIRONMENT_IS_PTHREAD)return _emscripten_proxy_to_main_thread_js(5,1,fd,iov,iovcnt,pnum);var num=0;for(var i=0;i<iovcnt;i++){var ptr=GROWABLE_HEAP_I32()[iov+i*8>>2];var len=GROWABLE_HEAP_I32()[iov+(i*8+4)>>2];for(var j=0;j<len;j++){SYSCALLS.printChar(fd,GROWABLE_HEAP_U8()[ptr+j])}num+=len}GROWABLE_HEAP_I32()[pnum>>2]=num;return 0}function _pthread_cleanup_pop(execute){var routine=PThread.threadExitHandlers.pop();if(execute)routine()}function _pthread_cleanup_push(routine,arg){PThread.threadExitHandlers.push(function(){wasmTable.get(routine)(arg)})}function spawnThread(threadParams){if(ENVIRONMENT_IS_PTHREAD)throw\"Internal Error! spawnThread() can only ever be called from main application thread!\";var worker=PThread.getNewWorker();if(worker.pthread!==undefined)throw\"Internal error!\";if(!threadParams.pthread_ptr)throw\"Internal error, no pthread ptr!\";PThread.runningWorkers.push(worker);var tlsMemory=_malloc(128*4);for(var i=0;i<128;++i){GROWABLE_HEAP_I32()[tlsMemory+i*4>>2]=0}var stackHigh=threadParams.stackBase+threadParams.stackSize;var pthread=PThread.pthreads[threadParams.pthread_ptr]={worker:worker,stackBase:threadParams.stackBase,stackSize:threadParams.stackSize,allocatedOwnStack:threadParams.allocatedOwnStack,threadInfoStruct:threadParams.pthread_ptr};var tis=pthread.threadInfoStruct>>2;Atomics.store(GROWABLE_HEAP_U32(),tis+(64>>2),threadParams.detached);Atomics.store(GROWABLE_HEAP_U32(),tis+(100>>2),tlsMemory);Atomics.store(GROWABLE_HEAP_U32(),tis+(40>>2),pthread.threadInfoStruct);Atomics.store(GROWABLE_HEAP_U32(),tis+(80>>2),threadParams.stackSize);Atomics.store(GROWABLE_HEAP_U32(),tis+(76>>2),stackHigh);Atomics.store(GROWABLE_HEAP_U32(),tis+(104>>2),threadParams.stackSize);Atomics.store(GROWABLE_HEAP_U32(),tis+(104+8>>2),stackHigh);Atomics.store(GROWABLE_HEAP_U32(),tis+(104+12>>2),threadParams.detached);var global_libc=_emscripten_get_global_libc();var global_locale=global_libc+40;Atomics.store(GROWABLE_HEAP_U32(),tis+(172>>2),global_locale);worker.pthread=pthread;var msg={\"cmd\":\"run\",\"start_routine\":threadParams.startRoutine,\"arg\":threadParams.arg,\"threadInfoStruct\":threadParams.pthread_ptr,\"stackBase\":threadParams.stackBase,\"stackSize\":threadParams.stackSize};worker.runPthread=function(){msg.time=performance.now();worker.postMessage(msg,threadParams.transferList)};if(worker.loaded){worker.runPthread();delete worker.runPthread}}function _pthread_create(pthread_ptr,attr,start_routine,arg){if(typeof SharedArrayBuffer===\"undefined\"){err(\"Current environment does not support SharedArrayBuffer, pthreads are not available!\");return 6}if(!pthread_ptr){err(\"pthread_create called with a null thread pointer!\");return 28}var transferList=[];var error=0;if(ENVIRONMENT_IS_PTHREAD&&(transferList.length===0||error)){return _emscripten_sync_run_in_main_thread_4(687865856,pthread_ptr,attr,start_routine,arg)}if(error)return error;var stackSize=0;var stackBase=0;var detached=0;if(attr&&attr!=-1){stackSize=GROWABLE_HEAP_I32()[attr>>2];stackSize+=81920;stackBase=GROWABLE_HEAP_I32()[attr+8>>2];detached=GROWABLE_HEAP_I32()[attr+12>>2]!==0}else{stackSize=2097152}var allocatedOwnStack=stackBase==0;if(allocatedOwnStack){stackBase=_memalign(16,stackSize)}else{stackBase-=stackSize;assert(stackBase>0)}var threadInfoStruct=_malloc(228);for(var i=0;i<228>>2;++i)GROWABLE_HEAP_U32()[(threadInfoStruct>>2)+i]=0;GROWABLE_HEAP_I32()[pthread_ptr>>2]=threadInfoStruct;GROWABLE_HEAP_I32()[threadInfoStruct+12>>2]=threadInfoStruct;var headPtr=threadInfoStruct+152;GROWABLE_HEAP_I32()[headPtr>>2]=headPtr;var

threadParams={stackBase:stackBase,stackSize:stackSize,allocatedOwnStack:allocatedOwnStack,detached:detached
,startRoutine:start_routine,pthread_ptr:threadInfoStruct,arg:arg,transferList:transferList};if(ENVIRONMENT_IS_P
THREAD){threadParams.cmd=\"spawnThread\";postMessage(threadParams,transferList)}else{spawnThread(thread
Params)}return
0}function __pthread_testcancel_js(){if(!ENVIRONMENT_IS_PTHREAD)return;var
tb=_pthread_self();if(!tb)return;var
cancelDisabled=Atomics.load(GROWABLE_HEAP_U32(),tb+56>>2);if(cancelDisabled)return;var
canceled=Atomics.load(GROWABLE_HEAP_U32(),tb+0>>2);if(canceled==2)throw\"Canceled!\"}function
_emscripten_check_blocking_allowed(){if(ENVIRONMENT_IS_NODE)return;if(ENVIRONMENT_IS_WORKE
R)return;warnOnce(\"Blocking on the main thread is very dangerous, see
https://emscripten.org/docs/porting/pthreads.html#blocking-on-the-main-browser-thread\")}function
__emscripten_do_pthread_join(thread,status,block){if(!thread){err(\"pthread_join attempted on a null thread
pointer!\");return
ERRNO_CODES.ESRCH}if(ENVIRONMENT_IS_PTHREAD&&_pthread_self()==thread){err(\"PThread
\"+thread+\" is attempting to join to itself!\");return ERRNO_CODES.EDEADLK}else
if(!ENVIRONMENT_IS_PTHREAD&&_emscripten_main_browser_thread_id()==thread){err(\"Main
thread \"+thread+\" is attempting to join to itself!\");return ERRNO_CODES.EDEADLK}var
self=GROWABLE_HEAP_I32()[thread+12>>2];if(self!==thread){err(\"pthread_join attempted on thread
\"+thread+\", which does not point to a valid thread, or does not exist anymore!\");return
ERRNO_CODES.ESRCH}var
detached=Atomics.load(GROWABLE_HEAP_U32(),thread+64>>2);if(detached){err(\"Attempted to join thread
\"+thread+\", which was already detached!\");return
ERRNO_CODES.EINVAL}if(block){_emscripten_check_blocking_allowed()}for(;;){var
threadStatus=Atomics.load(GROWABLE_HEAP_U32(),thread+0>>2);if(threadStatus==1){var
threadExitCode=Atomics.load(GROWABLE_HEAP_U32(),thread+4>>2);if(status)GROWABLE_HEAP_I32()[sta
tus>>2]=threadExitCode;Atomics.store(GROWABLE_HEAP_U32(),thread+64>>2,1);if(!ENVIRONMENT_IS_PT
HREAD)cleanupThread(thread);else postMessage({\"cmd\":\"cleanupThread\",\"thread\":thread});return
0}if(!block){return
ERRNO_CODES.EBUSY}__pthread_testcancel_js();if(!ENVIRONMENT_IS_PTHREAD)_emscripten_main_thre
ad_process_queued_calls();_emscripten_futex_wait(thread+0,threadStatus,ENVIRONMENT_IS_PTHREAD?100:1
)}}function
_pthread_join(thread,status){return __emscripten_do_pthread_join(thread,status,true)}function
_sysconf(name){if(ENVIRONMENT_IS_PTHREAD)return
_emscripten_proxy_to_main_thread_js(6,1,name);switch(name){case 30:return 16384;case 85:var
maxHeapSize=2147483648;return maxHeapSize/16384;case 132:case 133:case 12:case 137:case 138:case 15:case
235:case 16:case 17:case 18:case 19:case 20:case 149:case 13:case 10:case 236:case 153:case 9:case 21:case 22:case
159:case 154:case 14:case 77:case 78:case 139:case 82:case 68:case 67:case 164:case 11:case 29:case 47:case
48:case 95:case 52:case 51:case 46:return 200809;case 27:case 246:case 127:case 128:case 23:case 24:case 160:case
161:case 181:case 182:case 242:case 183:case 184:case 243:case 244:case 245:case 165:case 178:case 179:case
49:case 50:case 168:case 169:case 175:case 170:case 171:case 172:case
97:case 76:case 32:case 173:case 35:case 80:case 81:case 79:return-1;case 176:case 177:case 7:case 155:case 8:case
157:case 125:case 126:case 92:case 93:case 129:case 130:case 131:case 94:case 91:return 1;case 74:case 60:case
69:case 70:case 4:return 1024;case 31:case 42:case 72:return 32;case 87:case 26:case 33:return 2147483647;case
34:case 1:return 47839;case 38:case 36:return 99;case 43:case 37:return 2048;case 0:return 2097152;case 3:return
65536;case 28:return 32768;case 44:return 32767;case 75:return 16384;case 39:return 1e3;case 89:return 700;case
71:return 256;case 40:return 255;case 2:return 100;case 180:return 64;case 25:return 20;case 5:return 16;case
6:return 6;case 73:return 4;case 84:{if(typeof navigator===\"object\")return
navigator[\"hardwareConcurrency\"]||1;return 1}}setErrNo(28);return-

1}if(!ENVIRONMENT_IS_PTHREAD)PThread.initMainThreadBlock();var GLctx;var
proxiedFunctionTable=[null,_atexit,_emscripten_set_canvas_element_size_main_thread,_fd_close,_fd_seek,_fd_wr
ite,_sysconf];var
asmLibraryArg={\"e\":___assert_fail,\"r\":___call_main,\"x\":__emscripten_notify_thread_queue,\"b\":_abort,\"y\":
_emscripten_asm_const_int,\"j\":_emscripten_conditional_set_current_thread_status,\"d\":_emscripten_futex_wait,\
"c\":_emscripten_futex_wake,\"f\":_emscripten_get_now,\"p\":_emscripten_memcpy_big,\"A\":_emscripten_num_l
ogical_cores,\"u\":_emscripten_receive_on_main_thread_js,\"q\":_emscripten_resize_heap,\"v\":_emscripten_set_ca
nvas_element_size,\"i\":_emscripten_set_current_thread_status,\"s\":_emscripten_set_thread_name,\"w\":_emscript
en_webgl_create_context,\"l\":_fd_close,\"n\":_fd_seek,\"g\":_fd_write,\"o\":initPthreadsJS,\"a\":wasmMemory||Mo
dule[\"wasmMemory\"],\"z\":_pthread_cleanup_pop,\"k\":_pthread_cleanup_push,\"h\":_pthread_create,\"m\":_pthr
ead_join,\"t\":_sysconf};var asm=createWasm();var
___wasm_call_ctors=Module[\"___wasm_call_ctors\"]=function(){return(___wasm_call_ctors=Module[\"___wasm
_call_ctors\"]=Module[\"asm\"][\"B\"]).apply(null,arguments)};var
_init=Module[\"_init\"]=function(){return(_init=Module[\"_init\"]=Module[\"asm\"][\"C\"]).apply(null,arguments)};
var
_init_with_threads_count=Module[\"_init_with_threads_count\"]=function(){return(_init_with_threads_count=Mod
ule[\"_init_with_threads_count\"]=Module[\"asm\"][\"D\"]).apply(null,arguments)};var
_get_threads_count=Module[\"_get_threads_count\"]=function(){return(_get_threads_count=Module[\"_get_threads
_count\"]=Module[\"asm\"][\"E\"]).apply(null,arguments)};var
_register_tensor=Module[\"_register_tensor\"]=function(){return(_register_tensor=Module[\"_register_tensor\"]=M
odule[\"asm\"][\"F\"]).apply(null,arguments)};var
_dispose_data=Module[\"_dispose_data\"]=function(){return(_dispose_data=Module[\"_dispose_data\"]=Module[\"
asm\"][\"G\"]).apply(null,arguments)};var
_dispose=Module[\"_dispose\"]=function(){return(_dispose=Module[\"_dispose\"]=Module[\"asm\"][\"H\"]).apply(
null,arguments)};var
_Abs=Module[\"_Abs\"]=function(){return(_Abs=Module[\"_Abs\"]=Module[\"asm\"][\"J\"]).apply(null,arguments
)};var
_Add=Module[\"_Add\"]=function(){return(_Add=Module[\"_Add\"]=Module[\"asm\"][\"K\"]).apply(null,argumen
ts)};var
_AddN=Module[\"_AddN\"]=function(){return(_AddN=Module[\"_AddN\"]=Module[\"asm\"][\"L\"]).apply(null,ar
guments)};var
_All=Module[\"_All\"]=function(){return(_All=Module[\"_All\"]=Module[\"asm\"][\"M\"]).apply(null,arguments)};
var
_Any=Module[\"_Any\"]=function(){return(_Any=Module[\"_Any\"]=Module[\"asm\"][\"N\"]).apply(null,argumen
ts)};var
_ArgMax=Module[\"_ArgMax\"]=function(){return(_ArgMax=Module[\"_ArgMax\"]=Module[\"asm\"][\"O\"]).ap
ply(null,arguments)};var
_AvgPool=Module[\"_AvgPool\"]=function(){return(_AvgPool=Module[\"_AvgPool\"]=Module[\"asm\"][\"P\"]).a
pply(null,arguments)};var
_BatchMatMul=Module[\"_BatchMatMul\"]=function(){return(_BatchMatMul=Module[\"_BatchMatMul\"]=Modu
le[\"asm\"][\"Q\"]).apply(null,arguments)};var
_Ceil=Module[\"_Ceil\"]=function(){return(_Ceil=Module[\"_Ceil\"]=Module[\"asm\"][\"R\"]).apply(null,argument
s)};var
_ClipByValue=Module[\"_ClipByValue\"]=function(){return(_ClipByValue=Module[\"_ClipByValue\"]=Module[\
"asm\"][\"S\"]).apply(null,arguments)};var
_Conv2D=Module[\"_Conv2D\"]=function(){return(_Conv2D=Module[\"_Conv2D\"]=Module[\"asm\"][\"T\"]).app
ly(null,arguments)};var
_Conv2DBackpropInput=Module[\"_Conv2DBackpropInput\"]=function(){return(_Conv2DBackpropInput=Modul

e[\"_Conv2DBackpropInput\"]=Module[\"asm\"][\"U\"]).apply(null,arguments)};var
_Cos=Module[\"_Cos\"]=function(){return(_Cos=Module[\"_Cos\"]=Module[\"asm\"][\"V\"]).apply(null,arguments
)};var
_Cosh=Module[\"_Cosh\"]=function(){return(_Cosh=Module[\"_Cosh\"]=Module[\"asm\"][\"W\"]).apply(null,argu
ments)};var
_CropAndResize=Module[\"_CropAndResize\"]=function(){return(_CropAndResize=Module[\"_CropAndResize\"]
=Module[\"asm\"][\"X\"]).apply(null,arguments)};var
_Cumsum=Module[\"_Cumsum\"]=function(){return(_Cumsum=Module[\"_Cumsum\"]=Module[\"asm\"][\"Y\"]).a
pply(null,arguments)};var
_DepthToSpace=Module[\"_DepthToSpace\"]=function(){return(_DepthToSpace=Module[\"_DepthToSpace\"]=M
odule[\"asm\"][\"Z\"]).apply(null,arguments)};var
_DepthwiseConv2dNative=Module[\"_DepthwiseConv2dNative\"]=function(){return(_DepthwiseConv2dNative=M
odule[\"_DepthwiseConv2dNative\"]=Module[\"asm\"][\"_\"]).apply(null,arguments)};var
_Elu=Module[\"_Elu\"]=function(){return(_Elu=Module[\"_Elu\"]=Module[\"asm\"][\"$\"]).apply(null,arguments)}
;var
_Equal=Module[\"_Equal\"]=function(){return(_Equal=Module[\"_Equal\"]=Module[\"asm\"][\"aa\"]).apply(null,ar
guments)};var
_Exp=Module[\"_Exp\"]=function(){return(_Exp=Module[\"_Exp\"]=Module[\"asm\"][\"ba\"]).apply(null,argument
s)};var
_FlipLeftRight=Module[\"_FlipLeftRight\"]=function(){return(_FlipLeftRight=Module[\"_FlipLeftRight\"]=Modul
e[\"asm\"][\"ca\"]).apply(null,arguments)};var
_Floor=Module[\"_Floor\"]=function(){return(_Floor=Module[\"_Floor\"]=Module[\"asm\"][\"da\"]).apply(null,arg
uments)};var
_FloorDiv=Module[\"_FloorDiv\"]=function(){return(_FloorDiv=Module[\"_FloorDiv\"]=Module[\"asm\"][\"ea\"]).
apply(null,arguments)};var
_FusedBatchNorm=Module[\"_FusedBatchNorm\"]=function(){return(_FusedBatchNorm=Module[\"_FusedBatchN
orm\"]=Module[\"asm\"][\"fa\"]).apply(null,arguments)};var
_FusedConv2D=Module[\"_FusedConv2D\"]=function(){return(_FusedConv2D=Module[\"_FusedConv2D\"]=Mod
ule[\"asm\"][\"ga\"]).apply(null,arguments)};var
_FusedDepthwiseConv2D=Module[\"_FusedDepthwiseConv2D\"]=function(){return(_FusedDepthwiseConv2D=M
odule[\"_FusedDepthwiseConv2D\"]=Module[\"asm\"][\"ha\"]).apply(null,arguments)};var
_Gather=Module[\"_Gather\"]=function(){return(_Gather=Module[\"_Gather\"]=Module[\"asm\"][\"ia\"]).apply(nul
l,arguments)};var
_GatherNd=Module[\"_GatherNd\"]=function(){return(_GatherNd=Module[\"_GatherNd\"]=Module[\"asm\"][\"ja\"
]).apply(null,arguments)};var
_Greater=Module[\"_Greater\"]=function(){return(_Greater=Module[\"_Greater\"]=Module[\"asm\"][\"ka\"]).apply(
null,arguments)};var
_GreaterEqual=Module[\"_GreaterEqual\"]=function(){return(_GreaterEqual=Module[\"_GreaterEqual\"]=Module[\
"asm\"][\"la\"]).apply(null,arguments)};var
_LeakyRelu=Module[\"_LeakyRelu\"]=function(){return(_LeakyRelu=Module[\"_LeakyRelu\"]=Module[\"asm\"][\
"ma\"]).apply(null,arguments)};var
_Less=Module[\"_Less\"]=function(){return(_Less=Module[\"_Less\"]=Module[\"asm\"][\"na\"]).apply(null,argume
nts)};var
_LessEqual=Module[\"_LessEqual\"]=function(){return(_LessEqual=Module[\"_LessEqual\"]=Module[\"asm\"][\"o
a\"]).apply(null,arguments)};var
_Log=Module[\"_Log\"]=function(){return(_Log=Module[\"_Log\"]=Module[\"asm\"][\"pa\"]).apply(null,argument
s)};var
_LogicalAnd=Module[\"_LogicalAnd\"]=function(){return(_LogicalAnd=Module[\"_LogicalAnd\"]=Module[\"asm

\"][\"qa\"]).apply(null,arguments)};var
_Max=Module[\"_Max\"]=function(){return(_Max=Module[\"_Max\"]=Module[\"asm\"][\"ra\"]).apply(null,argume
nts)};var
_MaxPool=Module[\"_MaxPool\"]=function(){return(_MaxPool=Module[\"_MaxPool\"]=Module[\"asm\"][\"sa\"]).
apply(null,arguments)};var
_Maximum=Module[\"_Maximum\"]=function(){return(_Maximum=Module[\"_Maximum\"]=Module[\"asm\"][\"ta\"]).apply(null,arguments)};var
_Mean=Module[\"_Mean\"]=function(){return(_Mean=Module[\"_Mean\"]=Module[\"asm\"][\"ua\"]).apply(null,ar
guments)};var
_Min=Module[\"_Min\"]=function(){return(_Min=Module[\"_Min\"]=Module[\"asm\"][\"va\"]).apply(null,argumen
ts)};var
_Minimum=Module[\"_Minimum\"]=function(){return(_Minimum=Module[\"_Minimum\"]=Module[\"asm\"][\"wa
\"]).apply(null,arguments)};var
_MirrorPad=Module[\"_MirrorPad\"]=function(){return(_MirrorPad=Module[\"_MirrorPad\"]=Module[\"asm\"][\"xa\"]).apply(null,arguments)};var
_Multiply=Module[\"_Multiply\"]=function(){return(_Multiply=Module[\"_Multiply\"]=Module[\"asm\"][\"ya\"]).a
pply(null,arguments)};var
_Neg=Module[\"_Neg\"]=function(){return(_Neg=Module[\"_Neg\"]=Module[\"asm\"][\"za\"]).apply(null,argumen
ts)};var
_NonMaxSuppressionV3=Module[\"_NonMaxSuppressionV3\"]=function(){return(_NonMaxSuppressionV3=Mod
ule[\"_NonMaxSuppressionV3\"]=Module[\"asm\"][\"Aa\"]).apply(null,arguments)};var
_NonMaxSuppressionV4=Module[\"_NonMaxSuppressionV4\"]=function(){return(_NonMaxSuppressionV4=Mod
ule[\"_NonMaxSuppressionV4\"]=Module[\"asm\"][\"Ba\"]).apply(null,arguments)};var
_NonMaxSuppressionV5=Module[\"_NonMaxSuppressionV5\"]=function(){return(_NonMaxSuppressionV5=Mod
ule[\"_NonMaxSuppressionV5\"]=Module[\"asm\"][\"Ca\"]).apply(null,arguments)};var
_NotEqual=Module[\"_NotEqual\"]=function(){return(_NotEqual=Module[\"_NotEqual\"]=Module[\"asm\"][\"Da\"
]).apply(null,arguments)};var
_OneHot=Module[\"_OneHot\"]=function(){return(_OneHot=Module[\"_OneHot\"]=Module[\"asm\"][\"Ea\"]).appl
y(null,arguments)};var
_PadV2=Module[\"_PadV2\"]=function(){return(_PadV2=Module[\"_PadV2\"]=Module[\"asm\"][\"Fa\"]).apply(nu
ll,arguments)};var
_Pow=Module[\"_Pow\"]=function(){return(_Pow=Module[\"_Pow\"]=Module[\"asm\"][\"Ga\"]).apply(null,argume
nts)};var
_Prelu=Module[\"_Prelu\"]=function(){return(_Prelu=Module[\"_Prelu\"]=Module[\"asm\"][\"Ha\"]).apply(null,arguments)};var
_Prod=Module[\"_Prod\"]=function(){return(_Prod=Module[\"_Prod\"]=Module[\"asm\"][\"Ia\"]).apply(null,argum
ents)};var
_RealDiv=Module[\"_RealDiv\"]=function(){return(_RealDiv=Module[\"_RealDiv\"]=Module[\"asm\"][\"Ja\"]).app
ly(null,arguments)};var
_Relu=Module[\"_Relu\"]=function(){return(_Relu=Module[\"_Relu\"]=Module[\"asm\"][\"Ka\"]).apply(null,argum
ents)};var
_Relu6=Module[\"_Relu6\"]=function(){return(_Relu6=Module[\"_Relu6\"]=Module[\"asm\"][\"La\"]).apply(null,a
rguments)};var
_ResizeBilinear=Module[\"_ResizeBilinear\"]=function(){return(_ResizeBilinear=Module[\"_ResizeBilinear\"]=Mo
dule[\"asm\"][\"Ma\"]).apply(null,arguments)};var
_Reverse=Module[\"_Reverse\"]=function(){return(_Reverse=Module[\"_Reverse\"]=Module[\"asm\"][\"Na\"]).app
ly(null,arguments)};var
_RotateWithOffset=Module[\"_RotateWithOffset\"]=function(){return(_RotateWithOffset=Module[\"_RotateWith

Offset\"]=Module[\"asm\"][\"Oa\"]).apply(null,arguments)};var
_Round=Module[\"_Round\"]=function(){return(_Round=Module[\"_Round\"]=Module[\"asm\"][\"Pa\"]).apply(nul
l,arguments)};var
_Rsqrt=Module[\"_Rsqrt\"]=function(){return(_Rsqrt=Module[\"_Rsqrt\"]=Module[\"asm\"][\"Qa\"]).apply(null,arg
uments)};var
_ScatterNd=Module[\"_ScatterNd\"]=function(){return(_ScatterNd=Module[\"_ScatterNd\"]=Module[\"asm\"][\"Ra
\"]).apply(null,arguments)};var
_SelectV2=Module[\"_SelectV2\"]=function(){return(_SelectV2=Module[\"_SelectV2\"]=Module[\"asm\"][\"Sa\"]).
apply(null,arguments)};var
_Sigmoid=Module[\"_Sigmoid\"]=function(){return(_Sigmoid=Module[\"_Sigmoid\"]=Module[\"asm\"][\"Ta\"]).ap
ply(null,arguments)};var
_Sin=Module[\"_Sin\"]=function(){return(_Sin=Module[\"_Sin\"]=Module[\"asm\"][\"Ua\"]).apply(null,arguments)
};var
_Softmax=Module[\"_Softmax\"]=function(){return(_Softmax=Module[\"_Softmax\"]=Module[\"asm\"][\"Va\"]).a
pply(null,arguments)};var
_Sqrt=Module[\"_Sqrt\"]=function(){return(_Sqrt=Module[\"_Sqrt\"]=Module[\"asm\"][\"Wa\"]).apply(null,argume
nts)};var
_Square=Module[\"_Square\"]=function(){return(_Square=Module[\"_Square\"]=Module[\"asm\"][\"Xa\"]).apply(n
ull,arguments)};var
_SquaredDifference=Module[\"_SquaredDifference\"]=function(){return(_SquaredDifference=Module[\"_Squared
Difference\"]=Module[\"asm\"][\"Ya\"]).apply(null,arguments)};var
_Step=Module[\"_Step\"]=function(){return(_Step=Module[\"_Step\"]=Module[\"asm\"][\"Za\"]).apply(null,argume
nts)};var
_StridedSlice=Module[\"_StridedSlice\"]=function(){return(_StridedSlice=Module[\"_StridedSlice\"]=Module[\"as
m\"][\"_a\"]).apply(null,arguments)};var
_Sub=Module[\"_Sub\"]=function(){return(_Sub=Module[\"_Sub\"]=Module[\"asm\"][\"$a\"]).apply(null,argument
s)};var
_Sum=Module[\"_Sum\"]=function(){return(_Sum=Module[\"_Sum\"]=Module[\"asm\"][\"ab\"]).apply(null,argume
nts)};var
_Tan=Module[\"_Tan\"]=function(){return(_Tan=Module[\"_Tan\"]=Module[\"asm\"][\"bb\"]).apply(null,argument
s)};var
_Tanh=Module[\"_Tanh\"]=function(){return(_Tanh=Module[\"_Tanh\"]=Module[\"asm\"][\"cb\"]).apply(null,argu
ments)};var
_Tile=Module[\"_Tile\"]=function(){return(_Tile=Module[\"_Tile\"]=Module[\"asm\"][\"db\"]).apply(null,argument
s)};var
_TopK=Module[\"_TopK\"]=function(){return(_TopK=Module[\"_TopK\"]=Module[\"asm\"][\"eb\"]).apply(null,ar
guments)};var
_Transform=Module[\"_Transform\"]=function(){return(_Transform=Module[\"_Transform\"]=Module[\"asm\"][\"f
b\"]).apply(null,arguments)};var
_Transpose=Module[\"_Transpose\"]=function(){return(_Transpose=Module[\"_Transpose\"]=Module[\"asm\"][\"g
b\"]).apply(null,arguments)};var
__FusedMatMul=Module[\"__FusedMatMul\"]=function(){return(__FusedMatMul=Module[\"__FusedMatMul\"]=
Module[\"asm\"][\"hb\"]).apply(null,arguments)};var
_malloc=Module[\"_malloc\"]=function(){return(_malloc=Module[\"_malloc\"]=Module[\"asm\"][\"ib\"]).apply(nul
l,arguments)};var
_free=Module[\"_free\"]=function(){return(_free=Module[\"_free\"]=Module[\"asm\"][\"jb\"]).apply(null,arguments
)};var
___errno_location=Module[\"___errno_location\"]=function(){return(___errno_location=Module[\"___errno_locati

on\"]=Module[\"asm\"][\"kb\"]).apply(null,arguments)};var
_emscripten_get_global_libc=Module[\"_emscripten_get_global_libc\"]=function(){return(_emscripten_get_global
_libc=Module[\"_emscripten_get_global_libc\"]=Module[\"asm\"][\"lb\"]).apply(null,arguments)};var
_pthread_self=Module[\"_pthread_self\"]=function(){return(_pthread_self=Module[\"_pthread_self\"]=Module[\"as
m\"][\"mb\"]).apply(null,arguments)};var
___pthread_tsd_run_dtors=Module[\"___pthread_tsd_run_dtors\"]=function(){return(___pthread_tsd_run_dtors=M
odule[\"___pthread_tsd_run_dtors\"]=Module[\"asm\"][\"nb\"]).apply(null,arguments)};var
_emscripten_main_thread_process_queued_calls=Module[\"_emscripten_main_thread_process_queued_calls\"]=fu
nction(){return(_emscripten_main_thread_process_queued_calls=Module[\"_emscripten_main_thread_process_que
ued_calls\"]=Module[\"asm\"][\"ob\"]).apply(null,arguments)};var
_emscripten_current_thread_process_queued_calls=Module[\"_emscripten_current_thread_process_queued_calls\"]
=function(){return(_emscripten_current_thread_process_queued_calls=Module[\"_emscripten_current_thread_proc
ess_queued_calls\"]=Module[\"asm\"][\"pb\"]).apply(null,arguments)};var
_emscripten_register_main_browser_thread_id=Module[\"_emscripten_register_main_browser_thread_id\"]=functi
on(){return(_emscripten_register_main_browser_thread_id=Module[\"_emscripten_register_main_browser_thread_
id\"]=Module[\"asm\"][\"qb\"]).apply(null,arguments)};var
_emscripten_main_browser_thread_id=Module[\"_emscripten_main_browser_thread_id\"]=function(){return(_ems
cripten_main_browser_thread_id=Module[\"_emscripten_main_browser_thread_id\"]=Module[\"asm\"][\"rb\"]).app
ly(null,arguments)};var
__emscripten_do_dispatch_to_thread=Module[\"__emscripten_do_dispatch_to_thread\"]=function(){return(__emsc
ripten_do_dispatch_to_thread=Module[\"__emscripten_do_dispatch_to_thread\"]=Module[\"asm\"][\"sb\"]).apply(n
ull,arguments)};var
_emscripten_sync_run_in_main_thread_4=Module[\"_emscripten_sync_run_in_main_thread_4\"]=function(){retur
n(_emscripten_sync_run_in_main_thread_4=Module[\"_emscripten_sync_run_in_main_thread_4\"]=Module[\"asm\
"][\"tb\"]).apply(null,arguments)};var
_emscripten_run_in_main_runtime_thread_js=Module[\"_emscripten_run_in_main_runtime_thread_js\"]=function(
){return(_emscripten_run_in_main_runtime_thread_js=Module[\"_emscripten_run_in_main_runtime_thread_js\"]=
Module[\"asm\"][\"ub\"]).apply(null,arguments)};var
__emscripten_call_on_thread=Module[\"__emscripten_call_on_thread\"]=function(){return(__emscripten_call_on_t
hread=Module[\"__emscripten_call_on_thread\"]=Module[\"asm\"][\"vb\"]).apply(null,arguments)};var
_emscripten_tls_init=Module[\"_emscripten_tls_init\"]=function(){return(_emscripten_tls_init=Module[\"_emscript
en_tls_init\"]=Module[\"asm\"][\"wb\"]).apply(null,arguments)};var
__emscripten_thread_init=Module[\"__emscripten_thread_init\"]=function(){return(__emscripten_thread_init=Mod
ule[\"__emscripten_thread_init\"]=Module[\"asm\"][\"xb\"]).apply(null,arguments)};var
stackSave=Module[\"stackSave\"]=function(){return(stackSave=Module[\"stackSave\"]=Module[\"asm\"][\"yb\"]).a
pply(null,arguments)};var
stackRestore=Module[\"stackRestore\"]=function(){return(stackRestore=Module[\"stackRestore\"]=Module[\"asm\"
][\"zb\"]).apply(null,arguments)};var
stackAlloc=Module[\"stackAlloc\"]=function(){return(stackAlloc=Module[\"stackAlloc\"]=Module[\"asm\"][\"Ab\"
]).apply(null,arguments)};var
_emscripten_stack_set_limits=Module[\"_emscripten_stack_set_limits\"]=function(){return(_emscripten_stack_set_
limits=Module[\"_emscripten_stack_set_limits\"]=Module[\"asm\"][\"Bb\"]).apply(null,arguments)};var
_memalign=Module[\"_memalign\"]=function(){return(_memalign=Module[\"_memalign\"]=Module[\"asm\"][\"Cb
\"]).apply(null,arguments)};var
__emscripten_allow_main_runtime_queued_calls=Module[\"__emscripten_allow_main_runtime_queued_calls\"]=1
0512;var
__emscripten_main_thread_futex=Module[\"__emscripten_main_thread_futex\"]=12148;Module[\"cwrap\"]=cwrap
;Module[\"PThread\"]=PThread;Module[\"PThread\"]=PThread;Module[\"wasmMemory\"]=wasmMemory;Module

[\"ExitStatus\"]=ExitStatus;var
calledRun;function ExitStatus(status){this.name=\"ExitStatus\";this.message=\"Program terminated with exit(\"+status+\")\";this.status=status}dependenciesFulfilled=function runCaller(){if(!calledRun)run();if(!calledRun)dependenciesFulfilled=runCaller};function run(args){args=args||arguments_;if(runDependencies>0){return}if(ENVIRONMENT_IS_PTHREAD){readyPromiseResolve(Module);initRuntime();postMessage({\"cmd\":\"loaded\"});return}preRun();if(runDependencies>0){return}function doRun(){if(calledRun)return;calledRun=true;Module[\"calledRun\"]=true;if(ABORT)return;initRuntime();preMain();readyPromiseResolve(Module);if(Module[\"onRuntimeInitialized\"])Module[\"onRuntimeInitialized\"]();postRun()}if(Module[\"setStatus\"]){Module[\"setStatus\"](\"Running...\");setTimeout(function(){setTimeout(function(){Module[\"setStatus\"](\"\")},1);doRun()},1)}else{doRun()}}Module[\"run\"]=run;function exit(status,implicit){if(implicit&&noExitRuntime&&status===0){return}if(!implicit){if(ENVIRONMENT_IS_PTHREAD){postMessage({\"cmd\":\"exitProcess\",\"returnCode\":status});throw
new
ExitStatus(status)}else{}}if(noExitRuntime){}else{PThread.terminateAllThreads();EXITSTATUS=status;exitRuntime();if(Module[\"onExit\"])Module[\"onExit\"](status);ABORT=true}quit_(status,new ExitStatus(status))}if(Module[\"preInit\"]){if(typeof Module[\"preInit\"]==\"function\")Module[\"preInit\"]=[Module[\"preInit\"]];while(Module[\"preInit\"].length>0){Module[\"preInit\"].pop()()}}if(ENVIRONMENT_IS_PTHREAD){noExitRuntime=false;PThread.initWorker()}run();\n\n\n return WasmBackendModuleThreadedSimd.ready\n}\n);\n})();\nif (typeof exports === 'object' && typeof module === 'object')\n module.exports = WasmBackendModuleThreadedSimd;\nelse if (typeof define === 'function' && define['amd'])\n define([], function() { return WasmBackendModuleThreadedSimd; });\nelse if (typeof exports === 'object')\n exports[\"WasmBackendModuleThreadedSimd\"]
= WasmBackendModuleThreadedSimd;\n","\nvar WasmBackendModule = (function() {\n var _scriptDir = typeof document !== 'undefined' && document.currentScript ? document.currentScript.src : undefined;\n if (typeof __filename !== 'undefined') _scriptDir = _scriptDir || __filename;\n return (\nfunction(WasmBackendModule) {\n WasmBackendModule = WasmBackendModule || {};\n\n\nvar Module=typeof WasmBackendModule!==\"undefined\"?WasmBackendModule:{};var readyPromiseResolve,readyPromiseReject;Module[\"ready\"]=new Promise(function(resolve,reject){readyPromiseResolve=resolve;readyPromiseReject=reject});var moduleOverrides={};var key;for(key in Module){if(Module.hasOwnProperty(key)){moduleOverrides[key]=Module[key]}}var arguments_=[];var thisProgram=\"./this.program\";var quit_=function(status,toThrow){throw toThrow};var ENVIRONMENT_IS_WEB=false;var ENVIRONMENT_IS_WORKER=false;var ENVIRONMENT_IS_NODE=false;var ENVIRONMENT_IS_SHELL=false;ENVIRONMENT_IS_WEB=typeof window===\"object\";ENVIRONMENT_IS_WORKER=typeof
importScripts===\"function\";ENVIRONMENT_IS_NODE=typeof process===\"object\"&&typeof process.versions===\"object\"&&typeof process.versions.node===\"string\";ENVIRONMENT_IS_SHELL=!ENVIRONMENT_IS_WEB&&!ENVIRONMENT_IS_NODE&&!ENVIRONMENT_IS_WORKER;var scriptDirectory=\"\";function locateFile(path){if(Module[\"locateFile\"]){return Module[\"locateFile\"](path,scriptDirectory)}return scriptDirectory+path}var read_,readAsync,readBinary,setWindowTitle;var nodeFS;var nodePath;if(ENVIRONMENT_IS_NODE){if(ENVIRONMENT_IS_WORKER){scriptDirectory=require(\"path\").dirname(scriptDirectory)+\"/\"}else{scriptDirectory=__dirname+\"/\"}read_=function shell_read(filename,binary){if(!nodeFS)nodeFS=require(\"fs\");if(!nodePath)nodePath=require(\"path\");filename=nodePath[\"normalize\"](filename);return nodeFS[\"readFileSync\"](filename,binary?null:\"utf8\")};readBinary=function readBinary(filename){var ret=read_(filename,true);if(!ret.buffer){ret=new Uint8Array(ret)}assert(ret.buffer);return

ret};if(process[\"argv\"].length>1){thisProgram=process[\"argv\"][1].replace(/\\\\/g,\"/\")}arguments_=process[\"argv\"].slice(2);process[\"on\"](\"uncaughtException\",function(ex){if(!(ex instanceof ExitStatus)){throw ex}});process[\"on\"](\"unhandledRejection\",abort);quit_=function(status){process[\"exit\"](status)};Module[\"inspect\"]=function(){return\"[Emscripten Module object]\"}}else if(ENVIRONMENT_IS_SHELL){if(typeof read!=\"undefined\"){read_=function shell_read(f){return read(f)}}readBinary=function readBinary(f){var data;if(typeof readbuffer===\"function\"){return new Uint8Array(readbuffer(f))}data=read(f,\"binary\");assert(typeof data===\"object\");return data};if(typeof scriptArgs!=\"undefined\"){arguments_=scriptArgs}else if(typeof arguments!=\"undefined\"){arguments_=arguments}if(typeof quit===\"function\"){quit_=function(status){quit(status)}}if(typeof print!==\"undefined\"){if(typeof console===\"undefined\")console={};console.log=print;console.warn=console.error=typeof printErr!==\"undefined\"?printErr:print}}else if(ENVIRONMENT_IS_WEB||ENVIRONMENT_IS_WORKER){if(ENVIRONMENT_IS_WORKER){scriptDirectory=self.location.href}else if(typeof document!==\"undefined\"&&document.currentScript){scriptDirectory=document.currentScript.src}if(_scriptDir){scriptDirectory=_scriptDir}if(scriptDirectory.indexOf(\"blob:\")!==0){scriptDirectory=scriptDirectory.substr(0,scriptDirectory.lastIndexOf(\"/\")+1)}else{scriptDirectory=\"\"}{read_=function(url){var xhr=new XMLHttpRequest;xhr.open(\"GET\",url,false);xhr.send(null);return xhr.responseText};if(ENVIRONMENT_IS_WORKER){readBinary=function(url){var xhr=new XMLHttpRequest;xhr.open(\"GET\",url,false);xhr.responseType=\"arraybuffer\";xhr.send(null);return new Uint8Array(xhr.response)}}readAsync=function(url,onload,onerror){var xhr=new XMLHttpRequest;xhr.open(\"GET\",url,true);xhr.responseType=\"arraybuffer\";xhr.onload=function(){if(xhr.status==200||xhr.status==0&&xhr.response){onload(xhr.response);return}onerror()};xhr.onerror=onerror;xhr.send(null)}}setWindowTitle=function(title){document.title=title}}else{}var out=Module[\"print\"]||console.log.bind(console);var err=Module[\"printErr\"]||console.warn.bind(console);for(key in moduleOverrides){if(moduleOverrides.hasOwnProperty(key)){Module[key]=moduleOverrides[key]}}moduleOverrides=null;if(Module[\"arguments\"])arguments_=Module[\"arguments\"];if(Module[\"thisProgram\"])thisProgram=Module[\"thisProgram\"];if(Module[\"quit\"])quit_=Module[\"quit\"];var wasmBinary;if(Module[\"wasmBinary\"])wasmBinary=Module[\"wasmBinary\"];var noExitRuntime=Module[\"noExitRuntime\"]||true;if(typeof WebAssembly!==\"object\"){abort(\"no native wasm support detected\")}var wasmMemory;var ABORT=false;var EXITSTATUS;function assert(condition,text){if(!condition){abort(\"Assertion failed: \"+text)}}function getCFunc(ident){var func=Module[\"_\"+ident];assert(func,\"Cannot call unknown function \"+ident+\", make sure it is exported\");return func}function ccall(ident,returnType,argTypes,args,opts){var toC={\"string\":function(str){var ret=0;if(str!==null&&str!==undefined&&str!==0){var len=(str.length<<2)+1;ret=stackAlloc(len);stringToUTF8(str,ret,len)}return ret},\"array\":function(arr){var ret=stackAlloc(arr.length);writeArrayToMemory(arr,ret);return ret}};function convertReturnValue(ret){if(returnType===\"string\")return UTF8ToString(ret);if(returnType===\"boolean\")return Boolean(ret);return ret}var func=getCFunc(ident);var cArgs=[];var stack=0;if(args){for(var i=0;i<args.length;i++){var converter=toC[argTypes[i]];if(converter){if(stack===0)stack=stackSave();cArgs[i]=converter(args[i])}else{cArgs[i]=args[i]}}}var ret=func.apply(null,cArgs);ret=convertReturnValue(ret);if(stack!==0)stackRestore(stack);return ret}function cwrap(ident,returnType,argTypes,opts){argTypes=argTypes||[];var numericArgs=argTypes.every(function(type){return type===\"number\"});var numericRet=returnType!==\"string\";if(numericRet&&numericArgs&&!opts){return getCFunc(ident)}return

function(){return ccall(ident,returnType,argTypes,arguments,opts)}}var UTF8Decoder=typeof TextDecoder!==\"undefined\"?new TextDecoder(\"utf8\"):undefined;function UTF8ArrayToString(heap,idx,maxBytesToRead){var endIdx=idx+maxBytesToRead;var endPtr=idx;while(heap[endPtr]&&!(endPtr>=endIdx))++endPtr;if(endPtr-idx>16&&heap.subarray&&UTF8Decoder){return UTF8Decoder.decode(heap.subarray(idx,endPtr))}else{var str=\"\";while(idx<endPtr){var u0=heap[idx++];if(!(u0&128)){str+=String.fromCharCode(u0);continue}var u1=heap[idx++]&63;if((u0&224)==192){str+=String.fromCharCode((u0&31)<<6|u1);continue}var u2=heap[idx++]&63;if((u0&240)==224){u0=(u0&15)<<12|u1<<6|u2}else{u0=(u0&7)<<18|u1<<12|u2<<6|heap[idx++]&63}if(u0<65536){str+=String.fromCharCode(u0)}else{var ch=u0-65536;str+=String.fromCharCode(55296|ch>>10,56320|ch&1023)}}}return str}function UTF8ToString(ptr,maxBytesToRead){return ptr?UTF8ArrayToString(HEAPU8,ptr,maxBytesToRead):\"\"}function stringToUTF8Array(str,heap,outIdx,maxBytesToWrite){if(!(maxBytesToWrite>0))return 0;var startIdx=outIdx;var endIdx=outIdx+maxBytesToWrite-1;for(var i=0;i<str.length;++i){var u=str.charCodeAt(i);if(u>=55296&&u<=57343){var u1=str.charCodeAt(++i);u=65536+((u&1023)<<10)|u1&1023}if(u<=127){if(outIdx>=endIdx)break;heap[outIdx++]=u}else if(u<=2047){if(outIdx+1>=endIdx)break;heap[outIdx++]=192|u>>6;heap[outIdx++]=128|u&63}else if(u<=65535){if(outIdx+2>=endIdx)break;heap[outIdx++]=224|u>>12;heap[outIdx++]=128|u>>6&63;heap[outIdx++]=128|u&63}else{if(outIdx+3>=endIdx)break;heap[outIdx++]=240|u>>18;heap[outIdx++]=128|u>>12&63;heap[outIdx++]=128|u>>6&63;heap[outIdx++]=128|u&63}}heap[outIdx]=0;return outIdx-startIdx}function stringToUTF8(str,outPtr,maxBytesToWrite){return stringToUTF8Array(str,HEAPU8,outPtr,maxBytesToWrite)}function writeArrayToMemory(array,buffer){HEAP8.set(array,buffer)}function alignUp(x,multiple){if(x%multiple>0){x+=multiple-x%multiple}return x}var buffer,HEAP8,HEAPU8,HEAP16,HEAPU16,HEAP32,HEAPU32,HEAPF32,HEAPF64;function updateGlobalBufferAndViews(buf){buffer=buf;Module[\"HEAP8\"]=HEAP8=new Int8Array(buf);Module[\"HEAP16\"]=HEAP16=new Int16Array(buf);Module[\"HEAP32\"]=HEAP32=new Int32Array(buf);Module[\"HEAPU8\"]=HEAPU8=new Uint8Array(buf);Module[\"HEAPU16\"]=HEAPU16=new Uint16Array(buf);Module[\"HEAPU32\"]=HEAPU32=new Uint32Array(buf);Module[\"HEAPF32\"]=HEAPF32=new Float32Array(buf);Module[\"HEAPF64\"]=HEAPF64=new Float64Array(buf)}var INITIAL_MEMORY=Module[\"INITIAL_MEMORY\"]||16777216;var wasmTable;var __ATPRERUN__=[];var __ATINIT__=[];var __ATMAIN__=[];var __ATPOSTRUN__=[];var runtimeInitialized=false;__ATINIT__.push({func:function(){___wasm_call_ctors()}});function preRun(){if(Module[\"preRun\"]){if(typeof Module[\"preRun\"]==\"function\")Module[\"preRun\"]=[Module[\"preRun\"]];while(Module[\"preRun\"].length){addOnPreRun(Module[\"preRun\"].shift())}}callRuntimeCallbacks(__ATPRERUN__)}function initRuntime(){runtimeInitialized=true;callRuntimeCallbacks(__ATINIT__)}function preMain(){callRuntimeCallbacks(__ATMAIN__)}function postRun(){if(Module[\"postRun\"]){if(typeof Module[\"postRun\"]==\"function\")Module[\"postRun\"]=[Module[\"postRun\"]];while(Module[\"postRun\"].length){addOnPostRun(Module[\"postRun\"].shift())}}callRuntimeCallbacks(__ATPOSTRUN__)}function addOnPreRun(cb){__ATPRERUN__.unshift(cb)}function addOnPostRun(cb){__ATPOSTRUN__.unshift(cb)}var runDependencies=0;var runDependencyWatcher=null;var dependenciesFulfilled=null;function addRunDependency(id){runDependencies++;if(Module[\"monitorRunDependencies\"]){Module[\"monitorRunDependencies\"](runDependencies)}}function removeRunDependency(id){runDependencies--;if(Module[\"monitorRunDependencies\"]){Module[\"monitorRunDependencies\"](runDependencies)}if(runDependencies==0){if(runDependencyWatcher!==null){clearInterval(runDependencyWatcher);runDependencyWatcher=nul

l}if(dependenciesFulfilled){var
callback=dependenciesFulfilled;dependenciesFulfilled=null;callback()}}}Module[\"preloadedImages\"]={};Module
[\"preloadedAudios\"]={};function
abort(what){if(Module[\"onAbort\"]){Module[\"onAbort\"](what)}what+=\"\";err(what);ABORT=true;EXITSTAT
US=1;what=\"abort(\"+what+\"). Build with -s ASSERTIONS=1 for more info.\";var e=new
WebAssembly.RuntimeError(what);readyPromiseReject(e);throw e}function hasPrefix(str,prefix){return
String.prototype.startsWith?str.startsWith(prefix):str.indexOf(prefix)===0}var
dataURIPrefix=\"data:application/octet-stream; base64,\";function isDataURI(filename){return
hasPrefix(filename,dataURIPrefix)}var fileURIPrefix=\"file://\";function isFileURI(filename){return
hasPrefix(filename,fileURIPrefix)}var wasmBinaryFile=\"tfjs-backend-
wasm.wasm\";if(!isDataURI(wasmBinaryFile)){wasmBinaryFile=locateFile(wasmBinaryFile)}function
getBinary(file){try{if(file==wasmBinaryFile&&wasmBinary){return new
Uint8Array(wasmBinary)}if(readBinary){return readBinary(file)}else{throw\"both async and sync fetching of the
wasm failed\"}}catch(err){abort(err)}}function
getBinaryPromise(){if(!wasmBinary&&(ENVIRONMENT_IS_WEB||ENVIRONMENT_IS_WORKER)){if(typeof
fetch===\"function\"&&!isFileURI(wasmBinaryFile)){return fetch(wasmBinaryFile,{credentials:\"same-
origin\"}).then(function(response){if(!response[\"ok\"]){throw\"failed to load wasm binary file at
'\"+wasmBinaryFile+\"'\"}return response[\"arrayBuffer\"]()}).catch(function(){return
getBinary(wasmBinaryFile)})}else{if(readAsync){return new
Promise(function(resolve,reject){readAsync(wasmBinaryFile,function(response){resolve(new
Uint8Array(response))},reject)})}}}return Promise.resolve().then(function(){return
getBinary(wasmBinaryFile)})}function createWasm(){var info={\"a\":asmLibraryArg};function
receiveInstance(instance,module){var
exports=instance.exports;Module[\"asm\"]=exports;wasmMemory=Module[\"asm\"][\"j\"];updateGlobalBufferAnd
Views(wasmMemory.buffer);wasmTable=Module[\"asm\"][\"r\"];removeRunDependency(\"wasm-
instantiate\")}addRunDependency(\"wasm-instantiate\");function
receiveInstantiatedSource(output){receiveInstance(output[\"instance\"])}function
instantiateArrayBuffer(receiver){return getBinaryPromise().then(function(binary){return
WebAssembly.instantiate(binary,info)}).then(receiver,function(reason){err(\"failed to asynchronously prepare
wasm: \"+reason);abort(reason)})}function instantiateAsync(){if(!wasmBinary&&typeof
WebAssembly.instantiateStreaming===\"function\"&&!isDataURI(wasmBinaryFile)&&!isFileURI(wasmBinaryFil
e)&&typeof fetch===\"function\"){return fetch(wasmBinaryFile,{credentials:\"same-
origin\"}).then(function(response){var result=WebAssembly.instantiateStreaming(response,info);return
result.then(receiveInstantiatedSource,function(reason){err(\"wasm streaming compile failed: \"+reason);err(\"falling
back to ArrayBuffer instantiation\");return instantiateArrayBuffer(receiveInstantiatedSource)})})}else{return
instantiateArrayBuffer(receiveInstantiatedSource)}}if(Module[\"instantiateWasm\"]){try{var
exports=Module[\"instantiateWasm\"](info,receiveInstance);return exports}catch(e){err(\"Module.instantiateWasm
callback failed with error: \"+e);return false}}instantiateAsync().catch(readyPromiseReject);return{}}function
callRuntimeCallbacks(callbacks){while(callbacks.length>0){var callback=callbacks.shift();if(typeof
callback==\"function\"){callback(Module);continue}var func=callback.func;if(typeof
func===\"number\"){if(callback.arg===undefined){wasmTable.get(func)()}else{wasmTable.get(func)(callback.arg)
}}else{func(callback.arg===undefined?null:callback.arg)}}}function _abort(){abort()}function
_emscripten_memcpy_big(dest,src,num){HEAPU8.copyWithin(dest,src,src+num)}function
_emscripten_get_heap_size(){return HEAPU8.length}function
emscripten_realloc_buffer(size){try{wasmMemory.grow(size-
buffer.byteLength+65535>>>16);updateGlobalBufferAndViews(wasmMemory.buffer);return
1}catch(e){}}function _emscripten_resize_heap(requestedSize){var oldSize=_emscripten_get_heap_size();var
maxHeapSize=2147483648;if(requestedSize>maxHeapSize){return false}for(var

cutDown=1;cutDown<=4;cutDown*=2){var overGrownHeapSize=oldSize*(1+.2/cutDown);overGrownHeapSize=Math.min(overGrownHeapSize,requestedSize+100663296);var newSize=Math.min(maxHeapSize,alignUp(Math.max(requestedSize,overGrownHeapSize),65536));var replacement=emscripten_realloc_buffer(newSize);if(replacement){return true}}return false}var SYSCALLS={mappings:{},buffers:[null,[],[]],printChar:function(stream,curr){var buffer=SYSCALLS.buffers[stream];if(curr===0||curr===10){(stream===1?out:err)(UTF8ArrayToString(buffer,0));buffer.length=0}else{buffer.push(curr)}},varargs:undefined,get:function(){SYSCALLS.varargs+=4;var ret=HEAP32[SYSCALLS.varargs-4>>2];return ret},getStr:function(ptr){var ret=UTF8ToString(ptr);return ret},get64:function(low,high){return low}};function _fd_close(fd){return 0}function _fd_seek(fd,offset_low,offset_high,whence,newOffset){}function _fd_write(fd,iov,iovcnt,pnum){var num=0;for(var i=0;i<iovcnt;i++){var ptr=HEAP32[iov+i*8>>2];var len=HEAP32[iov+(i*8+4)>>2];for(var j=0;j<len;j++){SYSCALLS.printChar(fd,HEAPU8[ptr+j])}num+=len}HEAP32[pnum>>2]=num;return 0}function _pthread_create(){return 6}function _pthread_join(){return 28}function setErrNo(value){HEAP32[___errno_location()>>2]=value;return value}function _sysconf(name){switch(name){case 30:return 16384;case 85:var maxHeapSize=2147483648;return maxHeapSize/16384;case 132:case 133:case 12:case 137:case 138:case 15:case 235:case 16:case 17:case 18:case 19:case 20:case 149:case 13:case 10:case 236:case 153:case 9:case 21:case 22:case 159:case 154:case 14:case 77:case 78:case 139:case 82:case 68:case 67:case 164:case 11:case 29:case 47:case 48:case 95:case 52:case 51:case 46:return 200809;case 27:case 246:case 127:case 128:case 23:case 24:case 160:case 161:case 181:case 182:case 242:case 183:case 184:case 243:case 244:case 245:case 165:case 178:case 179:case 49:case 50:case 168:case 169:case 175:case 170:case 171:case 172:case 97:case 76:case 32:case 173:case 35:case 80:case 81:case 79:return-1;case 176:case 177:case 7:case 155:case 8:case 157:case 125:case 126:case 92:case 93:case 129:case 130:case 131:case 94:case 91:return 1;case 74:case 60:case 69:case 70:case 4:return 1024;case 31:case 42:case 72:return 32;case 87:case 26:case 33:return 2147483647;case 34:case 1:return 47839;case 38:case 36:return 99;case 43:case 37:return 2048;case 0:return 2097152;case 3:return 65536;case 28:return 32768;case 44:return 32767;case 75:return 16384;case 39:return 1e3;case 89:return 700;case 71:return 256;case 40:return 255;case 2:return 100;case 180:return 64;case 25:return 20;case 5:return 16;case 6:return 6;case 73:return 4;case 84:{if(typeof navigator===\"object\")return navigator[\"hardwareConcurrency\"]||1;return 1}}setErrNo(28);return-1};var asmLibraryArg={\"a\":_abort,\"d\":_emscripten_memcpy_big,\"e\":_emscripten_resize_heap,\"f\":_fd_close,\"c\":_fd_seek,\"b\":_fd_write,\"h\":_pthread_create,\"g\":_pthread_join,\"i\":_sysconf};var asm=createWasm();var ___wasm_call_ctors=Module[\"___wasm_call_ctors\"]=function(){return(___wasm_call_ctors=Module[\"___wasm_call_ctors\"]=Module[\"asm\"][\"k\"]).apply(null,arguments)};var _init=Module[\"_init\"]=function(){return(_init=Module[\"_init\"]=Module[\"asm\"][\"l\"]).apply(null,arguments)};var _init_with_threads_count=Module[\"_init_with_threads_count\"]=function(){return(_init_with_threads_count=Module[\"_init_with_threads_count\"]=Module[\"asm\"][\"m\"]).apply(null,arguments)};var _get_threads_count=Module[\"_get_threads_count\"]=function(){return(_get_threads_count=Module[\"_get_threads_count\"]=Module[\"asm\"][\"n\"]).apply(null,arguments)};var _register_tensor=Module[\"_register_tensor\"]=function(){return(_register_tensor=Module[\"_register_tensor\"]=Module[\"asm\"][\"o\"]).apply(null,arguments)};var _dispose_data=Module[\"_dispose_data\"]=function(){return(_dispose_data=Module[\"_dispose_data\"]=Module[\"asm\"][\"p\"]).apply(null,arguments)};var _dispose=Module[\"_dispose\"]=function(){return(_dispose=Module[\"_dispose\"]=Module[\"asm\"][\"q\"]).apply(null,arguments)};var _Abs=Module[\"_Abs\"]=function(){return(_Abs=Module[\"_Abs\"]=Module[\"asm\"][\"s\"]).apply(null,arguments)};var

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_Add=Module[\"_Add\"]=function(){return(_Add=Module[\"_Add\"]=Module[\"asm\"][\"t\"]).apply(null,arguments)};var
_AddN=Module[\"_AddN\"]=function(){return(_AddN=Module[\"_AddN\"]=Module[\"asm\"][\"u\"]).apply(null,arguments)};var
_All=Module[\"_All\"]=function(){return(_All=Module[\"_All\"]=Module[\"asm\"][\"v\"]).apply(null,arguments)};var
_Any=Module[\"_Any\"]=function(){return(_Any=Module[\"_Any\"]=Module[\"asm\"][\"w\"]).apply(null,arguments)};var
_ArgMax=Module[\"_ArgMax\"]=function(){return(_ArgMax=Module[\"_ArgMax\"]=Module[\"asm\"][\"x\"]).apply(null,arguments)};var
_AvgPool=Module[\"_AvgPool\"]=function(){return(_AvgPool=Module[\"_AvgPool\"]=Module[\"asm\"][\"y\"]).apply(null,arguments)};var
_BatchMatMul=Module[\"_BatchMatMul\"]=function(){return(_BatchMatMul=Module[\"_BatchMatMul\"]=Module[\"asm\"][\"z\"]).apply(null,arguments)};var
_Ceil=Module[\"_Ceil\"]=function(){return(_Ceil=Module[\"_Ceil\"]=Module[\"asm\"][\"A\"]).apply(null,arguments)};var
_ClipByValue=Module[\"_ClipByValue\"]=function(){return(_ClipByValue=Module[\"_ClipByValue\"]=Module[\"asm\"][\"B\"]).apply(null,arguments)};var
_Conv2D=Module[\"_Conv2D\"]=function(){return(_Conv2D=Module[\"_Conv2D\"]=Module[\"asm\"][\"C\"]).apply(null,arguments)};var
_Conv2DBackpropInput=Module[\"_Conv2DBackpropInput\"]=function(){return(_Conv2DBackpropInput=Module[\"_Conv2DBackpropInput\"]=Module[\"asm\"][\"D\"]).apply(null,arguments)};var
_Cos=Module[\"_Cos\"]=function(){return(_Cos=Module[\"_Cos\"]=Module[\"asm\"][\"E\"]).apply(null,arguments)};var
_Cosh=Module[\"_Cosh\"]=function(){return(_Cosh=Module[\"_Cosh\"]=Module[\"asm\"][\"F\"]).apply(null,arguments)};var
_CropAndResize=Module[\"_CropAndResize\"]=function(){return(_CropAndResize=Module[\"_CropAndResize\"]=Module[\"asm\"][\"G\"]).apply(null,arguments)};var
_Cumsum=Module[\"_Cumsum\"]=function(){return(_Cumsum=Module[\"_Cumsum\"]=Module[\"asm\"][\"H\"]).apply(null,arguments)};var
_DepthToSpace=Module[\"_DepthToSpace\"]=function(){return(_DepthToSpace=Module[\"_DepthToSpace\"]=Module[\"asm\"][\"I\"]).apply(null,arguments)};var
_DepthwiseConv2dNative=Module[\"_DepthwiseConv2dNative\"]=function(){return(_DepthwiseConv2dNative=Module[\"_DepthwiseConv2dNative\"]=Module[\"asm\"][\"J\"]).apply(null,arguments)};var
_Elu=Module[\"_Elu\"]=function(){return(_Elu=Module[\"_Elu\"]=Module[\"asm\"][\"K\"]).apply(null,arguments)};var
_Equal=Module[\"_Equal\"]=function(){return(_Equal=Module[\"_Equal\"]=Module[\"asm\"][\"L\"]).apply(null,arguments)};var
_Exp=Module[\"_Exp\"]=function(){return(_Exp=Module[\"_Exp\"]=Module[\"asm\"][\"M\"]).apply(null,arguments)};var
_FlipLeftRight=Module[\"_FlipLeftRight\"]=function(){return(_FlipLeftRight=Module[\"_FlipLeftRight\"]=Module[\"asm\"][\"N\"]).apply(null,arguments)};var
_Floor=Module[\"_Floor\"]=function(){return(_Floor=Module[\"_Floor\"]=Module[\"asm\"][\"O\"]).apply(null,arguments)};var
_FloorDiv=Module[\"_FloorDiv\"]=function(){return(_FloorDiv=Module[\"_FloorDiv\"]=Module[\"asm\"][\"P\"]).apply(null,arguments)};var
_FusedBatchNorm=Module[\"_FusedBatchNorm\"]=function(){return(_FusedBatchNorm=Module[\"_FusedBatchNorm\"]=Module[\"asm\"][\"Q\"]).apply(null,arguments)};var
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_FusedConv2D=Module[\"_FusedConv2D\"]=function(){return(_FusedConv2D=Module[\"_FusedConv2D\"]=Module[\"asm\"][\"R\"]).apply(null,arguments)};var
_FusedDepthwiseConv2D=Module[\"_FusedDepthwiseConv2D\"]=function(){return(_FusedDepthwiseConv2D=Module[\"_FusedDepthwiseConv2D\"]=Module[\"asm\"][\"S\"]).apply(null,arguments)};var
_Gather=Module[\"_Gather\"]=function(){return(_Gather=Module[\"_Gather\"]=Module[\"asm\"][\"T\"]).apply(null,arguments)};var
_GatherNd=Module[\"_GatherNd\"]=function(){return(_GatherNd=Module[\"_GatherNd\"]=Module[\"asm\"][\"U\"]).apply(null,arguments)};var
_Greater=Module[\"_Greater\"]=function(){return(_Greater=Module[\"_Greater\"]=Module[\"asm\"][\"V\"]).apply(null,arguments)};var
_GreaterEqual=Module[\"_GreaterEqual\"]=function(){return(_GreaterEqual=Module[\"_GreaterEqual\"]=Module[\"asm\"][\"W\"]).apply(null,arguments)};var
_LeakyRelu=Module[\"_LeakyRelu\"]=function(){return(_LeakyRelu=Module[\"_LeakyRelu\"]=Module[\"asm\"][\"X\"]).apply(null,arguments)};var
_Less=Module[\"_Less\"]=function(){return(_Less=Module[\"_Less\"]=Module[\"asm\"][\"Y\"]).apply(null,arguments)};var
_LessEqual=Module[\"_LessEqual\"]=function(){return(_LessEqual=Module[\"_LessEqual\"]=Module[\"asm\"][\"Z\"]).apply(null,arguments)};var
_Log=Module[\"_Log\"]=function(){return(_Log=Module[\"_Log\"]=Module[\"asm\"][\"_\"]).apply(null,arguments)};var
_LogicalAnd=Module[\"_LogicalAnd\"]=function(){return(_LogicalAnd=Module[\"_LogicalAnd\"]=Module[\"asm\"][\"$\"]).apply(null,arguments)};var
_Max=Module[\"_Max\"]=function(){return(_Max=Module[\"_Max\"]=Module[\"asm\"][\"aa\"]).apply(null,arguments)};var
_MaxPool=Module[\"_MaxPool\"]=function(){return(_MaxPool=Module[\"_MaxPool\"]=Module[\"asm\"][\"ba\"]).apply(null,arguments)};var
_Maximum=Module[\"_Maximum\"]=function(){return(_Maximum=Module[\"_Maximum\"]=Module[\"asm\"][\"ca\"]).apply(null,arguments)};var
_Mean=Module[\"_Mean\"]=function(){return(_Mean=Module[\"_Mean\"]=Module[\"asm\"][\"da\"]).apply(null,arguments)};var
_Min=Module[\"_Min\"]=function(){return(_Min=Module[\"_Min\"]=Module[\"asm\"][\"ea\"]).apply(null,arguments)};var
_Minimum=Module[\"_Minimum\"]=function(){return(_Minimum=Module[\"_Minimum\"]=Module[\"asm\"][\"fa\"]).apply(null,arguments)};var
_MirrorPad=Module[\"_MirrorPad\"]=function(){return(_MirrorPad=Module[\"_MirrorPad\"]=Module[\"asm\"][\"ga\"]).apply(null,arguments)};var
_Multiply=Module[\"_Multiply\"]=function(){return(_Multiply=Module[\"_Multiply\"]=Module[\"asm\"][\"ha\"]).apply(null,arguments)};var
_Neg=Module[\"_Neg\"]=function(){return(_Neg=Module[\"_Neg\"]=Module[\"asm\"][\"ia\"]).apply(null,arguments)};var
_NonMaxSuppressionV3=Module[\"_NonMaxSuppressionV3\"]=function(){return(_NonMaxSuppressionV3=Module[\"_NonMaxSuppressionV3\"]=Module[\"asm\"][\"ja\"]).apply(null,arguments)};var
_NonMaxSuppressionV4=Module[\"_NonMaxSuppressionV4\"]=function(){return(_NonMaxSuppressionV4=Module[\"_NonMaxSuppressionV4\"]=Module[\"asm\"][\"ka\"]).apply(null,arguments)};var
_NonMaxSuppressionV5=Module[\"_NonMaxSuppressionV5\"]=function(){return(_NonMaxSuppressionV5=Module[\"_NonMaxSuppressionV5\"]=Module[\"asm\"][\"la\"]).apply(null,arguments)};var
_NotEqual=Module[\"_NotEqual\"]=function(){return(_NotEqual=Module[\"_NotEqual\"]=Module[\"asm\"][\"ma\"]).apply(null,arguments)};var

_OneHot=Module[\"_OneHot\"]=function(){return(_OneHot=Module[\"_OneHot\"]=Module[\"asm\"][\"na\"]).apply(null,arguments)};var
_PadV2=Module[\"_PadV2\"]=function(){return(_PadV2=Module[\"_PadV2\"]=Module[\"asm\"][\"oa\"]).apply(null,arguments)};var
_Pow=Module[\"_Pow\"]=function(){return(_Pow=Module[\"_Pow\"]=Module[\"asm\"][\"pa\"]).apply(null,arguments)};var
_Prelu=Module[\"_Prelu\"]=function(){return(_Prelu=Module[\"_Prelu\"]=Module[\"asm\"][\"qa\"]).apply(null,arguments)};var
_Prod=Module[\"_Prod\"]=function(){return(_Prod=Module[\"_Prod\"]=Module[\"asm\"][\"ra\"]).apply(null,arguments)};var
_RealDiv=Module[\"_RealDiv\"]=function(){return(_RealDiv=Module[\"_RealDiv\"]=Module[\"asm\"][\"sa\"]).apply(null,arguments)};var
_Relu=Module[\"_Relu\"]=function(){return(_Relu=Module[\"_Relu\"]=Module[\"asm\"][\"ta\"]).apply(null,arguments)};var
_Relu6=Module[\"_Relu6\"]=function(){return(_Relu6=Module[\"_Relu6\"]=Module[\"asm\"][\"ua\"]).apply(null,arguments)};var
_ResizeBilinear=Module[\"_ResizeBilinear\"]=function(){return(_ResizeBilinear=Module[\"_ResizeBilinear\"]=Module[\"asm\"][\"va\"]).apply(null,arguments)};var
_Reverse=Module[\"_Reverse\"]=function(){return(_Reverse=Module[\"_Reverse\"]=Module[\"asm\"][\"wa\"]).apply(null,arguments)};var
_RotateWithOffset=Module[\"_RotateWithOffset\"]=function(){return(_RotateWithOffset=Module[\"_RotateWithOffset\"]=Module[\"asm\"][\"xa\"]).apply(null,arguments)};var
_Round=Module[\"_Round\"]=function(){return(_Round=Module[\"_Round\"]=Module[\"asm\"][\"ya\"]).apply(null,arguments)};var
_Rsqrt=Module[\"_Rsqrt\"]=function(){return(_Rsqrt=Module[\"_Rsqrt\"]=Module[\"asm\"][\"za\"]).apply(null,arguments)};var
_ScatterNd=Module[\"_ScatterNd\"]=function(){return(_ScatterNd=Module[\"_ScatterNd\"]=Module[\"asm\"][\"Aa\"]).apply(null,arguments)};var
_SelectV2=Module[\"_SelectV2\"]=function(){return(_SelectV2=Module[\"_SelectV2\"]=Module[\"asm\"][\"Ba\"]).apply(null,arguments)};var
_Sigmoid=Module[\"_Sigmoid\"]=function(){return(_Sigmoid=Module[\"_Sigmoid\"]=Module[\"asm\"][\"Ca\"]).apply(null,arguments)};var
_Sin=Module[\"_Sin\"]=function(){return(_Sin=Module[\"_Sin\"]=Module[\"asm\"][\"Da\"]).apply(null,arguments)};var
_Softmax=Module[\"_Softmax\"]=function(){return(_Softmax=Module[\"_Softmax\"]=Module[\"asm\"][\"Ea\"]).apply(null,arguments)};var
_Sqrt=Module[\"_Sqrt\"]=function(){return(_Sqrt=Module[\"_Sqrt\"]=Module[\"asm\"][\"Fa\"]).apply(null,arguments)};var
_Square=Module[\"_Square\"]=function(){return(_Square=Module[\"_Square\"]=Module[\"asm\"][\"Ga\"]).apply(null,arguments)};var
_SquaredDifference=Module[\"_SquaredDifference\"]=function(){return(_SquaredDifference=Module[\"_SquaredDifference\"]=Module[\"asm\"][\"Ha\"]).apply(null,arguments)};var
_Step=Module[\"_Step\"]=function(){return(_Step=Module[\"_Step\"]=Module[\"asm\"][\"Ia\"]).apply(null,arguments)};var
_StridedSlice=Module[\"_StridedSlice\"]=function(){return(_StridedSlice=Module[\"_StridedSlice\"]=Module[\"asm\"][\"Ja\"]).apply(null,arguments)};var
_Sub=Module[\"_Sub\"]=function(){return(_Sub=Module[\"_Sub\"]=Module[\"asm\"][\"Ka\"]).apply(null,arguments)};var

_Sum=Module[\"_Sum\"]=function(){return(_Sum=Module[\"_Sum\"]=Module[\"asm\"][\"La\"]).apply(null,arguments)};var
_Tan=Module[\"_Tan\"]=function(){return(_Tan=Module[\"_Tan\"]=Module[\"asm\"][\"Ma\"]).apply(null,arguments)};var
_Tanh=Module[\"_Tanh\"]=function(){return(_Tanh=Module[\"_Tanh\"]=Module[\"asm\"][\"Na\"]).apply(null,arguments)};var
_Tile=Module[\"_Tile\"]=function(){return(_Tile=Module[\"_Tile\"]=Module[\"asm\"][\"Oa\"]).apply(null,arguments)};var
_TopK=Module[\"_TopK\"]=function(){return(_TopK=Module[\"_TopK\"]=Module[\"asm\"][\"Pa\"]).apply(null,arguments)};var
_Transform=Module[\"_Transform\"]=function(){return(_Transform=Module[\"_Transform\"]=Module[\"asm\"][\"Qa\"]).apply(null,arguments)};var
_Transpose=Module[\"_Transpose\"]=function(){return(_Transpose=Module[\"_Transpose\"]=Module[\"asm\"][\"Ra\"]).apply(null,arguments)};var
__FusedMatMul=Module[\"__FusedMatMul\"]=function(){return(__FusedMatMul=Module[\"__FusedMatMul\"]=Module[\"asm\"][\"Sa\"]).apply(null,arguments)};var
_malloc=Module[\"_malloc\"]=function(){return(_malloc=Module[\"_malloc\"]=Module[\"asm\"][\"Ta\"]).apply(null,arguments)};var
_free=Module[\"_free\"]=function(){return(_free=Module[\"_free\"]=Module[\"asm\"][\"Ua\"]).apply(null,arguments)};var
___errno_location=Module[\"___errno_location\"]=function(){return(___errno_location=Module[\"___errno_location\"]=Module[\"asm\"][\"Va\"]).apply(null,arguments)};var
stackSave=Module[\"stackSave\"]=function(){return(stackSave=Module[\"stackSave\"]=Module[\"asm\"][\"Wa\"]).apply(null,arguments)};var
stackRestore=Module[\"stackRestore\"]=function(){return(stackRestore=Module[\"stackRestore\"]=Module[\"asm\"][\"Xa\"]).apply(null,arguments)};var
stackAlloc=Module[\"stackAlloc\"]=function(){return(stackAlloc=Module[\"stackAlloc\"]=Module[\"asm\"][\"Ya\"]).apply(null,arguments)};Module[\"cwrap\"]=cwrap;var calledRun;function
ExitStatus(status){this.name=\"ExitStatus\";this.message=\"Program terminated with
exit(\"+status+\")\";this.status=status}dependenciesFulfilled=function
runCaller(){if(!calledRun)run();if(!calledRun)dependenciesFulfilled=runCaller};function
run(args){args=args||arguments_;if(runDependencies>0){return}preRun();if(runDependencies>0){return}function
doRun(){if(calledRun)return;calledRun=true;Module[\"calledRun\"]=true;if(ABORT)return;initRuntime();preMain();readyPromiseResolve(Module);if(Module[\"onRuntimeInitialized\"])Module[\"onRuntimeInitialized\"]();postRun()}if(Module[\"setStatus\"]){Module[\"setStatus\"](\"Running...\");setTimeout(function(){setTimeout(function(){Module[\"setStatus\"](\"\")},1);doRun()},1)}else{doRun()}}Module[\"run\"]=run;if(Module[\"preInit\"]){if(typeof
Module[\"preInit\"]==\"function\")Module[\"preInit\"]=[Module[\"preInit\"]];while(Module[\"preInit\"].length>0){
Module[\"preInit\"].pop()()}}run();\n\n\n return WasmBackendModule.ready\n}\n);\n})();\nif (typeof exports ===
'object' && typeof module === 'object')\n module.exports = WasmBackendModule;\nelse if (typeof define ===
'function' && define['amd'])\n define([], function() { return WasmBackendModule; });\nelse if (typeof exports ===
'object')\n exports[\"WasmBackendModule\"] = WasmBackendModule;\n","/**\n * @license\n * Copyright 2019
Google LLC. All Rights Reserved.\n * Licensed under the
 Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the
License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n *
Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed
on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or
implied.\n * See the License for the specific language governing permissions and\n * limitations under the
License.\n *

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==========================================================================\n
*/\nimport './flags_wasm';\n\nimport {backend_util, BackendTimingInfo, DataStorage, DataType, deprecationWarn,
engine, env, KernelBackend, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasmModule,
WasmFactoryConfig} from '../wasm-out/tfjs-backend-wasm';\nimport {BackendWasmThreadedSimdModule} from
'../wasm-out/tfjs-backend-wasm-threaded-simd';\nimport
 wasmFactoryThreadedSimd from '../wasm-out/tfjs-backend-wasm-threaded-simd.js';\n// @ts-ignore\nimport
{wasmWorkerContents} from '../wasm-out/tfjs-backend-wasm-threaded-simd.worker.js';\nimport wasmFactory
from '../wasm-out/tfjs-backend-wasm.js';\n\ninterface TensorData {\n  id: number;\n  memoryOffset: number;\n
shape: number[];\n  dtype: DataType;\n  refCount: number;\n  /** Only used for string tensors, storing encoded
bytes. */\n  stringBytes?: Uint8Array[];\n}\n\nexport type DataId = object;  // object instead of {} to force non-
primitive.\n\nexport class BackendWasm extends KernelBackend {\n  // 0 is reserved for null data ids.\n  private
dataIdNextNumber = 1;\n  dataIdMap: DataStorage<TensorData>;\n\n  constructor(public wasm:
BackendWasmModule|BackendWasmThreadedSimdModule) {\n    super();\n
this.wasm.tfjs.initWithThreadsCount(threadsCount);\n    actualThreadsCount = this.wasm.tfjs.getThreadsCount();\n
 this.dataIdMap = new DataStorage(this, engine());\n  }\n\n  write(values:
 backend_util.BackendValues, shape: number[], dtype: DataType):\n      DataId {\n    const dataId = {id:
this.dataIdNextNumber++};\n    this.move(dataId, values, shape, dtype, 1);\n    return dataId;\n  }\n\n
numDataIds(): number {\n    return this.dataIdMap.numDataIds();\n  }\n\n  async time(f: () => void):
Promise<BackendTimingInfo> {\n    const start = util.now();\n    f();\n    const kernelMs = util.now() - start;\n
return {kernelMs};\n  }\n\n  move(\n      dataId: DataId, values: backend_util.BackendValues, shape: number[],\n
dtype: DataType, refCount: number): void {\n    const id = this.dataIdNextNumber++;\n    if (dtype === 'string') {\n
   const stringBytes = values as Uint8Array[];\n      this.dataIdMap.set(\n          dataId,\n          {id, stringBytes,
shape, dtype, memoryOffset: null, refCount});\n      return;\n    }\n\n    const size = util.sizeFromShape(shape);\n
const numBytes = size * util.bytesPerElement(dtype);\n    const memoryOffset = this.wasm._malloc(numBytes);\n\n
    this.dataIdMap.set(dataId, {id, memoryOffset, shape, dtype, refCount});\n\n    this.wasm.tfjs.registerTensor(id,
size, memoryOffset);\n\n    if (values != null) {\n      this.wasm.HEAPU8.set(\n          new Uint8Array(\n
(values as backend_util.TypedArray).buffer,\n              (values as backend_util.TypedArray).byteOffset,
numBytes),\n          memoryOffset);\n    }\n  }\n\n  async read(dataId: DataId):
Promise<backend_util.BackendValues> {\n    return this.readSync(dataId);\n  }\n\n  readSync(dataId: DataId):
backend_util.BackendValues {\n    const {memoryOffset, dtype, shape, stringBytes} =\n
this.dataIdMap.get(dataId);\n    if (dtype === 'string') {\n      return stringBytes;\n    }\n    const bytes =
this.wasm.HEAPU8.slice(\n        memoryOffset,\n        memoryOffset + util.sizeFromShape(shape) *
util.bytesPerElement(dtype));\n    return typedArrayFromBuffer(bytes.buffer, dtype);\n  }\n\n  /**\n   * Dispose the
memory if the dataId
 has 0 refCount. Return true if the memory\n   * is released, false otherwise.\n   * @param dataId\n   * @oaram force
Optional, remove the data regardless of refCount\n   */\n  disposeData(dataId: DataId, force = false): boolean {\n    if
(this.dataIdMap.has(dataId)) {\n      const data = this.dataIdMap.get(dataId);\n      data.refCount--;\n      if (!force
&& data.refCount > 0) {\n        return false;\n      }\n\n      this.wasm._free(data.memoryOffset);\n
this.wasm.tfjs.disposeData(data.id);\n      this.dataIdMap.delete(dataId);\n    }\n    return true;\n  }\n\n  /** Return
refCount of a `TensorData`. */\n  refCount(dataId: DataId): number {\n    if (this.dataIdMap.has(dataId)) {\n
const tensorData = this.dataIdMap.get(dataId);\n      return tensorData.refCount;\n    }\n    return 0;\n  }\n\n
incRef(dataId: DataId) {\n    const data = this.dataIdMap.get(dataId);\n    if (data != null) {\n      data.refCount++;\n
}\n  }\n\n  floatPrecision(): 32 {\n    return 32;\n  }\n\n
  // Returns the memory offset of a tensor. Useful for debugging and unit\n  // testing.\n  getMemoryOffset(dataId:
DataId): number {\n    return this.dataIdMap.get(dataId).memoryOffset;\n  }\n\n  dispose() {\n
this.wasm.tfjs.dispose();\n    if ('PThread' in this.wasm) {\n      this.wasm.PThread.terminateAllThreads();\n    }\n
this.wasm = null;\n  }\n\n  memory() {\n    return {unreliable: false};\n  }\n\n  /**\n   * Make a tensor info for the
output of an op. If `memoryOffset` is not\n   * present, this method allocates memory on the WASM heap. If
```

`memoryOffset`\n * is present, the memory was allocated elsewhere (in c++) and we just record\n * the pointer where that memory lives.\n */\n makeOutput(shape: number[], dtype: DataType, memoryOffset?: number):\n TensorInfo {\n let dataId: {};\n if (memoryOffset == null) {\n dataId = this.write(null /* values */, shape, dtype);\n } else {\n const id = this.dataIdNextNumber++;\n dataId = {id};\n this.dataIdMap.set(dataId, {id, memoryOffset, shape, dtype, refCount: 1});\n const size = util.sizeFromShape(shape);\n this.wasm.tfjs.registerTensor(id, size, memoryOffset);\n }\n return {dataId, shape, dtype};\n }\n\n typedArrayFromHeap({shape, dtype, dataId}: TensorInfo):\n backend_util.TypedArray {\n const buffer = this.wasm.HEAPU8.buffer;\n const {memoryOffset} = this.dataIdMap.get(dataId);\n const size = util.sizeFromShape(shape);\n switch (dtype) {\n case 'float32':\n return new Float32Array(buffer, memoryOffset, size);\n case 'int32':\n return new Int32Array(buffer, memoryOffset, size);\n case 'bool':\n return new Uint8Array(buffer, memoryOffset, size);\n default:\n throw new Error(`Unknown dtype ${dtype}`);\n }\n }\n}\n\nfunction createInstantiateWasmFunc(path: string) {\n // this will be replace by rollup plugin patchWechatWebAssembly in\n // minprogram's output.\n // tslint:disable-next-line:no-any\n return (imports: any, callback: any) => {\n util.fetch(path, {credentials: 'same-origin'}).then((response) => {\n if (!response['ok']) {\n imports.env.a(`failed to load wasm binary file at '${path}'`);\n }\n response.arrayBuffer().then(binary => {\n WebAssembly.instantiate(binary, imports).then(output => {\n callback(output.instance, output.module);\n });\n });\n });\n return {};\n };\n}\n\n/**\n * Returns the path of the WASM binary.\n * @param simdSupported whether SIMD is supported\n * @param threadsSupported whether multithreading is supported\n * @param wasmModuleFolder the directory containing the WASM binaries.\n */\nfunction getPathToWasmBinary(\n simdSupported: boolean, threadsSupported: boolean,\n wasmModuleFolder: string) {\n if (wasmPath != null) {\n // If wasmPath is defined, the user has supplied a full path to\n // the vanilla .wasm binary.\n return wasmPath;\n }\n\n let path: WasmBinaryName = 'tfjs-backend-wasm.wasm';\n if (simdSupported && threadsSupported) {\n path = 'tfjs-backend-wasm-threaded-simd.wasm';\n } else if (simdSupported) {\n path = 'tfjs-backend-wasm-simd.wasm';\n }\n\n if (wasmFileMap != null) {\n if (wasmFileMap[path] != null) {\n return wasmFileMap[path];\n }\n }\n\n return wasmModuleFolder + path;\n}\n\n/**\n * Initializes the wasm module and creates the js <--> wasm bridge.\n *\n * NOTE: We wrap the wasm module in a object with property 'wasm' instead of\n * returning Promise<BackendWasmModule> to avoid freezing Chrome (last tested\n * in Chrome 76).\n */\nexport async function init(): Promise<{wasm: BackendWasmModule}> {\n const [simdSupported, threadsSupported] = await Promise.all([\n env().getAsync('WASM_HAS_SIMD_SUPPORT'),\n env().getAsync('WASM_HAS_MULTITHREAD_SUPPORT')\n]);\n\n return new Promise((resolve, reject) => {\n const factoryConfig: WasmFactoryConfig = {};\n\n /**\n * This function overrides the Emscripten module locateFile utility.\n * @param path The relative path to the file that needs to be loaded.\n * @param prefix The path to the main JavaScript file's directory.\n */\n factoryConfig.locateFile = (path, prefix) => {\n if (path.endsWith('.worker.js')) {\n const response = wasmWorkerContents;\n const blob = new Blob([response], {type: 'application/javascript'});\n return URL.createObjectURL(blob);\n }\n\n if (path.endsWith('.wasm')) {\n return getPathToWasmBinary(\n simdSupported as boolean, threadsSupported as boolean,\n wasmPathPrefix != null ? wasmPathPrefix : prefix);\n }\n return prefix + path;\n };\n\n // Use the instantiateWasm override when system fetch is not available.\n // Reference:\n // https://github.com/emscripten-core/emscripten/blob/2bca083cbbd5a4133db61fbd74d04f7feecfa907/tests/manual_wasm_instantiate.html#L170\n if (customFetch) {\n factoryConfig.instantiateWasm =\n createInstantiateWasmFunc(getPathToWasmBinary(\n simdSupported as boolean, threadsSupported as boolean,\n wasmPathPrefix != null ? wasmPathPrefix : ''));\n }\n\n let initialized = false;\n factoryConfig.onAbort = () => {\n if (initialized) {\n // Emscripten already called console.warn so no need to double log.\n return;\n }\n if (initAborted) {\n // Emscripten calls `onAbort` twice, resulting in double error\n // messages.\n return;\n }\n initAborted = true;\n const rejectMsg =\n 'Make sure the server can serve the `.wasm` file relative to the ' +\n

'bundled js file. For more details see https://github.com/tensorflow/tfjs/blob/master/tfjs-backend-wasm/README.md#using-bundlers';\n reject({message: rejectMsg});\n };\n\n let wasm: Promise<BackendWasmModule>;\n // If `wasmPath` has been defined we must initialize the vanilla module.\n if (threadsSupported && simdSupported && wasmPath == null) {\n factoryConfig.mainScriptUrlOrBlob = new Blob(\n [`var WasmBackendModuleThreadedSimd = ` +\n wasmFactoryThreadedSimd.toString()],\n {type: 'text/javascript'});\n wasm = wasmFactoryThreadedSimd(factoryConfig);\n } else {\n // The wasmFactory works for both vanilla and SIMD binaries.\n wasm = wasmFactory(factoryConfig);\n }\n\n // The WASM module has been successfully created by the factory.\n // Any error will be caught by the onAbort callback defined above.\n wasm.then((module) => {\n initialized = true;\n initAborted = false;\n\n const voidReturnType: string = null;\n // Using the tfjs namespace to avoid conflict with emscripten's API.\n module.tfjs = {\n init: module.cwrap('init', null, []),\n initWithThreadsCount:\n module.cwrap('init_with_threads_count', null, ['number']),\n getThreadsCount: module.cwrap('get_threads_count', 'number', []),\n registerTensor: module.cwrap(\n 'register_tensor', null,\n [\n 'number', // id\n 'number', // size\n 'number', // memoryOffset\n]),\n disposeData: module.cwrap('dispose_data', voidReturnType, ['number']),\n dispose: module.cwrap('dispose', voidReturnType, []),\n };\n\n resolve({wasm: module});\n });\n });\n}\n\nfunction typedArrayFromBuffer(\n buffer: ArrayBuffer, dtype: DataType): backend_util.TypedArray {\n switch (dtype) {\n case 'float32':\n return new Float32Array(buffer);\n case 'int32':\n return new Int32Array(buffer);\n case 'bool':\n return new Uint8Array(buffer);\n default:\n throw new Error(`Unknown dtype ${dtype}`);\n }\n}\n\nconst wasmBinaryNames = [\n 'tfjs-backend-wasm.wasm', 'tfjs-backend-wasm-simd.wasm',\n 'tfjs-backend-wasm-threaded-simd.wasm'\n] as const;\ntype WasmBinaryName = typeof wasmBinaryNames[number];\n\nlet wasmPath: string = null;\nlet wasmPathPrefix: string = null;\nlet wasmFileMap: {[key in WasmBinaryName]?: string} = {};\nlet initAborted = false;\nlet customFetch = false;\n\n/**\n * @deprecated Use `setWasmPaths` instead.\n * Sets the path to the `.wasm` file which will be fetched when the wasm\n * backend is initialized. See\n * https://github.com/tensorflow/tfjs/blob/master/tfjs-backend-wasm/README.md#using-bundlers\n * for more details.\n * @param path wasm file path or url\n * @param usePlatformFetch optional boolean to use platform fetch to download\n * the wasm file, default to false.\n *\n * @doc {heading: 'Environment', namespace: 'wasm'}\n */\nexport function setWasmPath(path: string, usePlatformFetch = false): void {\n deprecationWarn(\n 'setWasmPath has been deprecated in favor of setWasmPaths and' +\n ' will be removed in a future release.');\n if (initAborted) {\n throw new Error(\n 'The WASM backend was already initialized. Make sure you call ' +\n '`setWasmPath()` before you call `tf.setBackend()` or `tf.ready()`');\n }\n wasmPath = path;\n customFetch = usePlatformFetch;\n}\n\n/**\n * Configures the locations of the WASM binaries.\n *\n * ```js\n * setWasmPaths({\n * 'tfjs-backend-wasm.wasm': 'renamed.wasm',\n * 'tfjs-backend-wasm-simd.wasm': 'renamed-simd.wasm',\n * 'tfjs-backend-wasm-threaded-simd.wasm': 'renamed-threaded-simd.wasm'\n * });\n * tf.setBackend('wasm');\n * ```\n *\n * @param prefixOrFileMap This can be either a string or object:\n * - (string) The path to the directory where the WASM binaries are located.\n * Note that this prefix will be used to load each binary (vanilla,\n * SIMD-enabled, threading-enabled, etc.).\n * - (object) Mapping from names of WASM binaries to custom\n * full paths specifying the locations of those binaries. This is useful if\n * your WASM binaries are not all located in the same directory,\n * or if your\n * WASM binaries have been renamed.\n * @param usePlatformFetch optional boolean to use platform fetch to download\n * the wasm file, default to false.\n *\n * @doc {heading: 'Environment', namespace: 'wasm'}\n */\nexport function setWasmPaths(\n prefixOrFileMap: string|{[key in WasmBinaryName]?: string},\n usePlatformFetch = false): void {\n if (initAborted) {\n throw new Error(\n 'The WASM backend was already initialized. Make sure you call ' +\n '`setWasmPaths()` before you call `tf.setBackend()` or ' +\n '`tf.ready()`');\n }\n\n if (typeof prefixOrFileMap === 'string') {\n wasmPathPrefix = prefixOrFileMap;\n } else

{\n wasmFileMap = prefixOrFileMap;\n const missingPaths =\n wasmBinaryNames.filter(name => wasmFileMap[name] == null);\n if (missingPaths.length > 0) {\n throw new Error(\n `There were no entries found for the following binaries: ` +\n `${missingPaths.join(',')}. Please either call setWasmPaths with a ` +\n `map providing a path for each binary, or with a string indicating ` +\n `the directory where all the binaries can be found.`);\n }\n }\n\n customFetch = usePlatformFetch;\n}\n\n/** Used in unit tests. */\nexport function resetWasmPath(): void {\n wasmPath = null;\n wasmPathPrefix = null;\n wasmFileMap = {};\n customFetch = false;\n initAborted = false;\n}\n\nlet threadsCount = -1;\nlet actualThreadsCount = -1;\n\n/**\n * Sets the number of threads that will be used by XNNPACK to create\n * threadpool (default to the number of logical CPU cores).\n *\n * This must be called before calling `tf.setBackend('wasm')`.\n */\nexport function setThreadsCount(numThreads: number) {\n threadsCount = numThreads;\n}\n\n/**\n * Gets the actual threads count that is used by XNNPACK.\n *\n * It is set after the backend is intialized.\n */\nexport function getThreadsCount(): number {\n if (actualThreadsCount === -1) {\n throw new Error(`WASM backend not initialized.`);\n }\n return actualThreadsCount;\n}\n","export const wasmWorkerContents = 'var Module={};function threadPrintErr(){var text=Array.prototype.slice.call(arguments).join(\" \");console.error(text)}function threadAlert(){var text=Array.prototype.slice.call(arguments).join(\" \");postMessage({cmd:\"alert\",text:text,threadId:Module[\"_pthread_self\"]()})}var err=threadPrintErr;this.alert=threadAlert;Module[\"instantiateWasm\"]=function(info,receiveInstance){var instance=new WebAssembly.Instance(Module[\"wasmModule\"],info);Module[\"wasmModule\"]=null;receiveInstance(instance);return instance.exports};function moduleLoaded(){}this.onmessage=function(e){try{if(e.data.cmd===\"load\"){Module[\"wasmModule\"]=e.data.wasmModule;Module[\"wasmMemory\"]=e.data.wasmMemory;Module[\"buffer\"]=Module[\"wasmMemory\"].buffer;Module[\"ENVIRONMENT_IS_PTHREAD\"]=true;if(typeof e.data.urlOrBlob===\"string\"){importScripts(e.data.urlOrBlob)}else{var objectUrl=URL.createObjectURL(e.data.urlOrBlob);importScripts(objectUrl);URL.revokeObjectURL(objectUrl)}WasmBackendModuleThreadedSimd(Module).then(function(instance){Module=instance;moduleLoaded()})}else if(e.data.cmd===\"objectTransfer\"){Module[\"PThread\"].receiveObjectTransfer(e.data)}else if(e.data.cmd===\"run\"){Module[\"__performance_now_clock_drift\"]=performance.now()-e.data.time;Module[\"__emscripten_thread_init\"](e.data.threadInfoStruct,0,0);var max=e.data.stackBase;var top=e.data.stackBase+e.data.stackSize;Module[\"establishStackSpace\"](top,max);Module[\"_emscripten_tls_init\"]();Module[\"PThread\"].receiveObjectTransfer(e.data);Module[\"PThread\"].setThreadStatus(Module[\"_pthread_self\"](),1);try{var result=Module[\"invokeEntryPoint\"](e.data.start_routine,e.data.arg);if(!Module[\"getNoExitRuntime\"]())Module[\"PThread\"].threadExit(result)}catch(ex){if(ex===\"Canceled!\"){Module[\"PThread\"].threadCancel()}else if(ex!=\"unwind\"){if(ex instanceof Module[\"ExitStatus\"]){if(Module[\"getNoExitRuntime\"]()){}else{Module[\"PThread\"].threadExit(ex.status)}}else{Module[\"PThread\"].threadExit(-2);throw ex}}}}else if(e.data.cmd===\"cancel\"){if(Module[\"_pthread_self\"]()){Module[\"PThread\"].threadCancel()}}else if(e.data.target===\"setimmediate\"){}else if(e.data.cmd===\"processThreadQueue\"){if(Module[\"_pthread_self\"]()){Module[\"_emscripten_current_thread_process_queued_calls\"]()}}else{err(\"worker.js received unknown command \"+e.data.cmd);err(e.data)}}catch(ex){err(\"worker.js onmessage() captured an uncaught exception: \"+ex);if(ex&&ex.stack)err(ex.stack);throw ex}};if(typeof process===\"object\"&&typeof process.versions===\"object\"&&typeof process.versions.node===\"string\"){self={location:{href:__filename}};var onmessage=this.onmessage;var nodeWorkerThreads=require(\"worker_threads\");global.Worker=nodeWorkerThreads.Worker;var

parentPort=nodeWorkerThreads.parentPort;parentPort.on(\"message\",function(data){onmessage({data:data})});var nodeFS=require(\"fs\");var nodeRead=function(filename){return nodeFS.readFileSync(filename,\"utf8\")};function globalEval(x){global.require=require;global.Module=Module;eval.call(null,x)}importScripts=function(f){globalEval(nodeRead(f))};postMessage=function(msg){parentPort.postMessage(msg)};if(typeof performance===\"undefined\"){performance={now:function(){return Date.now()}}}';","/** @license See the LICENSE file. */\n\n// This code is auto-generated, do not modify this file!\nconst version = '3.11.0';\nexport {version};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==\n */\n\nimport './flags_wasm';\n\nimport {registerBackend} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm, init} from './backend_wasm';\n\nexport {BackendWasm, getThreadsCount, setThreadsCount, setWasmPath, setWasmPaths} from './backend_wasm';\nexport {version as version_wasm} from './version';\n\nconst WASM_PRIORITY = 2;\nregisterBackend('wasm', async () => {\n const {wasm} = await init();\n return new BackendWasm(wasm);\n}, WASM_PRIORITY);\n"],"names":["CppDType","FusableActivation","wasmFusedMatMul","fusedMatMulConfig","kernelName","_FusedMatMul","backendName","setupFunc","backend","wasm","cwrap","kernelFunc","args","inputs","attrs","a","b","bias","preluActivationWeights","dtype","Error","transposeA","transposeB","activation","leakyreluAlpha","aId","dataIdMap","get","dataId","id","bId","biasId","biasData","shape","length","preluActivationWeightsId","fusedActivation","leftDim","rightDim","batchDim","out","makeOutput","outId","aShapeBytes","Uint8Array","Int32Array","buffer","bShapeBytes","createUnaryKernelConfig","outType","wasmFunc","x","xId","util","sizeFromShape","absConfig","Abs","createBinaryKernelConfig","supportsFullBroadcast","outputType","newShape","backend_util","assertAndGetBroadcastShape","aBroadcastDims","getBroadcastDims","bBroadcastDims","loopsOverAllOfA","every","v","i","loopsOverAllOfB","addConfig","Add","addNConfig","AddN","inputIds","map","inputIdsBytes","identity","inVals","typedArrayFromHeap","set","identityConfig","Identity","wasmTranspose","transpose","reducedShape","perm","newPerm","push","minValIdx","j","removeOneSizeDims","permIsNoOp","outShape","inShape","Array","computeOutShape","cloned","permBytes","xShapeBytes","transposeConfig","Transpose","permuteAxesAndTranspose","axis","xShape","xRank","originalAxes","parseAxisParam","axes","permutedAxes","getAxesPermutation","xTransposed","inputWasTransposed","getInnerMostAxes","transposed","wasmAll","allConfig","All","keepDims","inputId","input","inputRank","assertAxesAreInnerMostDims","reduceShape","computeOutAndReduceShapes","reduceSize","disposeData","expandShapeToKeepDim","wasmAny","anyConfig","Any","argMaxConfig","ArgMax","transposedId","slice","outerSize","innerSize","wasmAvgPool","avgPoolConfig","AvgPool","filterSize","strides","pad","dimRoundingMode","convInfo","computePool2DInfo","filterHeight","filterWidth","padTop","padInfo","top","padRight","right","padBottom","bottom","padLeft","left","strideHeight","strideWidth","channels","inChannels","dataFormat","dilationWidth","dilationHeight","reshape","xSize","$shape","inferFromImplicitShape","assert","incRef","reshapeConfig","Reshape","wasmBatchMatMul","batchMatMulConfig","BatchMatMul","aRank","bRank","innerShapeA","innerShapeB","outerShapeA","outerShapeB","outerDimsA","outerDimsB","batchDimA","batchDimB","batchDimsCompatible","concat","b3dShape","a3d","b3d","a3dId","b3dId","Math","max","sliceImpl","vals","begin","size","isContinous","slice_util","isSliceContinous","xStrides","computeStrides","flatOffset","computeFlatOffset","subarray","decodedData","fromUint8ToStringArray","inBuf","outBuf","outLoc","indexToLoc","inLoc","idx","fromStringArrayToUint8","values","begin_","size_","parseSliceParams","xVals","readSync","outData","stringBytes","res","sliceImplCPU","outVals","rank","xStride","outOffset","beginI","beginJ","endI","xOffset","slice2d","xStride1","xStride2","beginK","endJ","slice3d","xStride3","endK","beginL","k","slice4d","sliceConfig","Slice","batchT

oSpaceNDConfig","BatchToSpaceND","blockShape","crops","prod","reduce","reshaped","getReshaped","permuted","getPermuted","reshapedPermuted","getReshapedPermuted","sliceBeginCoords","getSliceBeginCoords","sliceSize","getSliceSize","xReshaped","result","cast","castConfig","Cast","ceilConfig","Ceil","wasmClip","clipByValueConfig","ClipByValue","clipValueMin","clipValueMax","t","$inputs","filter","shapes","assertParamsConsistent","inputs2D","inputsValShapes","simplyConcat","getArrayFromDType","offset","forEach","colOffset","tIdx","row","resIdx","col","concatImplCPU","finalOutShape","sumInnerDims","innerDims","innerDim","inOffset","concatConfig","Concat","wasmConv2d","conv2DConfig","Conv2D","filterId","dilations","$dataFormat","convertConv2DDataFormat","computeConv2DInfo","inputChannels","outputChannels","outChannels","isSamePad","type","wasmConv2DBackpropInput","conv2DBackpropInputConfig","Conv2DBackpropInput","dy","inputShape","batchSize","inHeight","inWidth","outHeight","outWidth","topPad","leftPad","isChannelsLast","dxStrides","dyStrides","fltS0","fltS1","fltS2","xBatchStride","xRowStride","xColStride","xChannelStride","yBatchStride","yRowStride","yColStride","yChannelStride","dyId","cosConfig","Cos","coshConfig","Cosh","InterpolationMethod","wasmCropAndResize","cropAndResizeConfig","CropAndResize","method","extrapolationValue","cropSize","image","boxes","boxInd","numBoxes","cropHeight","cropWidth","castedData","imagesData","imagesId","boxesId","boxIndId","imagesShapeBytes","wasmCumsum","cumsumConfig","Cumsum","exclusive","reverse","permutation","permutedX","permutedAxis","permutedOut","finalDim","permutedXId","permutedOutId","getUndoAxesPermutation","wasmDepthToSpace","depthToSpaceConfig","DepthToSpace","blockSize","outputHeight","outputWidth","outputDepth","outputShape","xStridesBytes","outputShapeBytes","outStridesBytes","wasmDepthwiseConv2d","depthwiseConv2dNativeConfig","DepthwiseConv2dNative","$dilations","eluConfig","Elu","equalConfig","Equal","expConfig","Exp","expandDims","dim","$dim","splice","expandDimsConfig","ExpandDims","fill","value","fillConfig","Fill","wasmFlipLeftRight","flipLeftRightConfig","FlipLeftRight","imageId","batch","imageHeight","imageWidth","numChannels","floorConfig","Floor","floorDivConfig","FloorDiv","wasmBatchNorm","fusedBatchNormConfig","FusedBatchNorm","varianceEpsilon","mean","variance","scale","meanId","varianceId","offsetId","scaleId","wasmFusedConv2d","fusedConv2DConfig","FusedConv2D","wasmFusedDepthwiseConv2d","fusedDepthwiseConv2DConfig","FusedDepthwiseConv2D","wasmGatherNd","gatherNdConfig","GatherNd","params","indices","resultShape","numSlices","gather_util","prepareAndValidate","indicesShape","sliceRank","indicesId","stridesBytes","wasmGather","gatherV2Config","GatherV2","batchDims","parsedAxis","indicesVals","axisDim","index","shapeInfo","segment_util","collectGatherOpShapeInfo","flattenX","dimSize","indicesSize","flattenIndex","flattenOutputShape","stridesSize","greaterConfig","Greater","greaterEqualConfig","GreaterEqual","leakyReluConfig","LeakyRelu","alpha","lessConfig","Less","lessEqualConfig","LessEqual","logConfig","Log","logicalAndConfig","LogicalAnd","wasmMax","maxConfig","Max","reductionIndices","maximumConfig","Maximum","wasmMaxPool","maxPoolConfig","MaxPool","wasmMean","meanConfig","Mean","reductionAxes","castedInput","wasmMin","minConfig","Min","minimumConfig","Minimum","MirrorPaddingMode","wasmMirrorPad","mirrorPadConfig","MirrorPad","paddings","mode","p","prePaddingsFlat","padTuple","postPaddingsFlat","prePaddingsBytes","postPaddingsBytes","multiplyConfig","Multiply","negConfig","Neg","parseResultStruct","resOffset","HEAPU8","pSelectedIndices","selectedSize","pSelectedScores","pValidOutputs","_free","nonMaxSuppressionV3Config","NonMaxSuppressionV3","iouThreshold","maxOutputSize","scoreThreshold","scores","scoresId","nonMaxSuppressionV4Config","NonMaxSuppressionV4","padToMaxOutputSize","nonMaxSuppressionV5Config","NonMaxSuppressionV5","softNmsSigma","notEqualConfig","NotEqual","wasmOneHot","oneHotConfig","OneHot","depth","onValue","offValue","onesLikeConfig","OnesLike","packConfig","Pack","assertShapesMatch","intermediateTensorInfos","expandedT","wasmPadV2","padV2Config","PadV2","constantValue","powConfig","Pow","wasmPrelu","preluConfig","Prelu","weightsId","wasmProd","prodConfig","Prod","rangeConfig","Range","start","stop","step","makeZerosTypedArray","numElements","abs","ceil","rangeImplCPU","realDivConfig","RealDiv","reluConfig","Relu","relu6Config","Relu6","wasmResizeBilinear","resizeBilinearConfig","ResizeBilinear","images","alignCorners","halfPixelCenters","newHeight","newWidth","oldHeight","oldWidth","xData","wasmReverse","reverseConfig","Reverse","dims","axesBytes","outShapeBytes","wasmRotate","rotateWithOffsetConfig","RotateWithOffset","radians","fillValue","center","centerX","centerY","getImageCenter","fillValues","fillBytes","roundConfig","Round","rsqrtConfig","Rsqrt","wasmScatterNd","scatterNdConfig","ScatterNd","updates","numUpdates","outputSize","scatter_util","calculateShapes","updatesId","wasmSelect","selectConfig","Select","conditi

on","e","conditionId","tId","eId","cRank","tRank","sigmoidConfig","Sigmoid","sinConfig","Sin","softmaxConfig","Softmax","logits","spaceToBatchNDConfig","SpaceToBatchND","completePaddings","paddedX","reshapedPaddedShape","permutedReshapedPaddedPermutation","flattenShape","paddedXReshaped","paddedXT","splitVConfig","SplitV","numOrSizeSplits","$axis","splitSizes","prepareSplitSize","s","xSliceSize","xSlice","sqrtConfig","Sqrt","squareConfig","Square","squaredDifferenceConfig","SquaredDifference","wasmStep","stepConfig","Step","wasmStridedSlice","stridedSliceConfig","StridedSlice","end","beginMask","endMask","ellipsisMask","newAxisMask","shrinkAxisMask","finalShapeSparse","finalShape","isIdentity","sliceDim0","isSimpleSlice","$begin","$end","$strides","sliceInfo","sliced","beginBytes","endBytes","subConfig","Sub","wasmSum","sumConfig","Sum","tanConfig","Tan","tanhConfig","Tanh","wasmTile","wasmTopK","wasmTransform","kernelConfigs","Tile","reps","newShapeBytes","TopK","sorted","outValues","outValuesId","outIndices","outIndicesId","Transform","transforms","interpolation","fillMode","transformsId","interpolationModeId","fillModeId","Unpack","numOutputs","outIndex","outs","ZerosLike","kernelConfig","registerKernel","ENV","env","registerFlag","async","WebAssembly","validate","MessageChannel","port1","postMessage","SharedArrayBuffer","_scriptDir","WasmBackendModuleThreadedSimd","document","currentScript","src","undefined","__filename","GROWABLE_HEAP_I8","wasmMemory","updateGlobalBufferAndViews","HEAP8","GROWABLE_HEAP_U8","GROWABLE_HEAP_I32","HEAP32","GROWABLE_HEAP_U32","HEAPU32","GROWABLE_HEAP_F64","HEAPF64","readyPromiseResolve","readyPromiseReject","Module","Promise","resolve","reject","key","moduleOverrides","hasOwnProperty","quit_","status","toThrow","ENVIRONMENT_IS_WEB","ENVIRONMENT_IS_WORKER","ENVIRONMENT_IS_NODE","ENVIRONMENT_IS_SHELL","window","importScripts","process","versions","node","ENVIRONMENT_IS_PTHREAD","read_","readAsync","readBinary","nodeFS","nodePath","scriptDirectory","locateFile","path","nodeWorkerThreads","require$$0","dirname","__dirname","filename","binary","require$$1","ret","replace","ex","ExitStatus","abort","require$$2","console","error","global","Worker","read","f","data","readbuffer","scriptArgs","quit","print","log","warn","printErr","self","location","href","indexOf","substr","lastIndexOf","url","xhr","XMLHttpRequest","open","send","responseText","responseType","response","onload","onerror","performance","require$$3","wasmBinary","bind","err","warnOnce","text","shown","wasmModule","noExitRuntime","ABORT","getCFunc","ident","func","ccall","returnType","argTypes","opts","toC","string","str","len","stringToUTF8","stackAlloc","array","arr","writeArrayToMemory","cArgs","stack","converter","stackSave","apply","UTF8ToString","Boolean","convertReturnValue","stackRestore","numericArgs","arguments","UTF8ArrayToString","heap","maxBytesToRead","endIdx","u0","u1","u2","String","fromCharCode","ch","ptr","stringToUTF8Array","outIdx","maxBytesToWrite","startIdx","u","charCodeAt","outPtr","lengthBytesUTF8","alignUp","multiple","buf","Int8Array","Int16Array","Uint16Array","Uint32Array","Float32Array","Float64Array","wasmTable","INITIAL_MEMORY","Memory","initial","maximum","shared","byteLength","__ATPRERUN__","__ATINIT__","__ATMAIN__","__ATPOSTRUN__","preRun","addOnPreRun","shift","callRuntimeCallbacks","initRuntime","preMain","postRun","addOnPostRun","cb","unshift","___wasm_call_ctors","runDependencies","dependenciesFulfilled","addRunDependency","removeRunDependency","callback","what","RuntimeError","hasPrefix","prefix","prototype","startsWith","dataURIPrefix","isDataURI","fileURIPrefix","isFileURI","wasmBinaryFile","getBinary","file","getBinaryPromise","fetch","credentials","then","catch","createWasm","info","asmLibraryArg","receiveInstance","instance","module","exports","numWorkersToLoad","PThread","unusedWorkers","w","loadWasmModuleToWorker","receiveInstantiatedSource","output","instantiateArrayBuffer","receiver","instantiate","reason","instantiateStreaming","ASM_CONSTS","10520","10538","$0","$1","setTimeout","__emscripten_do_dispatch_to_thread","initPthreadsJS","callbacks","arg","ERRNO_CODES","EPERM","ENOENT","ESRCH","EINTR","EIO","ENXIO","E2BIG","ENOEXEC","EBADF","ECHILD","EAGAIN","EWOULDBLOCK","ENOMEM","EACCES","EFAULT","ENOTBLK","EBUSY","EEXIST","EXDEV","ENODEV","ENOTDIR","EISDIR","EINVAL","ENFILE","EMFILE","ENOTTY","ETXTBSY","EFBIG","ENOSPC","ESPIPE","EROFS","EMLINK","EPIPE","EDOM","ERANGE","ENOMSG","EIDRM","ECHRNG","EL2NSYNC","EL3HLT","EL3RST","ELNRNG","EUNATCH","ENOCSI","EL2HLT","EDEADLK","ENOLCK","EBADE","EBADR","EXFULL","ENOANO","EBADRQC","EBADSLT","EDEADLOCK","EBFONT","ENOSTR","ENODATA","ETIME","ENOSR","ENONET","ENOPKG","EREMOTE","ENOLINK","EADV","ESRMNT","ECOMM","EPROTO","EMULTIHOP","EDOTDOT","EBADMSG","ENOTUNIQ","EBADFD","EREMCHG","ELIBACC","ELIBBAD","ELIBSCN","ELIBMAX","ELIBEXE

C","ENOSYS","ENOTEMPTY","ENAMETOOLONG","ELOOP","EOPNOTSUPP","EPFNOSUPPORT","ECONNRESET","ENOBUFS","EAFNOSUPPORT","EPROTOTYPE","ENOTSOCK","ENOPROTOOPT","ESHUTDOWN","ECONNREFUSED","EADDRINUSE","ECONNABORTED","ENETUNREACH","ENETDOWN","ETIMEDOUT","EHOSTDOWN","EHOSTUNREACH","EINPROGRESS","EALREADY","EDESTADDRREQ","EMSGSIZE","EPROTONOSUPPORT","ESOCKTNOSUPPORT","EADDRNOTAVAIL","ENETRESET","EISCONN","ENOTCONN","ETOOMANYREFS","EUSERS","EDQUOT","ESTALE","ENOTSUP","ENOMEDIUM","EILSEQ","EOVERFLOW","ECANCELED","ENOTRECOVERABLE","EOWNERDEAD","ESTRPIPE","_emscripten_futex_wake","addr","count","Infinity","mainThreadWaitAddress","Atomics","load","__emscripten_main_thread_futex","mainThreadWoken","compareExchange","notify","killThread","pthread_ptr","pthread","pthreads","worker","terminate","freeThreadData","runningWorkers","cancelThread","cmd","cleanupThread","returnWorkerToPool","_emscripten_get_now","initMainThreadBlock","allocateUnusedWorker","tb","_malloc","headPtr","tlsMemory","store","__emscripten_thread_init","_emscripten_register_main_browser_thread_id","initWorker","threadExitHandlers","setThreadStatus","runExitHandlers","pop","_pthread_self","___pthread_tsd_run_dtors","runExitHandlersAndDeinitThread","exitCode","threadExit","threadCancel","terminateAllThreads","threadInfoStruct","allocatedOwnStack","stackBase","runWithoutMainThreadQueuedCalls","__emscripten_allow_main_runtime_queued_calls","receiveObjectTransfer","onFinishedLoading","onmessage","d","currentProxiedOperationCallerThread","thread","targetThread","_emscripten_main_thread_process_queued_calls","spawnThread","loaded","runPthread","alert","exit","target","lineno","message","on","urlOrBlob","pthreadMainJs","getNewWorker","busySpinWait","msecs","now","establishStackSpace","stackTop","stackMax","_emscripten_stack_set_limits","getNoExitRuntime","invokeEntryPoint","___assert_fail","line","___call_main","argc","argv","_main","setErrNo","___errno_location","_atexit","_emscripten_proxy_to_main_thread_js","__emscripten_notify_thread_queue","targetThreadId","mainThreadId","_abort","_emscripten_asm_const_int","code","sigPtr","argbuf","readAsmConstArgs","_emscripten_conditional_set_current_thread_status","expectedStatus","newStatus","_emscripten_futex_wait","val","timeout","tNow","tEnd","exchange","wait","_emscripten_memcpy_big","dest","num","copyWithin","_emscripten_num_logical_cores","require$$4","cpus","navigator","sync","numCallArgs","serializedNumCallArgs","_emscripten_run_in_main_runtime_thread_js","dateNow","_emscripten_receive_on_main_thread_js_callArgs","readAsmConstArgsArray","double","_emscripten_receive_on_main_thread_js","proxiedFunctionTable","_emscripten_get_heap_size","emscripten_realloc_buffer","grow","_emscripten_resize_heap","requestedSize","oldSize","maxHeapSize","cutDown","overGrownHeapSize","min","JSEvents","inEventHandler","removeAllEventListeners","eventHandlers","_removeHandler","deferredCalls","registerRemoveEventListeners","removeEventListenersRegistered","deferCall","targetFunction","precedence","argsList","arraysHaveEqualContent","arrA","arrB","call","sort","y","removeDeferredCalls","canPerformEventHandlerRequests","currentEventHandler","allowsDeferredCalls","runDeferredCalls","removeAllHandlersOnTarget","eventTypeString","h","removeEventListener","eventListenerFunc","useCapture","registerOrRemoveHandler","eventHandler","jsEventHandler","event","handlerFunc","callbackfunc","addEventListener","queueEventHandlerOnThread_iiii","eventHandlerFunc","eventTypeId","eventData","userData","varargs","__emscripten_call_on_thread","getTargetThreadForEventCallback","getNodeNameForTarget","screen","nodeName","fullscreenEnabled","webkitFullscreenEnabled","stringToNewUTF8","jsString","cString","_emscripten_set_offscreencanvas_size_on_target_thread_js","targetCanvas","width","height","targetCanvasPtr","_emscripten_set_offscreencanvas_size_on_target_thread","maybeCStringToJsString","specialHTMLTargets","findEventTarget","querySelector","findCanvasEventTarget","_emscripten_set_canvas_element_size_calling_thread","canvas","canvasSharedPtr","offscreenCanvas","controlTransferredOffscreen","autoResizeViewport","GLctxObject","GLctx","prevViewport","getParameter","viewport","_emscripten_set_canvas_element_size_main_thread","_emscripten_set_canvas_element_size","_emscripten_set_current_thread_status","_emscripten_set_thread_name","threadId","name","__webgl_enable_ANGLE_instanced_arrays","ctx","ext","getExtension","divisor","first","primcount","__webgl_enable_OES_vertex_array_object","vao","__webgl_enable_WEBGL_draw_buffers","n","bufs","__webgl_enable_WEBGL_multi_draw","multiDrawWebgl","GL","counter","buffers","programs","framebuffers","renderbuffers","textures","uniforms","shaders","vaos","contexts","offscreenCanvases","timerQueriesEXT","programInfos","stringCache","unpackAlignment","recordError","errorCode","lastError","getNewId","table","getSource","shader","source","createContext","webGLContextAttributes","getContext","registerContext","handle",

"context","attributes","version","majorVersion","enableExtensionsByDefault","initExtensions","makeContextCurrent","contextHandle","currentContext","deleteContext","initExtensionsDone","disjointTimerQueryExt","getSupportedExtensions","populateUniformTable","program","ptable","maxUniformLength","maxAttributeLength","maxUniformBlockNameLength","utable","numUniforms","getProgramParameter","getActiveUniform","loc","getUniformLocation","__emscripten_webgl_power_preferences","_emscripten_webgl_do_create_context","powerPreference","contextAttributes","stencil","antialias","premultipliedAlpha","preserveDrawingBuffer","failIfMajorPerformanceCaveat","minorVersion","explicitSwapControl","proxyContextToMainThread","renderViaOffscreenBackBuffer","_emscripten_webgl_create_context","a0","a1","SYSCALLS","mappings","printChar","stream","curr","getStr","get64","low","high","_fd_close","fd","_fd_seek","offset_low","offset_high","whence","newOffset","_fd_write","iov","iovcnt","pnum","_pthread_cleanup_pop","execute","routine","_pthread_cleanup_push","threadParams","stackHigh","stackSize","tis","detached","global_locale","_emscripten_get_global_libc","msg","start_routine","startRoutine","time","transferList","_pthread_create","attr","_emscripten_sync_run_in_main_thread_4","_memalign","__pthread_testcancel_js","_emscripten_check_blocking_allowed","__emscripten_do_pthread_join","block","_emscripten_main_browser_thread_id","threadStatus","threadExitCode","_pthread_join","_sysconf","calledRun","r","c","A","q","l","g","o","z","m","this","run","doRun","implicit","returnCode","runCaller","ready","WasmBackendModule","UTF8Decoder","TextDecoder","endPtr","decode","BackendWasm","KernelBackend","[object
Object]","super","tfjs","initWithThreadsCount","threadsCount","actualThreadsCount","getThreadsCount","DataStorage","engine","dataIdNextNumber","move","numDataIds","kernelMs","refCount","memoryOffset","numBytes","bytesPerElement","registerTensor","byteOffset","typedArrayFromBuffer","force","has","delete","dispose","unreliable","write","getPathToWasmBinary","simdSupported","threadsSupported","wasmModuleFolder","wasmPath","wasmFileMap","init","all","getAsync","factoryConfig","endsWith","blob","Blob","URL","createObjectURL","wasmPathPrefix","customFetch","instantiateWasm","imports","arrayBuffer","createInstantiateWasmFunc","initialized","onAbort","initAborted","mainScriptUrlOrBlob","wasmFactoryThreadedSimd","toString","wasmFactory","wasmBinaryNames","setWasmPath","usePlatformFetch","deprecationWarn","setWasmPaths","prefixOrFileMap","missingPaths","join","setThreadsCount","numThreads","registerBackend"],"mappings":";;;;;;;;;;;;;;;;0rDAkBA,IAAYA,GASC,GCJZ,IAAIC,IDLJ,SAAYF,GACVA,EAAUA,EAAUG,QAAa,GAAK,UACtCH,EAAUA,EAAUI,QAAa,GAAK,UACtCJ,EAAUA,EAAUK,QAAa,GAAK,UACtCL,EAAUA,EAAUM,QAAa,GAAK,UACtCN,EAAUA,EAAUO,QAAa,GAAK,UACtCP,EAAUA,EAAUQ,QAAa,GAAK,UACtCR,EAAUA,EAAUS,QAAa,GAAK,UACtCT,EAAUA,EAAUU,QAAa,GAAK,UACtCV,EAAUA,EAAUW,QAAa,GAAK,UACtCX,EAAUA,EAAUY,QAAa,GAAK,UACtCZ,EAAUA,EAAUa,QAAa,GAAK,UACtCb,EAAUA,EAAUc,QAAa,GAAK,UACtCd,EAAUA,EAAUe,QAAa,GAAK,UACtCf,EAAUA,EAAUgB,QAAa,GAAK,UACtChB,EAAUA,EAAUiB,QAAa,GAAK,UACtCjB,EAAUA,EAAUkB,QAAa,GAAK,UACtClB,EAAUA,EAAUmB,QAAa,GAAK,UACtCnB,EAAUA,EAAUoB,QAAa,GAAK,UACtCpB,EAAUA,EAAUqB,QAAa,GAAK,UACtCrB,EAAUA,EAAUsB,QAAa,GAAK,UACtCtB,EAAUA,EAAUuB,QAAa,GAAK,UACtCvB,EAAUA,EAAUwB,QAAa,GAAK,UACtCxB,EAAUA,EAAUyB,QAAa,GAAK,UACtCzB,EAAUA,EAAU0B,QAAa,GAAK,UACtC1B,EAAUA,EAAU2B,QAAa,GAAK,UACtC3B,EAAUA,EAAU4B,QAAa,GAAK,UACtC5B,EAAUA,EAAU6B,QAAa,GAAK,UACtC7B,EAAUA,EAAU8B,QAAa,GAAK,UACtC9B,EAAUA,EAAU+B,QAAa,GAAK,UACtC/B,EAAUA,EAAUgC,QAAa,GAAK,UACtChC,EAAUA,EAAUiC,QAAa,GAAK,UACtCjC,EAAUA,EAAUkC,QAAa,GAAK,UACtClC,EAAUA,EAAUmC,QAAa,GAAK,UACtCnC,EAAUA,EAAUoC,QAAa,GAAK,UACtCpC,EAAUA,EAAUqC,QAAa,GAAK,UACtCrC,EAAUA,EAAUsC,QAAa,GAAK,UACtCtC,EAAUA,EAAUuC,QAAa,GAAK,UACtCvC,EAAUA,EAAUwC,QAAa,GAAK,UACtCxC,EAAUA,EAAUyC,QAAa,GAAK,UACtCzC,EAAUA,EAAU0C,QAAa,GAAK,UACtC1C,EAAUA,EAAU2C,QAAa,GAAK,UACtC3C,EAAUA,EAAU4C,QAAa,GAAK,UACtC5C,EAAUA,EAAU6C,QAAa,GAAK,UACtC7C,EAAUA,EAAU8C,QAAa,GAAK,UACtC9C,EAAUA,EAAU+C,QAAa,GAAK,UACtC/C,EAAUA,EAAUgD,QAAa,GAAK,UACtChD,EAAUA,EAAUiD,QAAa,GAAK,UACtCjD,EAAUA,EAAUkD,QAAa,GAAK,UACtClD,EAAUA,EAAUmD,QAAa,GAAK,UACtCnD,EAAUA,EAAUoD,QAAa,GAAK,UACtCpD,EAAUA,EAAUqD,QAAa,GAAK,UACtCrD,EAAUA,EAAUsD,QAAa,GAAK,UACtCtD,EAAUA,EAAUuD,QAAa,GAAK,UACtCvD,EAAUA,EAAUwD,QAAa,GAAK,UACtCxD,EAAUA,EAAUyD,QAAa,GAAK,UACtCzD,EAAUA,EAAU0D,QAAa,GAAK,UACtC1D,EAAUA,EAAU2D,QAAa,GAAK,UACtC3D,EAAUA,EAAU4D,QAAa,GAAK,UACtC5D,EAAUA,EAAU6D,QAAa,GAAK,UACtC7D,EAAUA,EAAU8D,QAAa,GAAK,UACtC9D,EAAUA,EAAU+D,QAAa,GAAK,UACtC/D,EAAUA,EAAUgE,QAAa,GAAK,UACtChE,EAAUA,EAAUiE,QAAa,GAAK,UACtCjE,EAAUA,EAAUkE,QAAa,GAAK,UACtClE,EAAUA,EAAUmE,QAAa,GAAK,UACtCnE,EAAUA,EAAUoE,QAAa,GAAK,UACtCpE,EAAUA,EAAUqE,QAAa,GAAK,UACtCrE,EAAUA,EAAUsE,QAAa,GAAK,UACtCtE,EAAUA,EAAUuE,QAAa,GAAK,UACtCvE,EAAUA,EAAUwE,QAAa,GAAK,UACtCxE,EAAUA,EAAUyE,QAAa,GAAK,UACtCzE,EAAUA,EAAU0E,QAAa,GAAK,UACtC1E,EAAUA,EAAU2E,QAAa,GAAK,UACtC3E,EAAUA,EAAU4E,QAAa,GAAK,UACtC5E,EAAUA,EAAU6E,QAAa,GAAK,UACtC7E,EAAUA,EAAU8E,QAAa,GAAK,UACtC9E,EAAUA,EAAU+E,QAAa,GAAK,UACtC/E,EAAUA,EAAUgF,QAAa,GAAK,UACtChF,EAAUA,EAAUiF,QAAa,GAAK,UACtCjF,EAAUA,EAAUkF,QAAa,GAAK,UACtClF,EAAUA,EAAUmF,QAAa,GAAK,UACtCnF,EAAUA,EAAUoF,QAAa,GAAK,UACtCpF,EAAUA,EAAUqF,QAAa,GAAK,UACtCrF,EAAUA,EAAUsF,QAAa,GAAK,UACtCtF,EAAUA,EAAUuF,QAAa,GAAK,UACtCvF,EAAUA,EAAUwF,QAAa,GAAK,UACtCxF,EAAUA,EAAUyF,QAAa,GAAK,UACtCzF,EAAUA,EAAU0F,QAAa,GAAK,UACtC1F,EAAUA,EAAU2F,QAAa,GAAK,UACtC3F,EAAUA,EAAU4F,QAAa,GAAK,UACtC5F,EAAUA,EAAU6F,QAAa,GAAK,UACtC7F,EAAUA,EAAU8F,QAAa,GAAK,UACtC9F,EAAUA,EAAU+F,QAAa,GAAK,UACtC/F,EAAUA,EAAUgG,QAAa,GAAK,UACtChG,EAAUA,EAAUiG,QAAa,GAAK,UACtCjG,EAAUA,EAAUkG,QAAa,GAAK,UACtClG,EAAUA,EAAUmG,QAAa,GAAK,UACtCnG,EAAUA,EAAUoG,QAAa,GAAK,UACtCpG,EAAUA,EAAUqG,QAAa,GAAK,UACtCrG,EAAUA,EAAUsG,QAAa,GAAK,UACtCtG,EAAUA,EAAUuG,QAAa,GAAK,UACtCvG,EAAUA,EAAUwG,QAAa,GAAK,UACtCxG,EAAUA,EAAUyG,QAAa,GAAK,UACtCzG,EAAUA,EAAU0G,QAAa,GAAK,UACtC1G,EAAUA,EAAU2G,QAAa,GAAK,UACtC3G,EAAUA,EAAU4G,QAAa,GAAK,UACtC5G,EAAUA,EAAU6G,QAAa,GAAK,UACtC7G,EAAUA,EAAU8G,QAAa,GAAK,UACtC9G,EAAUA,EAAU+G,QAAa,GAAK,UACtC/G,EAAUA,EAAUgH,QAAa,GAAK,UACtChH,EAAUA,EAAUiH,QAAa,GAAK,UACtCjH,EAAUA,EAAUkH,QAAa,GAAK,UACtClH,EAAUA,EAAUmH,QAAa,GAAK,UACtCnH,EAAUA,EAAUoH,QAAa,GAAK,UACtCpH,EAAUA,EAAUqH,QAAa,GAAK,UACtCrH,EAAUA,EAAUsH,QAAa,GAAK,UACtCtH,EAAUA,EAAUuH,QAAa,GAAK,UACtCvH,EAAUA,EAAUwH,QAAa,GAAK,UACtCxH,EAAUA,EAAUyH,QAAa,GAAK,UACtCzH,EAAUA,EAAU0H,QAAa,GAAK,UACtC1H,EAAUA,EAAU2H,QAAa,GAAK,UACtC3H,EAAUA,EAAU4H,QAAa,GAAK,UACtC5H,EAAUA,EAAU6H,QAAa,GAAK,UACtC7H,EAAUA,EAAU8H,QAAa,GAAK,UACtC9H,EAAUA,EAAU+H,QAAa,GAAK,UACtC/H,EAAUA,EAAUgI,QAAa,GAAK,UACtChI,EAAUA,EAAUiI,QAAa,GAAK,UACtCjI,EAAUA,EAAUkI,QAAa,GAAK,UACtClI,EAAUA,EAAUmI,QAAa,GAAK,UACtCnI,EAAUA,EAAUoI,QAAa,GAAK,UACtCpI,EAAUA,EAA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backend.disposeData(transposed.dataId);\n }\n\n if (keepDims) {\n   // reshape\n   const newShape = backend_util.expandShapeToKeepDim(out.shape, originalAxes);\n   out.shape = newShape;\n }\n\n return out;\n}\n\nexport const anyConfig: KernelConfig = {\n kernelName: Any,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: any as {} as KernelFunc\n};\n"]}

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/\n\nimport {DataType, KernelConfig, TensorInfo, UnaryInputs, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nimport {CppDType} from './types';\n\nexport function createUnaryKernelConfig(\n kernelName: string, outType?: DataType): KernelConfig {\n let wasmFunc: (xId: number, dtype: number, outId: number) => void;\n\n function setupFunc(backend: BackendWasm): void {\n wasmFunc = backend.wasm.cwrap(kernelName, null / void */, [\n 'number', // x_id\n 'number', // dtype\n 'number', // out_id\n]);\n }\n\n function kernelFunc(args: {backend: BackendWasm, inputs: UnaryInputs}):\n TensorInfo {\n const {backend, inputs: {x}} = args;\n const xId = backend.dataIdMap.get(x.dataId).id;\n const out = backend.makeOutput(x.shape, outType || x.dtype);\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n // Short-circuit zero-sized tensors.\n if (util.sizeFromShape(out.shape) === 0) {\n return out;\n }\n\n wasmFunc(xId, CppDType[x.dtype], outId);\n return out;\n }\n\n return {kernelName, backendName: 'wasm', setupFunc, kernelFunc};\n}\n"]}

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backend.wasm.cwrap(Prelu, null /* void */, [\n 'number', // x_id\n 'number', // weights_id\n 'number' // out_id\n]);\n}\n\nfunction prelu(args: {inputs: PreluInputs, backend: BackendWasm}) {\n const {inputs, backend} = args;\n const {x, alpha} = inputs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n const weightsId = backend.dataIdMap.get(alpha.dataId).id;\n\n
let inputId = xId;\n const input = x;\n let castedInput = input;\n if (input.dtype !== 'float32') {\n castedInput = cast({backend, inputs: {x}, attrs: {dtype: 'float32'}});\n inputId = backend.dataIdMap.get(castedInput.dataId).id;\n }\n\n const out = backend.makeOutput(x.shape, 'float32');\n const outId = backend.dataIdMap.get(out.dataId).id;\n wasmPrelu(inputId, weightsId, outId);\n\n if (input.dtype !== 'float32') {\n backend.disposeData(castedInput.dataId);\n }\n return out;\n}\n\nexport const preluConfig: KernelConfig = {\n kernelName: Prelu,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: prelu as {} as KernelFunc\n};\n"]}

Found in path(s):
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernels/Prelu.js.map
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* ==*/

Found in path(s):
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/src/cc/kernels/Floor.cc
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* /tfjs-backend-wasm-zip/tfjs-backend-wasm/src/cc/batch_mat_mul_impl.cc
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No license file was found, but licenses were detected in source scan.

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backend.dataIdMap.get(t.dataId).id;\n const eId = backend.dataIdMap.get(e.dataId).id;\n const out = backend.makeOutput(t.shape, t.dtype);\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n const cRank = condition.shape.length;\n const tRank = t.shape.length;\n\n const offset = cRank === 0 || cRank > 1 || tRank === 1 ?\n   1 :\n   util.sizeFromShape(t.shape.slice(1));\n\n wasmSelect(conditionId, tId, eId, offset, outId);\n return out;\n}\n\nexport const selectConfig: KernelConfig = {\n kernelName: Select,\n backendName: 'wasm',\n kernelFunc: select as {} as KernelFunc,\n setupFunc: setup\n};\n"]}

Found in path(s):
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernels/Select.js.map
No license file was found, but licenses were detected in source scan.

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halfPixelCenters: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm): void {\n wasmResizeBilinear = backend.wasm.cwrap(ResizeBilinear, null /*void*/, [\n 'number', // xId\n 'number', // batch\n 'number', // oldHeight\n 'number', // oldWidth\n 'number', // numChannels\n 'number', // newHeight\n 'number', // newWidth\n 'number', // alignCorners\n 'number', // halfPixelCenters\n 'number' // outId\n]);\n}\n\nfunction resizeBilinear(args: {\n backend: BackendWasm,\n inputs: ResizeBilinearInputs,\n attrs: ResizeBilinearAttrs\n}): TensorInfo {\n const {backend, inputs, attrs} = args;\n\n const {images} = inputs;\n const {alignCorners, halfPixelCenters, size} = attrs;\n const [newHeight, newWidth] = size;\n\n const [batch, oldHeight, oldWidth, numChannels] = images.shape;\n const outShape = [batch, newHeight, newWidth, numChannels];\n\n let xData = backend.dataIdMap.get(images.dataId);\n let castedData;\n if (xData.dtype !== 'float32') {\n castedData =\n cast({backend, inputs: {x: images}, attrs: {dtype: 'float32'}});\n xData = backend.dataIdMap.get(castedData.dataId);\n }\n const xId = xData.id;\n\n const out = backend.makeOutput(outShape, 'float32');\n if (util.sizeFromShape(images.shape) === 0) {\n return out;\n }\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n wasmResizeBilinear(\n xId, batch, oldHeight, oldWidth, numChannels, newHeight, newWidth,\n alignCorners ? 1 : 0, halfPixelCenters ? 1 : 0, outId);\n\n if (castedData != null) {\n backend.disposeData(castedData.dataId);\n }\n\n return out;\n}\n\nexport const resizeBilinearConfig: KernelConfig = {\n kernelName: ResizeBilinear,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: resizeBilinear as {} as KernelFunc\n};\n"]}

Found in path(s):
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernels/ResizeBilinear.js.map
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 * ==\n
*/\n\nimport {KernelConfig, KernelFunc, TensorInfo, Transform, TransformAttrs, TransformInputs, util} from
'@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmTransform: (\n imageId:
number, transformsId: number, isBatchTransform: boolean,\n batch: number, outHeight: number, outWidth:
number, numChannels: number,\n imageWidth: number, imageHeight: number, strides: Uint8Array,\n
stridesLength: number, interpolationModeId: number, fillModeId: number,\n fillValue: number, outId: number)
=> void;\n\nfunction setup(backend: BackendWasm): void {\n wasmTransform = backend.wasm.cwrap(Transform,
null /*void*/, [\n 'number', // imageId\n 'number', // transformsId\n 'bool', // isBatchTransform\n 'number',
// batch\n 'number', // outHeight\n 'number', // outWidth\n 'number', // numChannels\n 'number', //
imageWidth\n 'number',
  // imageHeight\n 'array', // strides\n 'number', // stridesLength\n 'number', // interpolationModeId\n
'number', // fillModeId\n 'number', // fillValue\n 'number' // outId\n]);\n}\n\nfunction transform(\n args:\n
  {backend: BackendWasm, inputs: TransformInputs, attrs: TransformAttrs}):\n TensorInfo {\n const {backend,
inputs, attrs} = args;\n const {image, transforms} = inputs;\n const {interpolation, fillMode, fillValue,
outputShape} = attrs;\n\n const [batch, imageHeight, imageWidth, numChannels] = image.shape;\n const
[outHeight, outWidth] =\n   outputShape != null ? outputShape : [imageHeight, imageWidth];\n const outShape

=\n [batch, outHeight, outWidth,\n numChannels] as [number, number, number, number];\n const strides =\n new Uint8Array(new Int32Array(util.computeStrides(image.shape)).buffer);\n\n const out =
backend.makeOutput(outShape, image.dtype);\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n
const imageData = backend.dataIdMap.get(image.dataId);\n const imageId = imageData.id;\n\n const
transformsData = backend.dataIdMap.get(transforms.dataId);\n const transformsId = transformsData.id;\n\n const
interpolationModeId = interpolation === 'nearest' ? 1 : 2;\n let fillModeId;\n switch (fillMode) {\n case
'constant':\n fillModeId = 1;\n break;\n case 'reflect':\n fillModeId = 2;\n break;\n case 'wrap':\n
fillModeId = 3;\n break;\n case 'nearest':\n fillModeId = 4;\n break;\n default:\n fillModeId = 1;\n
break;\n }\n\n wasmTransform(\n imageId, transformsId, (transforms.shape[0] > 1), batch, outHeight,\n
outWidth, numChannels, imageWidth, imageHeight, strides,\n image.shape.length - 1, interpolationModeId,
fillModeId, fillValue,\n outId);\n\n return out;\n}\n\nexport const transformConfig: KernelConfig = {\n
kernelName: Transform,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc:
transform as {} as KernelFunc\n};\n"]}

Found in path(s):
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernels/Transform.js.map
No license file was found, but licenses were detected in source scan.

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MAAM,CAAC,OAAO,EAAE,CAAC"},"sourcesContent":["/**\n * @license\n * Copyright 2018 Google LLC. All
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governing permissions and\n * limitations under the License.\n *
==\n
*/\n\n// Register the wasm backend.\nimport './index';\n\n// tslint:disable-next-line: no-imports-from-dist\nimport
{setTestEnvs} from '@tensorflow/tfjs-core/dist/jasmine_util';\nimport jasmine from
'jasmine';\n\nError.stackTraceLimit = Infinity;\n\nprocess.on('unhandledRejection', e => {\n throw
e;\n});\n\nsetTestEnvs([{name: 'wasm-node', backendName: 'wasm', isDataSync: true}]);\n\nconst runner = new
jasmine({});\nrunner.loadConfig({spec_files:
['src/**/*_test.ts'], random: false});\n\nif (process.env.JASMINE_SEED) {\n
runner.seed(process.env.JASMINE_SEED);\n}\n\nrunner.execute();\n"]}

Found in path(s):
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/test_node.js.map
No license file was found, but licenses were detected in source scan.

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permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {KernelConfig, Multiply} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from './binary_kernel';\n\nconst supportsFullBroadcast = true;\nexport const multiplyConfig: KernelConfig =\n createBinaryKernelConfig(Multiply, supportsFullBroadcast);\n"]}

Found in path(s):
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernels/Multiply.js.map
No license file was found, but licenses were detected in source scan.

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WASM backend`);\n // permute required axis to inner most axis\n const permutation = backend_util.getAxesPermutation([axis], xRank);\n let permutedX = x;\n if (permutation !== null) {\n permutedX = transpose({inputs: {x}, attrs: {perm: permutation}, backend});\n }\n const permutedAxis = backend_util.getInnerMostAxes(1, xRank)[0];\n backend_util.assertAxesAreInnerMostDims('cumsum', [permutedAxis], xRank);\n\n const permutedOut = backend.makeOutput(permutedX.shape, permutedX.dtype);\n const finalDim = permutedX.shape[permutedAxis];\n const permutedXId = backend.dataIdMap.get(permutedX.dataId).id;\n const permutedOutId = backend.dataIdMap.get(permutedOut.dataId).id;\n wasmCumsum(permutedXId, exclusive ? 1 : 0, reverse ? 1 : 0, finalDim,\n permutedOutId, CppDType[x.dtype]);\n\n // transpose data back if permuted\n let out = permutedOut;\n if (permutation !== null) {\n   const undoPermutation = backend_util.getUndoAxesPermutation(permutation);\n   out = transpose(\n   {inputs: {x: permutedOut}, attrs: {perm: undoPermutation}, backend});\n backend.disposeData(permutedX.dataId);\n   backend.disposeData(permutedOut.dataId);\n }\n return out;\n}\n\nexport const cumsumConfig: KernelConfig = {\n kernelName: Cumsum,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: cumsum as {} as KernelFunc\n};\n"]}

Found in path(s):
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernels/Cumsum.js.map
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{"version":3,"file":"Abs.js","sourceRoot":"","sources":["../../src/kernels/Abs.ts"],"names":[],"mappings":"AAAA;;;;;;;;;;;;;GAeG;AACH,OAAO,EAAC,GAAG,EAAE,MAAM,uBAAuB,CAAC;AAExD,OAAO,EAAC,uBAAuB,EAAC,MAAM,gBAAgB,CAAC;AAEvD,MAAM,CAAC,MAAM,SAAS,GAAe,uBAAuB,CAAC,GAAG,CAAC,CAAC","sourcesContent":["/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n
 * ===\n
*/\nimport {Abs, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\n\nexport const absConfig: KernelConfig = createUnaryKernelConfig(Abs);\n"]}

Found in path(s):
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernels/Abs.js.map
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* ===
*/

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 /tfjs-backend-wasm-zip/tfjs-backend-wasm/src/kernels/All.ts
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 /tfjs-backend-wasm-zip/tfjs-backend-wasm/src/kernels/MirrorPad.ts
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* /tfjs-backend-wasm-zip/tfjs-backend-wasm/src/kernels/Round.ts
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernels/Cosh.d.ts

* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernels/Elu.d.ts
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernels/Cosh.js
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blockShape.length; i < x.shape.length; ++i) {\n   completePaddings.push([0, 0]);\n }\n\n const paddedX = padV2Config.kernelFunc({\n
    inputs: {x},\n   backend,\n   attrs: {paddings: completePaddings, constantValue: 0}\n }) as TensorInfo;\n\n const reshapedPaddedShape =\n   backend_util.getReshaped(paddedX.shape, blockShape, prod, false);\n\n const permutedReshapedPaddedPermutation = backend_util.getPermuted(\n   reshapedPaddedShape.length, blockShape.length, false);\n\n const flattenShape =\n   backend_util.getReshapedPermuted(paddedX.shape, blockShape, prod, false);\n\n const reshapeInputs: ReshapeInputs = {x: paddedX};\n const reshapeAttrs: ReshapeAttrs = {shape: reshapedPaddedShape};\n const paddedXReshaped =\n   reshape({inputs: reshapeInputs, backend, attrs: reshapeAttrs});\n\n const transposeInputs: TransposeInputs = {x: paddedXReshaped};\n const transposeAttrs:\n   TransposeAttrs = {perm: permutedReshapedPaddedPermutation};\n const paddedXT =\n transpose({inputs: transposeInputs, backend, attrs: transposeAttrs});\n\n const resultReshapeInputs: ReshapeInputs = {x: paddedXT};\n
  const resultReshapeAttrs: ReshapeAttrs = {shape: flattenShape};\n const result = reshape(\n   {inputs: resultReshapeInputs, backend, attrs: resultReshapeAttrs});\n\n backend.disposeData(paddedX.dataId);\n backend.disposeData(paddedXReshaped.dataId);\n backend.disposeData(paddedXT.dataId);\n\n return result;\n}\n\nexport const spaceToBatchNDConfig: KernelConfig = {\n kernelName: SpaceToBatchND,\n backendName: 'wasm',\n kernelFunc: spaceToBatchND as {} as KernelFunc\n};\n"]}

Found in path(s):
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernels/SpaceToBatchND.js.map
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* ==*/

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 permissions and\n * limitations under the License.\n *
==\n
*/\nimport {KernelConfig, Maximum} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from './binary_kernel';\nconst supportsFullBroadcast = false;\nexport const maximumConfig: KernelConfig =\n createBinaryKernelConfig(Maximum, supportsFullBroadcast);\n"]}

Found in path(s):
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernels/Maximum.js.map
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 permissions and\n * limitations under the License.\n *
==\n
*/\nimport {KernelConfig, Maximum} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from './binary_kernel';\nconst supportsFullBroadcast = false;\nexport const maximumConfig: KernelConfig =\n createBinaryKernelConfig(Maximum, supportsFullBroadcast);\n"]}

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 permissions and\n * limitations under the License.\n *
==\n
*/\nimport {KernelConfig, Maximum} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from './binary_kernel';\nconst supportsFullBroadcast = false;\nexport const maximumConfig: KernelConfig =\n createBinaryKernelConfig(Maximum, supportsFullBroadcast);\n"]}

Found in path(s):
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No license file was found, but licenses were detected in source scan.

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 permissions and\n * limitations under the License.\n *
==\n
*/\nimport {KernelConfig, Maximum} from '@tensorflow/tfjs-core';\n\nimport {createBinaryKernelConfig} from './binary_kernel';\nconst supportsFullBroadcast = false;\nexport const maximumConfig: KernelConfig =\n createBinaryKernelConfig(Maximum, supportsFullBroadcast);\n"]}

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'number' // out_id\n]);\n}\n\nfunction batchMatMul(args: {\n inputs: BatchMatMulInputs,\n backend: BackendWasm,\n
 attrs: BatchMatMulAttrs\n}) {\n const {inputs, backend, attrs} = args;\n const {a, b} = inputs;\n const {transposeA, transposeB} = attrs;\n\n if (a.dtype !== 'float32' || b.dtype !== 'float32') {\n   throw new Error(\n `BatchMatMul for non non-float32 tensors not yet supported.`);\n }\n\n const aRank = a.shape.length;\n const bRank = b.shape.length;\n\n const innerShapeA = transposeA ? a.shape[aRank - 2] : a.shape[aRank - 1];\n const innerShapeB = transposeB ? b.shape[bRank - 1] : b.shape[bRank - 2];\n\n const outerShapeA = transposeA ? a.shape[aRank - 1] : a.shape[aRank - 2];\n const outerShapeB = transposeB ? b.shape[bRank - 2] : b.shape[bRank - 1];\n\n const outerDimsA = a.shape.slice(0, -2);\n const outerDimsB = b.shape.slice(0, -2);\n\n const batchDimA = util.sizeFromShape(outerDimsA);\n const batchDimB = util.sizeFromShape(outerDimsB);\n\n const batchDimsCompatible =\n   batchDimA === batchDimB || batchDimA === 1 || batchDimB === 1;\n\n util.assert(\n
      aRank >= 2 && bRank >= 2 && batchDimsCompatible,\n   () => `Error in matMul: the input batch dimensions must either be the ` +\n   `same or at least one input batch dimension must be 1. Got input ` +\n `batch dimensions of (${outerDimsA}) and (${outerDimsB}).`);\n\n const outShapeOuterDims =\n   batchDimA > batchDimB ? a.shape.slice(0, -2) : b.shape.slice(0, -2);\n const outShape = outShapeOuterDims.concat([outerShapeA, outerShapeB]);\n\n util.assert(\n   innerShapeA === innerShapeB,\n   () => `Error in matMul: inner shapes (${innerShapeA}) and (` +\n   `${innerShapeB}) of Tensors with shapes ${a.shape} and ` +\n   `${b.shape} and transposeA=${transposeA}` +\n   ` and transposeB=${transposeB} must match.`);\n\n const a3dShape = transposeA ? [batchDimA, innerShapeA, outerShapeA] :\n [batchDimA, outerShapeA, innerShapeA];\n const b3dShape = transposeB ? [batchDimB, outerShapeB, innerShapeB] :\n
                [batchDimB, innerShapeB, outerShapeB];\n\n // The rest of the implementation is designed to operate on rank-3 tensors\n const a3d = reshape({inputs: {x: a}, backend, attrs: {shape: a3dShape}});\n const b3d = reshape({inputs: {x: b}, backend, attrs: {shape: b3dShape}});\n\n const a3dId = backend.dataIdMap.get(a3d.dataId).id;\n const b3dId = backend.dataIdMap.get(b3d.dataId).id;\n\n const leftDim = transposeA ? a3d.shape[2] : a3d.shape[1];\n const rightDim = transposeB ? b3d.shape[1] : b3d.shape[2];\n const batchDim = Math.max(batchDimA, batchDimB);\n\n const out = backend.makeOutput([batchDim, leftDim, rightDim], a3d.dtype);\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n const aShapeBytes = new Uint8Array(new Int32Array(a3d.shape).buffer);\n const bShapeBytes = new Uint8Array(new Int32Array(b3d.shape).buffer);\n\n wasmBatchMatMul(\n   a3dId, aShapeBytes, a3d.shape.length, b3dId, bShapeBytes,\n   b3d.shape.length, transposeA, transposeB,
 outId);\n\n backend.disposeData(a3d.dataId);\n backend.disposeData(b3d.dataId);\n\n out.shape = outShape;\n return out;\n}\n\nexport const batchMatMulConfig: KernelConfig = {\n kernelName: BatchMatMul,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: batchMatMul as {} as KernelFunc\n};\n"]}

Found in path(s):
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernels/BatchMatMul.js.map
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 * ==\n
*/\nimport {KernelConfig, Tanh} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from './unary_kernel';\nexport const tanhConfig: KernelConfig = createUnaryKernelConfig(Tanh);\n"]}

Found in path(s):
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernels/Tanh.js.map
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{"version":3,"file":"All.js","sourceRoot":"","sources":["../../src/kernels/All.ts"],"names":[],"mappings":"AAAA;;;;;;;;;;;;;;;GAeG;AAEH,OAAO,EAAC,GAAG,EAAuB,YAAY,EAAwC,IAAI,EAAC,MAAM,uBAAuB,CAAC;AAIzH,OAAO,EAAC,uBAAuB,EAAC,MAAM,gBAAgB,CAAC;AAEvD,IAAI,OAAiE,CAAC;AAEtE,SAAS,KAAK,CAAC,OAAoB;IACjC,OAAO,GAAG,OAAO,CAAC,IAAI,CAAC,KAAK,CAAC,CAAC,GAAG,EAAE,IAAI,EAAE,IAAI,EAAE,IAAI

args;\n const {axis, keepDims} = attrs;\n const {x} = inputs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n let inputId = xId;\n let input = x;\n\n const {transposed, axes, originalAxes, inputWasTransposed} =\n permuteAxesAndTranspose(x, axis, backend);\n\n if (inputWasTransposed) {\n   const transposedId =\n backend.dataIdMap.get(transposed.dataId).id;\n   input = transposed;\n   inputId = transposedId;\n }\n\n const\n inputRank = input.shape.length;\n backend_util.assertAxesAreInnerMostDims('all', axes, inputRank);\n const\n [outShape, reduceShape] =\n   backend_util.computeOutAndReduceShapes(input.shape, axes);\n const\n reduceSize\n   = util.sizeFromShape(reduceShape);\n\n const out = backend.makeOutput(outShape, x.dtype);\n if\n (util.sizeFromShape(input.shape) !== 0) {\n   const outId = backend.dataIdMap.get(out.dataId).id;\n wasmAll(inputId, reduceSize, outId);\n }\n\n if (inputWasTransposed) {\n   // dispose of the transposed tensor.\n backend.disposeData(transposed.dataId);\n }\n\n if (keepDims) {\n   // reshape\n   const newShape =\n backend_util.expandShapeToKeepDim(out.shape, originalAxes);\n   out.shape = newShape;\n }\n\n return\n out;\n}\n\nexport const allConfig: KernelConfig = {\n kernelName: All,\n backendName: 'wasm',\n setupFunc:\n setup,\n kernelFunc: all as {} as KernelFunc\n};\n"]}

Found in path(s):
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernels/All.js.map
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{"version":3,"file":"Sqrt.js","sourceRoot":"","sources":["../../src/kernels/Sqrt.ts"],"names":[],"mappings":"AAAA;;;;;;;;;;;;;GAeG;AAEH,OAAO,EAAe,IAAI,EAAC,MAAM,uBAAuB,CAAC;AAEzD,OAAO,EAAC,uBAAuB,EAAC,MAAM,gBAAgB,CAAC;AACvD,MAAM,CAAC,MAAM,UAAU,GAAG,uBAAuB,CAAC,IAAI,EAAE,IAAI,CAAC,CAAC","sourcesContent":["/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n
 * ===\n
*/\n\nimport {KernelConfig, Sqrt} from '@tensorflow/tfjs-core';\n\nimport {createUnaryKernelConfig} from
'./unary_kernel';\nexport const sqrtConfig: KernelConfig = createUnaryKernelConfig(Sqrt);\n"]}

Found in path(s):
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernels/Sqrt.js.map
No license file was found, but licenses were detected in source scan.

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==\n
*/\n\nimport {KernelConfig, KernelFunc, SplitV, SplitVAttrs, SplitVInputs, util} from '@tensorflow/tfjs-
core';\nimport {backend_util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from
'../backend_wasm';\n\nimport {slice} from './Slice';\n\nexport function splitV(\n args: {inputs: SplitVInputs, attrs:
SplitVAttrs, backend: BackendWasm}) {\n const {inputs, attrs, backend} = args;\n const {x} = inputs;\n const
{numOrSizeSplits, axis} = attrs;\n\n const $axis = util.parseAxisParam(axis, x.shape)[0];\n\n const splitSizes =
backend_util.prepareSplitSize(x, numOrSizeSplits, $axis);\n const begin = new Array(x.shape.length).fill(0);\n
const size = x.shape.slice();\n return splitSizes.map(s => {\n const xSliceSize = [...size];\n xSliceSize[$axis] =
s;\n const xSlice =\n slice({inputs: {x}, attrs: {begin, size: xSliceSize}, backend});\n begin[$axis] += s;\n
return xSlice;\n });\n}\n\nexport const
splitVConfig: KernelConfig = {\n kernelName: SplitV,\n backendName: 'wasm',\n kernelFunc: splitV as {} as
KernelFunc\n};\n"]}

Found in path(s):
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernels/SplitV.js.map
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 * ========================================================================
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```

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*** */
/**
 * @deprecated Use `setWasmPaths` instead.
 * Sets the path to the `.wasm` file which will be fetched when the wasm
 * backend is initialized. See
 * https://github.com/tensorflow/tfjs/blob/master/tfjs-backend-wasm/README.md#using-bundlers
  * for more details.
 * @param path wasm file path or url
 * @param usePlatformFetch optional boolean to use platform fetch to download
 *   the wasm file, default to false.
 *
 * @doc {heading: 'Environment', namespace: 'wasm'}
 */

Found in path(s):
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/tf-backend-wasm.js
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let reductionAxes = axes;\n if (inputWasTransposed) {\n   const transposedId = backend.dataIdMap.get(transposed.dataId).id;\n   if (transposedId !== xId) {\n   // transpose was not a no-op. We will need to dispose of this\n   // once we are done.\n   input = transposed;\n   inputId = transposedId;\n   reductionAxes = backend_util.getInnerMostAxes(\n   reductionAxes.length, input.shape.length);\n   }\n }\n\n backend_util.assertAxesAreInnerMostDims(\n   'prod', reductionAxes, input.shape.length);\n const [outShape, reduceShape] =\n   backend_util.computeOutAndReduceShapes(input.shape, reductionAxes);\n const reduceSize = util.sizeFromShape(reduceShape);\n\n const out = backend.makeOutput(outShape, input.dtype);\n if (util.sizeFromShape(input.shape) !== 0) {\n   const outId = backend.dataIdMap.get(out.dataId).id;\n   wasmProd(inputId, reduceSize, CppDType[out.dtype], outId);\n }\n\n if (inputWasTransposed) {\n   // dispose of the transposed tensor.\n   backend.disposeData(transposed.dataId);\n }\n\n if (keepDims) {\n   // reshape\n   const newShape = backend_util.expandShapeToKeepDim(out.shape, originalAxes);\n   out.shape = newShape;\n }\n\n return out;\n}\n\nexport const prodConfig: KernelConfig = {\n kernelName: Prod,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: prod as {} as KernelFunc\n};\n"]}

Found in path(s):
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernels/Prod.js.map
No license file was found, but licenses were detected in source scan.

{"version":3,"file":"Pack.js","sourceRoot":"","sources":["../../src/kernels/Pack.ts"],"names":[],"mappings":"AAAA;;;;;;;;;;;;;;GAeG;AAEH,OAAO,EAA2B,IAAI,EAAqC,IAAI,EAAC,MAAM,uBAAuB,CAAC;AAG9G,OAAO,EAAC,MAAM,EAAC,MAAM,UAAU,CAAC;AAChC,OAAO,EAAC,UAAU,EAAC,MAAM,cAAc,CAAC;AAExC,MAAM,UAAU,IAAI,CAAC,EAAC,MAAM,EAAC,MAAM,EAAE,OAAO,EAAE,KAAK,EAAC,EAAC,GAAG,IAAI,CAAC;IACtD,MAAM,EAAC,MAAM,EAAC,IAAI,EAAC,GAAG,KAAK,CAAC;IAC5B,MAAM,EAAC,MAAM,EAAC,GAAG,OAAO,CAAC;IACzB,MAAM,EAAC,MAAM,EAAC,GAAG,MAAM,CAAC;IAExB,MAAM,KAAK,GAAG,MAAM,CAAC,KAAK,CAAC;IAC3B,MAAM,MAAM,GAAG,MAAM,CAAC,MAAM,CAAC;IAC7B,MAAM,QAAQ,GAAG,KAAK,CAAC,MAAM,CAAC;IAE9B,IAAI,QAAQ,KAAK,CAAC,EAAE;QAClB,MAAM,IAAI,KAAK,CAAC,+CAA+C,CAAC,CAAC;KAClE;IAED,MAAM,KAAK,GAAG,KAAK,CAAC,KAAK,CAAC,CAAC,CAAC

core';\nimport {BackendWasm} from '../backend_wasm';\n\nimport {concat} from './Concat';\nimport {expandDims} from './ExpandDims';\n\nexport function pack(\n args: {inputs: PackInputs, backend: BackendWasm, attrs: PackAttrs}):\n TensorInfo {\n const {inputs, backend, attrs} = args;\n const {axis} = attrs;\n\n if (inputs.length === 1) {\n return expandDims(\n {inputs: {input: inputs[0]}, backend, attrs: {dim: axis}});\n }\n\n const shape = inputs[0].shape;\n const dtype = inputs[0].dtype;\n\n inputs.forEach(t => {\n util.assertShapesMatch(\n shape, t.shape,\n 'All tensors passed to stack must have matching shapes');\n util.assert(\n dtype === t.dtype,\n () => 'All tensors passed to stack must have matching dtypes');\n });\n\n const intermediateTensorInfos: TensorInfo[] = [];\n const expandedTensors = inputs.map(t => {\n const expandedT =\n expandDims({inputs: {input: t}, backend, attrs: {dim: axis}});\n intermediateTensorInfos.push(expandedT);\n return expandedT;\n });\n\n const result = concat({inputs: expandedTensors, backend, attrs: {axis}});\n\n intermediateTensorInfos.forEach(t => backend.disposeData(t.dataId));\n\n return result;\n}\n\nexport const packConfig: KernelConfig = {\n kernelName: Pack,\n backendName: 'wasm',\n kernelFunc: pack as {} as KernelFunc\n};\n"]}

Found in path(s):
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernels/Pack.js.map
No license file was found, but licenses were detected in source scan.

{"version":3,"file":"MaxPool.js","sourceRoot":"","sources":["../../src/kernels/MaxPool.ts"],"names":[],"mappings":"AAAA;;;;;;;;;;;;;;;GAeG;AAEH,OAAO,EAAC,YAAY,EAA4B,OAAO,EAAyC,IAAI,EAAC,MAAM,uBAAuB,CAAC;AAInI,IAAI,WAAqE,CAAC;AAE1E,SAAS,KAAK,CAAC,OAAoB;IAAC,WAAW,GAAG,OAAO,CAAC,IAAI,CAAC,KAAK,CAAC,KAAK,CAAC,OAAO,EAAE

OAA2B;CACxC,CAAC","sourcesContent":["/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {backend_util, KernelConfig, KernelFunc, MaxPool, MaxPoolAttrs, MaxPoolInputs, Tensor4D, util} from '@tensorflow/tfjs-core';\n\nimport {BackendWasm} from '../backend_wasm';\n\nlet wasmMaxPool: (\n xId: number, batchSize: number, inputHeight: number, inputWidth: number,\n filterHeight: number, filterWidth: number, padTop: number, padRight: number,\n padBottom: number, padLeft: number, dilationHeight: number,\n dilationWidth: number, strideHeight: number, strideWidth: number,\n inputChannels: number, outputChannels: number, outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmMaxPool = backend.wasm.cwrap(MaxPool, null /* void */, [\n 'number', // xId\n 'number', // batchSize\n 'number', // inputHeight\n 'number', // inputWidth\n 'number',\n // filterHeight\n 'number', // filterWidth\n 'number', // padTop\n 'number', // padRight\n 'number', // padBottom\n 'number', // padLeft\n 'number', // dilationHeight\n 'number', // dilationWidth\n 'number', // strideHeight\n 'number', // strideWidth\n 'number', // inputChannels\n 'number', // outputChannels\n 'number', // outId\n]);\n}\n\nfunction maxPool(\n args: {inputs: MaxPoolInputs, backend: BackendWasm, attrs: MaxPoolAttrs}) {\n const {inputs, attrs, backend} = args;\n\n const x = inputs.x as Tensor4D;\n const xId = backend.dataIdMap.get(x.dataId).id;\n\n // TF API supports int32 input. CPU and WebGL backend also support int32\n // input. WASM backend doesn't support it because it uses xnnpack which only\n // supports float32.\n //\n // Add the following assert only for the WASM backend instead of at core op\n // level.\n //\n // TODO: add support for int32 input.\n util.assert(\n x.dtype === 'float32',\n () =>\n `Error in MaxPool: only float32 input is supported. Got ${x.dtype}.`);\n\n const {filterSize, strides, pad, dimRoundingMode} = attrs;\n const convInfo = backend_util.computePool2DInfo(\n x.shape, filterSize, strides, 1 /* dilations */, pad, dimRoundingMode);\n\n const filterHeight = convInfo.filterHeight;\n const filterWidth = convInfo.filterWidth;\n const padTop = convInfo.padInfo.top;\n const padRight = convInfo.padInfo.right;\n const padBottom = convInfo.padInfo.bottom;\n const padLeft = convInfo.padInfo.left;\n const dilationHeight = convInfo.dilationHeight;\n const dilationWidth = convInfo.dilationWidth;\n const strideHeight = convInfo.strideHeight;\n const strideWidth = convInfo.strideWidth;\n const inputChannels = convInfo.inChannels;\n const outputChannels = convInfo.outChannels;\n\n if (convInfo.dataFormat !== 'channelsLast') {\n throw new Error(\n `wasm backend does not support dataFormat:` +\n `${convInfo.dataFormat}'.\n Please use 'channelsLast'.`);\n }\n\n const out = backend.makeOutput(convInfo.outShape, 'float32');\n const outId = backend.dataIdMap.get(out.dataId).id;\n\n wasmMaxPool(\n xId, x.shape[0], x.shape[1], x.shape[2], filterHeight, filterWidth,\n padTop, padRight, padBottom, padLeft, dilationHeight, dilationWidth,\n strideHeight, strideWidth, inputChannels, outputChannels, outId);\n return out;\n}\n\nexport const maxPoolConfig: KernelConfig = {\n kernelName: MaxPool,\n backendName: 'wasm',\n setupFunc: setup,\n kernelFunc: maxPool as {} as KernelFunc\n};\n"]}

Found in path(s):
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernels/MaxPool.js.map
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{"version":3,"file":"register_all_kernels.js","sourceRoot":"","sources":["../src/register_all_kernels.ts"],"names":[],"mappings":"AAAA;;;;;;;;;;;;;;;GAeG;AACH,yEAAyE;AACzE,6EAA6E;AAC7E,yEAAyE;AACzE,OAAO,EAAE,c

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'./kernels/FusedBatchNorm';\nimport {fusedConv2DConfig} from './kernels/FusedConv2D';\nimport {fusedDepthwiseConv2DConfig} from './kernels/FusedDepthwiseConv2D';\nimport {gatherNdConfig} from './kernels/GatherNd';\nimport {gatherV2Config} from './kernels/GatherV2';\nimport {greaterConfig} from './kernels/Greater';\nimport {greaterEqualConfig} from './kernels/GreaterEqual';\nimport {identityConfig} from './kernels/Identity';\nimport {leakyReluConfig} from './kernels/LeakyRelu';\nimport {lessConfig} from './kernels/Less';\nimport {lessEqualConfig} from './kernels/LessEqual';\nimport {logConfig} from './kernels/Log';\nimport {logicalAndConfig} from './kernels/LogicalAnd';\nimport {maxConfig} from './kernels/Max';\nimport {maximumConfig} from './kernels/Maximum';\nimport {maxPoolConfig} from './kernels/MaxPool';\nimport {meanConfig} from './kernels/Mean';\nimport {minConfig} from './kernels/Min';\nimport {minimumConfig} from './kernels/Minimum';\nimport {mirrorPadConfig} from './kernels/MirrorPad';\nimport {multiplyConfig} from './kernels/Multiply';\nimport {negConfig} from './kernels/Neg';\nimport {nonMaxSuppressionV3Config} from './kernels/NonMaxSuppressionV3';\nimport {nonMaxSuppressionV4Config} from './kernels/NonMaxSuppressionV4';\nimport {nonMaxSuppressionV5Config} from './kernels/NonMaxSuppressionV5';\nimport {notEqualConfig} from './kernels/NotEqual';\nimport {oneHotConfig} from './kernels/OneHot';\nimport {onesLikeConfig} from './kernels/OnesLike';\nimport {packConfig} from './kernels/Pack';\nimport {padV2Config} from './kernels/PadV2';\nimport {powConfig} from './kernels/Pow';\nimport {preluConfig} from './kernels/Prelu';\nimport {prodConfig} from './kernels/Prod';\nimport {rangeConfig} from './kernels/Range';\nimport {realDivConfig} from './kernels/RealDiv';\nimport {reluConfig} from './kernels/Relu';\nimport {relu6Config} from './kernels/Relu6';\nimport {reshapeConfig} from './kernels/Reshape';\nimport {resizeBilinearConfig} from './kernels/ResizeBilinear';\nimport {reverseConfig} from './kernels/Reverse';\nimport {rotateWithOffsetConfig} from './kernels/RotateWithOffset';\nimport {roundConfig} from './kernels/Round';\nimport {rsqrtConfig} from './kernels/Rsqrt';\nimport {scatterNdConfig} from './kernels/ScatterNd';\nimport {selectConfig} from './kernels/Select';\nimport {sigmoidConfig} from './kernels/Sigmoid';\nimport {sinConfig} from './kernels/Sin';\nimport {sliceConfig} from './kernels/Slice';\nimport {softmaxConfig} from './kernels/Softmax';\nimport {spaceToBatchNDConfig} from './kernels/SpaceToBatchND';\nimport {splitVConfig} from './kernels/SplitV';\nimport {sqrtConfig} from './kernels/Sqrt';\nimport {squareConfig} from './kernels/Square';\nimport {squaredDifferenceConfig} from './kernels/SquaredDifference';\nimport {stepConfig} from './kernels/Step';\nimport {stridedSliceConfig} from './kernels/StridedSlice';\nimport {subConfig} from './kernels/Sub';\nimport {sumConfig} from './kernels/Sum';\nimport {tanConfig} from './kernels/Tan';\nimport {tanhConfig} from './kernels/Tanh';\nimport {tileConfig} from './kernels/Tile';\nimport {topKConfig} from './kernels/TopK';\nimport {transformConfig} from './kernels/Transform';\nimport {transposeConfig} from './kernels/Transpose';\nimport {unpackConfig} from './kernels/Unpack';\nimport {zerosLikeConfig} from './kernels/ZerosLike';\n\n// List all kernel configs here\nconst kernelConfigs: KernelConfig[] = [\n absConfig,\n addConfig,\n addNConfig,\n allConfig,\n anyConfig,\n argMaxConfig,\n avgPoolConfig,\n batchMatMulConfig,\n batchToSpaceNDConfig,\n castConfig,\n ceilConfig,\n clipByValueConfig,\n concatConfig,\n conv2DConfig,\n conv2DBackpropInputConfig,\n cosConfig,\n coshConfig,\n cropAndResizeConfig,\n cumsumConfig,\n depthToSpaceConfig,\n depthwiseConv2dNativeConfig,\n eluConfig,\n equalConfig,\n expConfig,\n expandDimsConfig,\n fillConfig,\n flipLeftRightConfig,\n floorConfig,\n floorDivConfig,\n fusedMatMulConfig,\n fusedBatchNormConfig,\n fusedConv2DConfig,\n fusedDepthwiseConv2DConfig,\n gatherNdConfig,\n gatherV2Config,\n greaterConfig,\n greaterEqualConfig,\n identityConfig,\n leakyReluConfig,\n lessConfig,\n lessEqualConfig,\n logConfig,\n logicalAndConfig,\n maxConfig,\n maximumConfig,\n maxPoolConfig,\n meanConfig,\n minConfig,\n minimumConfig,\n mirrorPadConfig,\n multiplyConfig,\n negConfig,\n nonMaxSuppressionV3Config,\n nonMaxSuppressionV4Config,\n nonMaxSuppressionV5Config,\n notEqualConfig,\n oneHotConfig,\n onesLikeConfig,\n packConfig,\n padV2Config,\n powConfig,\n preluConfig,\n prodConfig,\n rangeConfig,\n realDivConfig,\n reluConfig,\n relu6Config,\n reshapeConfig,\n resizeBilinearConfig,\n reverseConfig,\n rotateWithOffsetConfig,\n rsqrtConfig,\n roundConfig,\n

scatterNdConfig,\n selectConfig,\n sigmoidConfig,\n sinConfig,\n sliceConfig,\n softmaxConfig,\n spaceToBatchNDConfig,\n splitVConfig,\n sqrtConfig,\n squareConfig,\n squaredDifferenceConfig,\n stepConfig,\n stridedSliceConfig,\n subConfig,\n sumConfig,\n tanConfig,\n tanhConfig,\n tileConfig,\n topKConfig,\n transformConfig,\n transposeConfig,\n unpackConfig,\n zerosLikeConfig\n];\n\nfor (const kernelConfig of kernelConfigs) {\n registerKernel(kernelConfig);\n}\n"]}

Found in path(s):
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/register_all_kernels.js.map
No license file was found, but licenses were detected in source scan.

{"version":3,"file":"DepthwiseConv2dNative.js","sourceRoot":"","sources":["../../src/kernels/DepthwiseConv2dNative.ts"],"names":[],"mappings":"AAAA;;;;;;;;;;;;;;;GAeG;AAEH,OAAO,EAAC,YAAY,EAAE,qBAAqB,EAA8F,MAAM,uBAAuB,CAAC;AAIvK,IAAI,mBAAmB,CAAC;AAE3B,SAAS,KAAK,CAAC,OAAO,CAAC;IACjC,mBAAmB;QACf,OAAO,CAAC,IAAI,CAAC,KAAK,CAAC,qBAAqB,EAAE,IAAI,CAAC,UAAU,EAAE,YACzD,CAAC;IACR,CAAC;AACH,CAAC;AAED

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==========\n
*/\n\nimport {backend_util, DepthwiseConv2dNative, DepthwiseConv2dNativeAttrs,
DepthwiseConv2dNativeInputs, KernelConfig, KernelFunc, Tensor4D} from '@tensorflow/tfjs-core';\n\nimport
{BackendWasm} from '../backend_wasm';\n\nlet wasmDepthwiseConv2d: (\n xId: number, batchSize: number,
inputHeight: number, inputWidth: number,\n filterId: number, filterHeight: number, filterWidth: number, padTop:
number,\n padRight: number, padBottom: number, padLeft: number, isSamePad: number,\n dilationHeight:
number, dilationWidth: number, strideHeight: number,\n strideWidth: number, inputChannels: number,
outputChannels:
number,\n outId: number) => void;\n\nfunction setup(backend: BackendWasm) {\n wasmDepthwiseConv2d =\n
backend.wasm.cwrap(DepthwiseConv2dNative, null /* void */, [\n 'number', // xId\n 'number', //
batchSize\n 'number', // inputHeight\n 'number', // inputWidth\n 'number', // filterId\n 'number', //
filterHeight\n 'number', // filterWidth\n 'number', // padTop\n 'number', // padRight\n 'number', //
padBottom\n 'number', // padLeft\n 'number', // isSamePad\n 'number', // dilationHeight\n
'number', // dilationWidth\n 'number', // strideHeight\n 'number', // strideWidth\n 'number', //
inputChannels\n 'number', // outputChannels\n 'number', // outId\n]);\n}\n\nfunction
depthwiseConv2d(args: {\n inputs: DepthwiseConv2dNativeInputs,\n backend: BackendWasm,\n attrs:
DepthwiseConv2dNativeAttrs\n}) {\n const {inputs, attrs,
backend} = args;\n\n const {x, filter} = inputs;\n const xId = backend.dataIdMap.get(x.dataId).id;\n const filterId
= backend.dataIdMap.get(filter.dataId).id;\n\n const {strides, dilations, pad, dimRoundingMode} = attrs;\n\n const
$dilations = dilations == null ? [1, 1] : dilations;\n\n const convInfo = backend_util.computeConv2DInfo(\n (x as
Tensor4D).shape, (filter as Tensor4D).shape, strides,\n ($dilations as number | [number, number]), pad,
dimRoundingMode,\n true /* depthwise */);\n\n const filterHeight = convInfo.filterHeight;\n const filterWidth =
convInfo.filterWidth;\n const padTop = convInfo.padInfo.top;\n const padRight = convInfo.padInfo.right;\n const
padBottom = convInfo.padInfo.bottom;\n const padLeft = convInfo.padInfo.left;\n const dilationHeight =
convInfo.dilationHeight;\n const dilationWidth = convInfo.dilationWidth;\n const strideHeight =
convInfo.strideHeight;\n const strideWidth = convInfo.strideWidth;\n const inputChannels =
convInfo.inChannels;\n const outputChannels = convInfo.outChannels;\n const isSamePad =
convInfo.padInfo.type === 'SAME' ? 1 : 0;\n\n if (convInfo.dataFormat !== 'channelsLast') {\n throw new
Error(\n `wasm backend DepthwiseConv2dNative does not support dataFormat:'` +\n
`${convInfo.dataFormat}'. Please use 'channelsLast'.`);\n }\n\n const out =
backend.makeOutput(convInfo.outShape, 'float32');\n const outId = backend.dataIdMap.get(out.dataId).id;\n
wasmDepthwiseConv2d(\n xId, x.shape[0], x.shape[1], x.shape[2], filterId, filterHeight,\n filterWidth,
padTop, padRight, padBottom, padLeft, isSamePad,\n dilationHeight, dilationWidth, strideHeight, strideWidth,
inputChannels,\n outputChannels, outId);\n return out;\n}\n\nexport const depthwiseConv2dNativeConfig:
KernelConfig = {\n kernelName: DepthwiseConv2dNative,\n backendName: 'wasm',\n setupFunc: setup,\n
kernelFunc: depthwiseConv2d as {} as KernelFunc\n};\n"]}

Found in path(s):
* /tfjs-backend-wasm-zip/tfjs-backend-wasm/dist/kernels/DepthwiseConv2dNative.js.map

1.122 @tensorflow/tfjs-backend-webgl 3.11.0

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1.123 @tensorflow/tfjs-backend-cpu 3.11.0

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1.124 @tensorflow-models/body-pix 2.2

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* /tensorflow-models-zip/@tensorflow-models/body-pix/dist/body_pix_test.d.ts
*
 /tensorflow-models-zip/@tensorflow-models/body-pix/dist/single_person/argmax2d_test.js
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* /tensorflow-models-zip/@tensorflow-models/body-pix/dist/single_person/argmax2d_test.d.ts
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* /tensorflow-models-zip/@tensorflow-models/body-pix/dist/setup_test.js
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* /tensorflow-models-zip/@tensorflow-models/body-pix/dist/decode_part_map.js
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* /tensorflow-models-zip/@tensorflow-models/body-pix/dist/saved_models.js
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/tensorflow-models-zip/@tensorflow-models/body-pix/dist/resnet.d.ts
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* /tensorflow-models-zip/@tensorflow-models/body-pix/dist/resnet.js

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{"version":3,"file":"body-pix.esm.js","sources":["../src/decode_part_map.ts","../src/base_model.ts","../src/mobilenet.ts","../src/keypoints.ts","../src/multi_person/util.ts","../src/multi_person/decode_multiple_masks_cpu.ts","../src/multi_person/decode_multiple_masks_webgl.ts","../src/multi_person/decode_instance_masks.ts","../src/multi_person/max_heap.ts","../src/multi_person/build_part_with_score_queue.ts","../src/multi_person/decode_pose.ts","../src/multi_person/decode_multiple_poses.ts","../src/resnet.ts","../src/saved_models.ts","../src/util.ts","../src/body_pix_model.ts","../src/blur.ts","../src/output_rendering_util.ts","../src/part_channels.ts","../src/version.ts"],"sourcesContent":["/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport * as tf from '@tensorflow/tfjs-core';\n\n/**\n * Takes the sigmoid of the part heatmap output and generates a 2d one-hot\n * tensor with ones where the part's score has the maximum value.\n *\n * @param partHeatmapScores\n */\nfunction toFlattenedOneHotPartMap(partHeatmapScores: tf.Tensor3D): tf.Tensor2D {\n const numParts = partHeatmapScores.shape[2];\n const partMapLocations = tf.argMax(partHeatmapScores, 2);\n\n const partMapFlattened = tf.reshape(partMapLocations, [-1]);\n\n return tf.oneHot(partMapFlattened, numParts) as tf.Tensor2D;\n}\n\nfunction clipByMask2d(image: tf.Tensor2D, mask: tf.Tensor2D): tf.Tensor2D {\n return tf.mul(image, mask);\n}\n\n/**\n * Takes the sigmoid of the segmentation output, and generates a segmentation\n * mask with a 1 or 0 at each pixel where there is a person or not a person. The\n * segmentation threshold determines the threshold of a score for a pixel for it\n * to be considered part of a person.\n *\n * @param segmentScores A 3d-tensor of the sigmoid of the segmentation output.\n * @param segmentationThreshold The minimum that segmentation values must have\n * to be considered part of the person. Affects the generation of the\n * segmentation mask and the clipping of the colored part image.\n *\n * @returns A segmentation mask with a 1 or 0 at each pixel where there is a\n * person or not a person.\n */\nexport function toMaskTensor(\n   segmentScores: tf.Tensor2D, threshold: number): tf.Tensor2D {\n return tf.tidy(\n   () =>\n   (tf.cast(tf.greater(\n   segmentScores, tf.scalar(threshold)), 'int32') as tf.Tensor2D));\n}\n\n/**\n * Takes the sigmoid of the person and part map output, and returns a 2d tensor\n * of an image with the corresponding value at each pixel corresponding to the\n * part with the highest value. These part ids are clipped by the segmentation\n * mask. Wherever the a pixel is clipped by the segmentation mask, its value\n * will set to -1, indicating that there is no part in that pixel.\n *\n * @param segmentScores A 3d-tensor of the sigmoid of the segmentation output.\n * @param partHeatmapScores A 3d-tensor of the sigmoid of the part heatmap\n * output. The third dimension corresponds to the part.\n *\n * @returns A 2d tensor of an image with the corresponding value at each pixel\n * corresponding to the part with the highest value. These part ids are clipped\n * by the segmentation mask. It will have values of -1 for pixels that are\n * outside of the body and do not have a corresponding part.\n */\nexport function decodePartSegmentation(\n   segmentationMask: tf.Tensor2D,\n   partHeatmapScores: tf.Tensor3D): tf.Tensor2D {\n const [partMapHeight, partMapWidth, numParts] = partHeatmapScores.shape;\n return tf.tidy(() => {\n   const flattenedMap = toFlattenedOneHotPartMap(partHeatmapScores);\n   const partNumbers = tf.expandDims(tf.range(0, numParts, 1, 'int32'), 1);\n\n   const partMapFlattened =\n   tf.cast(tf.matMul(flattenedMap, partNumbers as tf.Tensor2D), 'int32');\n\n   const partMap = tf.reshape(partMapFlattened, [partMapHeight, partMapWidth]);\n\n   const partMapShiftedUpForClipping = tf.add(partMap, tf.scalar(1, 'int32'));\n\n   return tf.sub(clipByMask2d(\n   partMapShiftedUpForClipping as tf.Tensor2D, segmentationMask)\n   , tf.scalar(1, 'int32'));\n });\n}\n\nexport function decodeOnlyPartSegmentation(partHeatmapScores: tf.Tensor3D):\n   tf.Tensor2D {\n const

[partMapHeight, partMapWidth, numParts] = partHeatmapScores.shape;\n
return tf.tidy(() => {\n const flattenedMap = toFlattenedOneHotPartMap(partHeatmapScores);\n const partNumbers = tf.expandDims(tf.range(0, numParts, 1, 'int32'), 1);\n\n const partMapFlattened =\n tf.cast(tf.matMul(flattenedMap, partNumbers as tf.Tensor2D), 'int32');\n\n return tf.reshape(partMapFlattened, [partMapHeight, partMapWidth]);\n });\n}\n","\n/**\n * @license\n * Copyright 2019 Google Inc. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n
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==\n
*/\n\nimport * as tfconv from '@tensorflow/tfjs-converter';\nimport * as tf from '@tensorflow/tfjs-core';\nimport {BodyPixOutputStride} from './types';\n\n/**\n * BodyPix supports using various convolution neural network models\n * (e.g. ResNet and MobileNetV1) as its underlying base model.\n * The following BaseModel interface defines a unified interface for\n * creating such BodyPix base models. Currently both MobileNet (in\n * ./mobilenet.ts) and ResNet (in ./resnet.ts) implements the BaseModel\n * interface. New base models that conform to the BaseModel interface can be\n * added to BodyPix.\n */\nexport abstract class BaseModel {\n constructor(\n protected readonly model: tfconv.GraphModel,\n public readonly outputStride: BodyPixOutputStride) {\n const inputShape =\n this.model.inputs[0].shape as [number, number, number, number];\n tf.util.assert(\n (inputShape[1] === -1) && (inputShape[2] === -1),\n () => `Input shape [${inputShape[1]}, ${inputShape[2]}] ` +\n `must both be equal to or -1`);\n }\n\n abstract preprocessInput(input: tf.Tensor3D): tf.Tensor3D;\n\n /**\n * Predicts intermediate Tensor representations.\n *\n * @param input The input RGB image of the base model.\n * A Tensor of shape: [`inputResolution`, `inputResolution`, 3].\n *\n * @return A dictionary of base model's intermediate predictions.\n * The returned dictionary should contains the following elements:\n * - heatmapScores: A Tensor3D that represents the keypoint heatmap scores.\n * - offsets: A Tensor3D that represents the offsets.\n * - displacementFwd: A Tensor3D that represents the forward displacement.\n * - displacementBwd: A Tensor3D that represents the backward displacement.\n * - segmentation: A Tensor3D that represents the segmentation of all\n * people.\n * - longOffsets: A Tensor3D that represents the long offsets used for\n * instance grouping.\n * - partHeatmaps: A Tensor3D that represents the body part segmentation.\n */\n predict(input: tf.Tensor3D): {\n heatmapScores: tf.Tensor3D,\n offsets: tf.Tensor3D,\n displacementFwd: tf.Tensor3D,\n displacementBwd: tf.Tensor3D,\n segmentation: tf.Tensor3D,\n partHeatmaps: tf.Tensor3D,\n longOffsets: tf.Tensor3D,\n partOffsets: tf.Tensor3D\n } {\n return tf.tidy(() => {\n const asFloat = this.preprocessInput(tf.cast(input, 'float32'));\n const asBatch = tf.expandDims(asFloat, 0);\n const results = this.model.predict(asBatch) as tf.Tensor4D[];\n const results3d: tf.Tensor3D[] = results.map(y => tf.squeeze(y, [0]));\n const namedResults = this.nameOutputResults(results3d);\n\n return {\n heatmapScores: tf.sigmoid(namedResults.heatmap),\n offsets: namedResults.offsets,\n displacementFwd: namedResults.displacementFwd,\n displacementBwd: namedResults.displacementBwd,\n segmentation: namedResults.segmentation,\n partHeatmaps: namedResults.partHeatmaps,\n longOffsets: namedResults.longOffsets,\n partOffsets: namedResults.partOffsets\n };\n });\n }\n\n // Because MobileNet and ResNet predict() methods output a different order for\n // these values, we have a method that needs to be implemented to order them.\n abstract nameOutputResults(results: tf.Tensor3D[]): {\n heatmap: tf.Tensor3D,\n offsets: tf.Tensor3D,\n displacementFwd: tf.Tensor3D,\n displacementBwd: tf.Tensor3D,\n segmentation: tf.Tensor3D,\n partHeatmaps: tf.Tensor3D,\n longOffsets: tf.Tensor3D,\n partOffsets: tf.Tensor3D\n };\n\n /**\n * Releases the CPU and GPU memory allocated by the model.\n */\n dispose() {\n this.model.dispose();\n }\n}\n","/**\n * @license\n * Copyright 2019 Google Inc. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0

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==========\n
*/\n\nimport * as tf from '@tensorflow/tfjs-core';\n\nimport {BaseModel} from './base_model';\n\nexport class MobileNet extends BaseModel {\n preprocessInput(input: tf.Tensor3D): tf.Tensor3D {\n // Normalize the pixels [0, 255] to be between [-1, 1].\n return tf.tidy(() => tf.sub(tf.div(input, 127.5), 1.0));\n }\n\n nameOutputResults(results: tf.Tensor3D[]) {\n const [\n offsets,\n segmentation,\n partHeatmaps,\n longOffsets,\n heatmap,\n displacementFwd,\n displacementBwd,\n partOffsets,\n] = results;\n return {\n offsets,\n segmentation,\n partHeatmaps,\n longOffsets,\n heatmap,\n displacementFwd,\n displacementBwd,\n partOffsets\n };\n }\n}\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n
/\n\nexport type Tuple<T> = [T, T];\nexport type StringTuple = Tuple<string>;\nexport type NumberTuple = Tuple<number>;\n\nexport const PART_NAMES = [\n 'nose', 'leftEye', 'rightEye', 'leftEar', 'rightEar', 'leftShoulder',\n 'rightShoulder', 'leftElbow', 'rightElbow', 'leftWrist', 'rightWrist',\n 'leftHip', 'rightHip', 'leftKnee', 'rightKnee', 'leftAnkle', 'rightAnkle'\n];\n\nexport const NUM_KEYPOINTS = PART_NAMES.length;\n\nexport interface NumberDict {\n [jointName: string]: number;\n}\n\nexport const PART_IDS =\n PART_NAMES.reduce((result: NumberDict, jointName, i): NumberDict => {\n result[jointName] = i;\n return result;\n }, {});\n\nconst CONNECTED_PART_NAMES: StringTuple[] = [\n ['leftHip', 'leftShoulder'], ['leftElbow', 'leftShoulder'],\n ['leftElbow', 'leftWrist'], ['leftHip', 'leftKnee'],\n ['leftKnee', 'leftAnkle'], ['rightHip', 'rightShoulder'],\n ['rightElbow', 'rightShoulder'], ['rightElbow', 'rightWrist'],\n ['rightHip', 'rightKnee'], ['rightKnee', 'rightAnkle'],\n ['leftShoulder', 'rightShoulder'], ['leftHip', 'rightHip']\n];\n\n/\n * Define the skeleton. This defines the parent->child relationships of our\n * tree. Arbitrarily this defines the nose as the root of the tree, however\n * since we will infer the displacement for both parent->child and\n * child->parent, we can define the tree root as any node.\n */\nexport const POSE_CHAIN: StringTuple[] = [\n ['nose', 'leftEye'], ['leftEye', 'leftEar'], ['nose', 'rightEye'],\n ['rightEye', 'rightEar'], ['nose', 'leftShoulder'],\n ['leftShoulder', 'leftElbow'], ['leftElbow', 'leftWrist'],\n ['leftShoulder', 'leftHip'], ['leftHip', 'leftKnee'],\n ['leftKnee', 'leftAnkle'], ['nose', 'rightShoulder'],\n ['rightShoulder', 'rightElbow'], ['rightElbow', 'rightWrist'],\n ['rightShoulder', 'rightHip'], ['rightHip', 'rightKnee'],\n ['rightKnee', 'rightAnkle']\n];\n\nexport const CONNECTED_PART_INDICES = CONNECTED_PART_NAMES.map(\n ([jointNameA, jointNameB]) =>\n ([PART_IDS[jointNameA], PART_IDS[jointNameB]]));\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n
*/\n\nimport {NUM_KEYPOINTS} from '../keypoints';\nimport {Padding, Part, TensorBuffer3D, Vector2D} from

'../types';\n\nexport function getScale(\n [height, width]: [number,
number],\n [inputResolutionY, inputResolutionX]: [number, number],\n padding: Padding): [number, number]
{\n const {top: padT, bottom: padB, left: padL, right: padR} = padding;\n const scaleY = inputResolutionY / (padT
+ padB + height);\n const scaleX = inputResolutionX / (padL + padR + width);\n return [scaleX,
scaleY];\n}\n\nexport function getOffsetPoint(\n y: number, x: number, keypoint: number, offsets:
TensorBuffer3D): Vector2D {\n return {\n y: offsets.get(y, x, keypoint),\n x: offsets.get(y, x, keypoint +
NUM_KEYPOINTS)\n };\n}\n\nexport function getImageCoords(\n part: Part, outputStride: number, offsets:
TensorBuffer3D): Vector2D {\n const {heatmapY, heatmapX, id: keypoint} = part;\n const {y, x} =
getOffsetPoint(heatmapY, heatmapX, keypoint, offsets);\n return {\n x: part.heatmapX * outputStride + x,\n y:
part.heatmapY * outputStride + y\n };\n}\n\nexport function fillArray<T>(element: T, size: number): T[] {\n const
result: T[] = new Array(size);\n\n
for (let i = 0; i < size; i++) {\n result[i] = element;\n }\n\n return result;\n}\n\nexport function clamp(a: number,
min: number, max: number): number {\n if (a < min) {\n return min;\n }\n if (a > max) {\n return max;\n }\n
return a;\n}\n\nexport function squaredDistance(\n y1: number, x1: number, y2: number, x2: number): number {\n
const dy = y2 - y1;\n const dx = x2 - x1;\n return dy * dy + dx * dx;\n}\n\nexport function addVectors(a:
Vector2D, b: Vector2D): Vector2D {\n return {x: a.x + b.x, y: a.y + b.y};\n}\n\nexport function clampVector(a:
Vector2D, min: number, max: number): Vector2D {\n return {y: clamp(a.y, min, max), x: clamp(a.x, min,
max)};\n}\n","/**\n * @license\n * Copyright 2019 Google Inc. All Rights Reserved.\n * Licensed under the
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==\n
*/\n\nimport {NUM_KEYPOINTS} from '../keypoints';\nimport {Padding, Pose} from '../types';\n\nimport
{getScale} from './util';\n\ninterface Pair {\n x: number;\n y: number;\n}\n\nfunction computeDistance(embedding:
Pair[], pose: Pose, minPartScore = 0.3) {\n let distance = 0.0;\n let numKpt = 0;\n for (let p = 0; p <
embedding.length; p++) {\n if (pose.keypoints[p].score > minPartScore) {\n numKpt += 1;\n distance +=
(embedding[p].x - pose.keypoints[p].position.x) ** 2 +\n (embedding[p].y - pose.keypoints[p].position.y) **
2;\n }\n }\n
if (numKpt === 0) {\n distance = Infinity;\n } else {\n distance = distance / numKpt;\n }\n return
distance;\n}\n\nfunction convertToPositionInOuput(\n position: Pair, [padT, padL]: [number, number],\n
[scaleX, scaleY]: [number, number], stride: number): Pair {\n const y = Math.round(((padT + position.y + 1.0) *
scaleY - 1.0) / stride);\n const x = Math.round(((padL + position.x + 1.0) * scaleX - 1.0) / stride);\n return {x,
y};\n}\n\nfunction getEmbedding(\n location: Pair, keypointIndex: number,\n convertToPosition: (pair: Pair) =>
Pair, outputResolutionX: number,\n longOffsets: Float32Array, refineSteps: number,\n [height, width]: [number,
number]): Pair {\n const newLocation = convertToPosition(location);\n\n const nn = newLocation.y *
outputResolutionX + newLocation.x;\n let dy = longOffsets[NUM_KEYPOINTS * (2 * nn) + keypointIndex];\n let
dx = longOffsets[NUM_KEYPOINTS * (2 * nn + 1) + keypointIndex];\n let y = location.y + dy;\n let x =
location.x
+ dx;\n for (let t = 0; t < refineSteps; t++) {\n y = Math.min(y, height - 1);\n x = Math.min(x, width - 1);\n
const newPos = convertToPosition({x, y});\n const nn = newPos.y * outputResolutionX + newPos.x;\n dy =
longOffsets[NUM_KEYPOINTS * (2 * nn) + keypointIndex];\n dx = longOffsets[NUM_KEYPOINTS * (2 * nn
+ 1) + keypointIndex];\n y = y + dy;\n x = x + dx;\n }\n\n return {x, y};\n}\n\nfunction
matchEmbeddingToInstance(\n location: Pair, longOffsets: Float32Array, poses: Pose[],\n numKptForMatching:
number, [padT, padL]: [number, number],\n [scaleX, scaleY]: [number, number], outputResolutionX: number,\n
[height, width]: [number, number], stride: number,\n refineSteps: number): number {\n const embed: Pair[] = [];\n

```
const convertToPosition = (pair: Pair) =>\n      convertToPositionInOuput(pair, [padT, padL], [scaleX, scaleY],
stride);\n\n  for (let keypointsIndex = 0; keypointsIndex < numKptForMatching;\n       keypointsIndex++) {\n
    const embedding = getEmbedding(\n         location, keypointsIndex, convertToPosition, outputResolutionX,\n
longOffsets, refineSteps, [height, width]);\n\n    embed.push(embedding);\n  }\n\n  let kMin = -1;\n  let kMinDist =
Infinity;\n  for (let k = 0; k < poses.length; k++) {\n    const dist = computeDistance(embed, poses[k]);\n    if (dist <
kMinDist) {\n      kMin = k;\n      kMinDist = dist;\n    }\n  }\n  return kMin;\n}\n\nfunction getOutputResolution(\n
 [inputResolutionY, inputResolutionX]: [number, number],\n    stride: number): [number, number] {\n  const
outputResolutionX = Math.round((inputResolutionX - 1.0) / stride + 1.0);\n  const outputResolutionY =
Math.round((inputResolutionY - 1.0) / stride + 1.0);\n  return [outputResolutionX, outputResolutionY];\n}\n\nexport
function decodeMultipleMasksCPU(\n    segmentation: Uint8Array, longOffsets: Float32Array,\n
posesAboveScore: Pose[], height: number, width: number, stride: number,\n    [inHeight, inWidth]: [number,
 number], padding: Padding,\n    refineSteps: number, numKptForMatching = 5): Uint8Array[] {\n  const dataArrays
=\n      posesAboveScore.map(x => new Uint8Array(height * width).fill(0));\n\n  const {top: padT, left: padL} =
padding;\n\n  const [scaleX, scaleY] =\n      getScale([height, width], [inHeight, inWidth], padding);\n  const
[outputResolutionX, ] =\n    getOutputResolution([inHeight, inWidth], stride);\n  for (let i = 0; i < height; i += 1) {\n
  for (let j = 0; j < width; j += 1) {\n      const n = i * width + j;\n      const prob = segmentation[n];\n      if (prob ===
1) {\n        const kMin = matchEmbeddingToInstance(\n            {x: j, y: i}, longOffsets, posesAboveScore,
numKptForMatching,\n            [padT, padL], [scaleX, scaleY], outputResolutionX, [height, width],\n            stride,
refineSteps);\n        if (kMin >= 0) {\n          dataArrays[kMin][n] = 1;\n        }\n      }\n    }\n  }\n\n  return
dataArrays;\n}\n\nexport function decodeMultiplePartMasksCPU(\n
    segmentation: Uint8Array, longOffsets: Float32Array,\n    partSegmentaion: Uint8Array, posesAboveScore:
Pose[], height: number,\n    width: number, stride: number, [inHeight, inWidth]: [number, number],\n    padding:
Padding, refineSteps: number,\n    numKptForMatching = 5): Int32Array[] {\n  const dataArrays =\n
posesAboveScore.map(x => new Int32Array(height * width).fill(-1));\n\n  const {top: padT, left: padL} =
padding;\n\n  const [scaleX, scaleY] =\n      getScale([height, width], [inHeight, inWidth], padding);\n  const
[outputResolutionX, ] =\n    getOutputResolution([inHeight, inWidth], stride);\n\n  for (let i = 0; i < height; i += 1)
{\n    for (let j = 0; j < width; j += 1) {\n      const n = i * width + j;\n      const prob = segmentation[n];\n      if (prob
=== 1) {\n        const kMin = matchEmbeddingToInstance(\n            {x: j, y: i}, longOffsets, posesAboveScore,
numKptForMatching,\n            [padT, padL], [scaleX, scaleY], outputResolutionX, [height,
 width],\n            stride, refineSteps);\n        if (kMin >= 0) {\n          dataArrays[kMin][n] = partSegmentaion[n];\n
  }\n      }\n    }\n  }\n\n  return dataArrays;\n}\n","/**\n * @license\n * Copyright 2019 Google Inc. All Rights
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OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language
governing permissions and\n * limitations under the License.\n *
==========================================================================\n
*/\n\nimport * as tf from '@tensorflow/tfjs-core';\nimport * as tf_webgl from '@tensorflow/tfjs-backend-
webgl';\n\nimport
 {NUM_KEYPOINTS} from '../keypoints';\nimport {Padding, Pose} from '../types';\nimport {getScale} from
'./util';\n\nexport function decodeMultipleMasksWebGl(\n    segmentation: tf.Tensor2D, longOffsets: tf.Tensor3D,\n
  posesAboveScore: Pose[], height: number, width: number, stride: number,\n    [inHeight, inWidth]: [number,
number], padding: Padding,\n    refineSteps: number, minKptScore: number,\n    maxNumPeople: number):
tf.TensorInfo {\n  // The height/width of the image/canvas itself.\n  const [origHeight, origWidth] =
segmentation.shape;\n  // The height/width of the output of the model.\n  const [outHeight, outWidth] =
longOffsets.shape.slice(0, 2);\n\n  const shapedLongOffsets: tf.Tensor4D =\n      tf.reshape(longOffsets, [outHeight,
outWidth, 2, NUM_KEYPOINTS]);\n\n  // Make pose tensor of shape [MAX_NUM_PEOPLE,
```

NUM_KEYPOINTS, 3] where\n // the last 3 coordinates correspond to the score, h and w coordinate of that\n // keypoint.\n const poseVals
 = new Float32Array(maxNumPeople * NUM_KEYPOINTS * 3).fill(0.0);\n for (let i = 0; i < posesAboveScore.length; i++) {\n const poseOffset = i * NUM_KEYPOINTS * 3;\n const pose = posesAboveScore[i];\n for (let kp = 0; kp < NUM_KEYPOINTS; kp++) {\n const keypoint = pose.keypoints[kp];\n const offset = poseOffset + kp * 3;\n poseVals[offset] = keypoint.score;\n poseVals[offset + 1] = keypoint.position.y;\n poseVals[offset + 2] = keypoint.position.x;\n }\n }\n\n const [scaleX, scaleY] =\n getScale([height, width], [inHeight, inWidth], padding);\n\n const posesTensor = tf.tensor(poseVals, [maxNumPeople, NUM_KEYPOINTS, 3]);\n\n const {top: padT, left: padL} = padding;\n\n const program: tf_webgl.GPGPUProgram = {\n variableNames: ['segmentation', 'longOffsets', 'poses'],\n outputShape: [origHeight, origWidth],\n userCode: `\n int convertToPositionInOutput(int pos, int pad, float scale, int stride) {\n return round(((float(pos +
 pad) + 1.0) * scale - 1.0) / float(stride));\n }\n\n float convertToPositionInOutputFloat(\n int pos, int pad, float scale, int stride) {\n return ((float(pos + pad) + 1.0) * scale - 1.0) / float(stride);\n }\n\n float dist(float x1, float y1, float x2, float y2) {\n return pow(x1 - x2, 2.0) + pow(y1 - y2, 2.0);\n }\n\n float sampleLongOffsets(float h, float w, int d, int k) {\n float fh = fract(h);\n float fw = fract(w);\n int clH = int(ceil(h));\n int clW = int(ceil(w));\n int flH = int(floor(h));\n int flW = int(floor(w));\n float o11 = getLongOffsets(flH, flW, d, k);\n float o12 = getLongOffsets(flH, clW, d, k);\n float o21 = getLongOffsets(clH, flW, d, k);\n float o22 = getLongOffsets(clH, clW, d, k);\n float o1 = mix(o11, o12, fw);\n float o2 = mix(o21, o22, fw);\n return mix(o1, o2, fh);\n }\n\n int findNearestPose(int h, int w) {\n float prob = getSegmentation(h, w);\n
  if (prob < 1.0) {\n return -1;\n }\n\n // Done(Tyler): convert from output space h/w to strided space.\n float stridedH = convertToPositionInOutputFloat(\n h, ${padT}, ${scaleY}, ${stride});\n float stridedW = convertToPositionInOutputFloat(\n w, ${padL}, ${scaleX}, ${stride});\n\n float minDist = 1000000.0;\n int iMin = -1;\n for (int i = 0; i < ${maxNumPeople}; i++) {\n float curDistSum = 0.0;\n int numKpt = 0;\n for (int k = 0; k < ${NUM_KEYPOINTS}; k++) {\n float dy = sampleLongOffsets(stridedH, stridedW, 0, k);\n float dx = sampleLongOffsets(stridedH, stridedW, 1, k);\n\n float y = float(h) + dy;\n float x = float(w) + dx;\n\n for (int s = 0; s < ${refineSteps}; s++) {\n int yRounded = round(min(y, float(${height - 1.0})));\n int xRounded = round(min(x, float(${width - 1.0})));\n\n float yStrided = convertToPositionInOutputFloat(\n yRounded, ${padT}, ${scaleY}, ${stride});\n float xStrided = convertToPositionInOutputFloat(\n xRounded, ${padL}, ${scaleX}, ${stride});\n\n float dy = sampleLongOffsets(yStrided, xStrided, 0, k);\n float dx = sampleLongOffsets(yStrided, xStrided, 1, k);\n\n y = y + dy;\n x = x + dx;\n }\n\n float poseScore = getPoses(i, k, 0);\n float poseY = getPoses(i, k, 1);\n float poseX = getPoses(i, k, 2);\n if (poseScore > ${minKptScore}) {\n numKpt = numKpt + 1;\n curDistSum = curDistSum + dist(x, y, poseX, poseY);\n }\n }\n if (numKpt > 0 && curDistSum / float(numKpt) < minDist) {\n minDist = curDistSum / float(numKpt);\n iMin = i;\n }\n }\n return iMin;\n }\n\n void main() {\n ivec2 coords = getOutputCoords();\n int nearestPose = findNearestPose(coords[0], coords[1]);\n
  setOutput(float(nearestPose));\n }\n `\n };\n const webglBackend = tf.backend() as tf_webgl.MathBackendWebGL;\n return webglBackend.compileAndRun(\n program, [segmentation, shapedLongOffsets, posesTensor]);\n}\n","/**\n * @license\n * Copyright 2019 Google Inc. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *

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==========================================================================\n
*/\n\nimport * as tf from '@tensorflow/tfjs-core';\nimport
 {getBackend} from '@tensorflow/tfjs-core';\n\nimport {Padding, PartSegmentation, PersonSegmentation, Pose}
from '../types';\n\nimport {decodeMultipleMasksCPU, decodeMultiplePartMasksCPU} from
'./decode_multiple_masks_cpu';\nimport {decodeMultipleMasksWebGl} from
'./decode_multiple_masks_webgl';\n\nexport function toPersonKSegmentation(\n    segmentation: tf.Tensor2D, k:
number): tf.Tensor2D {\n  return tf.tidy(\n      () => (tf.cast(tf.equal(\n          segmentation, tf.scalar(k)), 'int32') as
tf.Tensor2D));\n}\n\nexport function toPersonKPartSegmentation(\n    segmentation: tf.Tensor2D, bodyParts:
tf.Tensor2D, k: number): tf.Tensor2D {\n  return tf.tidy(\n      () => tf.sub(tf.mul(tf.cast(tf.equal(\n
segmentation, tf.scalar(k)), 'int32'), tf.add(bodyParts, 1)), 1));\n}\n\nfunction isWebGlBackend() {\n  return
getBackend() === 'webgl';\n}\n\nexport async function decodePersonInstanceMasks(\n    segmentation:
tf.Tensor2D, longOffsets: tf.Tensor3D, poses:
 Pose[],\n    height: number, width: number, stride: number,\n    [inHeight, inWidth]: [number, number], padding:
Padding, minPoseScore = 0.2,\n    refineSteps = 8, minKeypointScore = 0.3,\n    maxNumPeople = 10):
Promise<PersonSegmentation[]> {\n  // Filter out poses with smaller score.\n  const posesAboveScore =
poses.filter(pose => pose.score >= minPoseScore);\n\n  let personSegmentationsData: Uint8Array[];\n\n  if
(isWebGlBackend()) {\n    const personSegmentations = tf.tidy(() => {\n      const masksTensorInfo =
decodeMultipleMasksWebGl(\n          segmentation, longOffsets, posesAboveScore, height, width, stride,\n
[inHeight, inWidth], padding, refineSteps, minKeypointScore,\n          maxNumPeople);\n      const masksTensor =
tf.engine().makeTensorFromDataId(\n          masksTensorInfo.dataId, masksTensorInfo.shape,\n
masksTensorInfo.dtype) as tf.Tensor2D;\n\n      return posesAboveScore.map(\n          (_, k) =>
toPersonKSegmentation(masksTensor, k));\n    });\n\n
   personSegmentationsData =\n        (await Promise.all(personSegmentations.map(mask => mask.data())) as\n
Uint8Array[]);\n\n    personSegmentations.forEach(x => x.dispose());\n  } else {\n    const segmentationsData =
await segmentation.data() as Uint8Array;\n    const longOffsetsData = await longOffsets.data() as Float32Array;\n\n
 personSegmentationsData = decodeMultipleMasksCPU(\n        segmentationsData, longOffsetsData,
posesAboveScore, height, width,\n        stride, [inHeight, inWidth], padding, refineSteps);\n  }\n\n  return
personSegmentationsData.map(\n      (data, i) => ({data, pose: posesAboveScore[i], width, height}));\n}\n\nexport
async function decodePersonInstancePartMasks(\n    segmentation: tf.Tensor2D, longOffsets: tf.Tensor3D,\n
partSegmentation: tf.Tensor2D, poses: Pose[], height: number, width: number,\n    stride: number, [inHeight,
inWidth]: [number, number], padding: Padding,\n    minPoseScore = 0.2, refineSteps = 8, minKeypointScore =
0.3,\n
   maxNumPeople = 10): Promise<PartSegmentation[]> {\n  const posesAboveScore = poses.filter(pose =>
pose.score >= minPoseScore);\n\n  let partSegmentationsByPersonData: Int32Array[];\n\n  if (isWebGlBackend())
{\n    const partSegmentations = tf.tidy(() => {\n      const masksTensorInfo = decodeMultipleMasksWebGl(\n
segmentation, longOffsets, posesAboveScore, height, width, stride,\n          [inHeight, inWidth], padding,
refineSteps, minKeypointScore,\n          maxNumPeople);\n      const masksTensor =
tf.engine().makeTensorFromDataId(\n          masksTensorInfo.dataId, masksTensorInfo.shape,\n
masksTensorInfo.dtype) as tf.Tensor2D;\n\n      return posesAboveScore.map(\n          (_, k) =>\n
toPersonKPartSegmentation(masksTensor, partSegmentation, k));\n    });\n\n    partSegmentationsByPersonData =\n
     (await Promise.all(partSegmentations.map(x => x.data()))) as\n        Int32Array[];\n\n
partSegmentations.forEach(x => x.dispose());\n  } else
 {\n    const segmentationsData = await segmentation.data() as Uint8Array;\n    const longOffsetsData = await
longOffsets.data() as Float32Array;\n    const partSegmentaionData = await partSegmentation.data() as
Uint8Array;\n\n    partSegmentationsByPersonData = decodeMultiplePartMasksCPU(\n        segmentationsData,
longOffsetsData, partSegmentaionData,\n        posesAboveScore, height, width, stride, [inHeight, inWidth],
padding,\n        refineSteps);\n  }\n\n  return partSegmentationsByPersonData.map(\n      (data, k) => ({pose:
posesAboveScore[k], data, height, width}));\n}\n","/**\n * @license\n * Copyright 2019 Google Inc. All Rights
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==========\n */\n\n// algorithm based on Coursera Lecture from Algorithms, Part 1:\n// https://www.coursera.org/learn/algorithms-part1/lecture/ZjoSM/heapsort\n\nfunction half(k: number) {\n return Math.floor(k / 2);\n}\n\nexport class MaxHeap<T> {\n private priorityQueue: T[];\n private numberOfElements: number;\n private getElementValue: (element: T) => number;\n\n constructor(maxSize: number, getElementValue: (element: T) => number) {\n this.priorityQueue = new Array(maxSize);\n this.numberOfElements = -1;\n this.getElementValue = getElementValue;\n }\n\n public enqueue(x: T): void {\n this.priorityQueue[++this.numberOfElements] = x;\n this.swim(this.numberOfElements);\n }\n\n public dequeue(): T {\n const max = this.priorityQueue[0];\n this.exchange(0, this.numberOfElements--);\n this.sink(0);\n this.priorityQueue[this.numberOfElements + 1] = null;\n return max;\n }\n\n public empty(): boolean {\n return this.numberOfElements === -1;\n }\n\n public size(): number {\n return this.numberOfElements + 1;\n }\n\n public all(): T[] {\n return this.priorityQueue.slice(0, this.numberOfElements + 1);\n }\n\n public max(): T {\n return this.priorityQueue[0];\n }\n\n private swim(k: number): void {\n while (k > 0 && this.less(half(k), k)) {\n this.exchange(k, half(k));\n k = half(k);\n }\n }\n\n private sink(k: number): void {\n while (2 * k <= this.numberOfElements) {\n let j = 2 * k;\n if (j < this.numberOfElements && this.less(j, j + 1)) {\n j++;\n }\n if (!this.less(k, j)) {\n break;\n }\n this.exchange(k, j);\n k = j;\n }\n }\n\n private getValueAt(i: number): number {\n return this.getElementValue(this.priorityQueue[i]);\n }\n\n private less(i: number, j: number): boolean {\n return this.getValueAt(i) < this.getValueAt(j);\n }\n\n private exchange(i: number, j: number): void {\n const t = this.priorityQueue[i];\n this.priorityQueue[i] = this.priorityQueue[j];\n this.priorityQueue[j] = t;\n }\n}\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under
the License.\n *
==========\n */\n\nimport {PartWithScore, TensorBuffer3D} from '../types';\n\nimport {MaxHeap} from './max_heap';\n\nfunction scoreIsMaximumInLocalWindow(\n keypointId: number, score: number, heatmapY: number, heatmapX: number,\n localMaximumRadius: number, scores: TensorBuffer3D): boolean {\n const [height, width] = scores.shape;\n\n let localMaximum = true;\n const yStart = Math.max(heatmapY - localMaximumRadius, 0);\n const yEnd = Math.min(heatmapY + localMaximumRadius + 1, height);\n for (let yCurrent = yStart; yCurrent < yEnd; ++yCurrent) {\n const xStart = Math.max(heatmapX - localMaximumRadius, 0);\n const xEnd = Math.min(heatmapX + localMaximumRadius + 1, width);\n for (let xCurrent = xStart; xCurrent < xEnd; ++xCurrent) {\n if (scores.get(yCurrent, xCurrent, keypointId) > score) {\n localMaximum = false;\n break;\n }\n }\n if (!localMaximum)
{\n break;\n }\n }\n\n return localMaximum;\n}\n\n/**\n * Builds a priority queue with part candidate positions for a specific image in\n * the batch. For this we find all local maxima in the score maps with score\n * values above a threshold. We create a single priority queue across all parts.\n */\nexport function

buildPartWithScoreQueue(\n scoreThreshold: number, localMaximumRadius: number,\n scores: TensorBuffer3D): MaxHeap<PartWithScore> {\n const [height, width, numKeypoints] = scores.shape;\n\n const queue = new MaxHeap<PartWithScore>(\n height * width * numKeypoints, ({score}) => score);\n\n for (let heatmapY = 0; heatmapY < height; ++heatmapY) {\n for (let heatmapX = 0; heatmapX < width; ++heatmapX) {\n for (let keypointId = 0; keypointId < numKeypoints; ++keypointId) {\n const score = scores.get(heatmapY, heatmapX, keypointId);\n\n // Only consider parts with score greater or equal to threshold as\n // root candidates.\n if (score < scoreThreshold) {\n continue;\n }\n\n // Only consider keypoints whose score is maximum in a local window.\n if (scoreIsMaximumInLocalWindow(\n keypointId, score, heatmapY, heatmapX, localMaximumRadius,\n scores)) {\n queue.enqueue({score, part: {heatmapY, heatmapX, id: keypointId}});\n }\n }\n }\n }\n\n return queue;\n}\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {NumberTuple, PART_IDS, PART_NAMES, POSE_CHAIN} from '../keypoints';\nimport {Keypoint, PartWithScore, TensorBuffer3D, Vector2D} from '../types';\n\nimport {clamp, getOffsetPoint} from './util';\nimport {addVectors, getImageCoords} from './util';\n\nconst parentChildrenTuples: NumberTuple[] = POSE_CHAIN.map(\n ([parentJoinName, childJoinName]): NumberTuple =>\n ([PART_IDS[parentJoinName], PART_IDS[childJoinName]]));\n\nconst parentToChildEdges: number[] =\n parentChildrenTuples.map(([, childJointId]) => childJointId);\n\nconst childToParentEdges: number[] =\n parentChildrenTuples.map(([\n parentJointId,\n]) => parentJointId);\n\nfunction getDisplacement(\n edgeId: number, point: Vector2D, displacements: TensorBuffer3D): Vector2D {\n const numEdges = displacements.shape[2] / 2;\n return {\n y: displacements.get(point.y, point.x, edgeId),\n x: displacements.get(point.y, point.x, numEdges + edgeId)\n };\n}\n\nfunction getStridedIndexNearPoint(\n point: Vector2D, outputStride: number, height: number,\n width: number): Vector2D {\n return {\n y: clamp(Math.round(point.y / outputStride), 0, height - 1),\n x: clamp(Math.round(point.x / outputStride), 0, width - 1)\n };\n}\n\n/**\n * We get a new keypoint along the `edgeId` for the pose instance, assuming\n * that the position of the `idSource` part is already known. For this, we\n * follow the displacement vector from the source to target part (stored in\n * the `i`-t channel of the displacement tensor). The displaced keypoint\n * vector is refined using the offset vector by `offsetRefineStep` times.\n */\nfunction traverseToTargetKeypoint(\n edgeId: number, sourceKeypoint: Keypoint, targetKeypointId: number,\n scoresBuffer: TensorBuffer3D, offsets: TensorBuffer3D, outputStride: number,\n displacements: TensorBuffer3D, offsetRefineStep = 2): Keypoint {\n const [height, width] = scoresBuffer.shape;\n\n // Nearest neighbor interpolation for the source->target displacements.\n const sourceKeypointIndices = getStridedIndexNearPoint(\n sourceKeypoint.position, outputStride, height, width);\n\n const displacement =\n getDisplacement(edgeId, sourceKeypointIndices, displacements);\n\n const displacedPoint = addVectors(sourceKeypoint.position, displacement);\n let targetKeypoint = displacedPoint;\n for (let i = 0; i < offsetRefineStep; i++) {\n const targetKeypointIndices =\n getStridedIndexNearPoint(targetKeypoint, outputStride, height, width);\n\n const offsetPoint = getOffsetPoint(\n targetKeypointIndices.y, targetKeypointIndices.x, targetKeypointId,\n offsets);\n\n targetKeypoint = addVectors(\n {\n x: targetKeypointIndices.x * outputStride,\n y: targetKeypointIndices.y * outputStride\n },\n {x: offsetPoint.x, y: offsetPoint.y});\n }\n const targetKeyPointIndices =\n getStridedIndexNearPoint(targetKeypoint, outputStride, height, width);\n const score = scoresBuffer.get(\n targetKeyPointIndices.y, targetKeyPointIndices.x, targetKeypointId);\n\n return {position: targetKeypoint, part:

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PART_NAMES[targetKeypointId], score};\n}\n\n/**\n * Follows the displacement fields to decode the full pose of the object\n * instance given the position of a part that acts as root.\n *\n * @return An array of decoded keypoints and their scores for a single pose\n */\nexport function decodePose(\n    root: PartWithScore, scores: TensorBuffer3D, offsets: TensorBuffer3D,\n    outputStride: number, displacementsFwd: TensorBuffer3D,\n displacementsBwd: TensorBuffer3D): Keypoint[] {\n  const numParts = scores.shape[2];\n  const numEdges = parentToChildEdges.length;\n\n  const instanceKeypoints: Keypoint[] = new Array(numParts);\n  // Start a new detection instance at the position of the root.\n  const {part: rootPart, score: rootScore} = root;\n  const rootPoint = getImageCoords(rootPart, outputStride, offsets);\n\n  instanceKeypoints[rootPart.id] = {\n    score: rootScore,\n part: PART_NAMES[rootPart.id],\n    position: rootPoint\n  };\n\n  // Decode the part positions upwards in the tree, following the backward\n  // displacements.\n  for (let edge = numEdges - 1; edge >= 0; --edge) {\n    const sourceKeypointId = parentToChildEdges[edge];\n    const targetKeypointId = childToParentEdges[edge];\n    if (instanceKeypoints[sourceKeypointId] &&\n        !instanceKeypoints[targetKeypointId]) {\n instanceKeypoints[targetKeypointId] = traverseToTargetKeypoint(\n          edge, instanceKeypoints[sourceKeypointId], targetKeypointId, scores,\n          offsets, outputStride, displacementsBwd);\n    }\n  }\n\n  // Decode the part positions downwards in the tree, following the forward\n  // displacements.\n  for (let edge = 0;
 edge < numEdges; ++edge) {\n    const sourceKeypointId = childToParentEdges[edge];\n    const targetKeypointId = parentToChildEdges[edge];\n    if (instanceKeypoints[sourceKeypointId] &&\n!instanceKeypoints[targetKeypointId]) {\n      instanceKeypoints[targetKeypointId] = traverseToTargetKeypoint(\n      edge, instanceKeypoints[sourceKeypointId], targetKeypointId, scores,\n          offsets, outputStride, displacementsFwd);\n    }\n  }\n\n  return instanceKeypoints;\n}\n","/**\n * @license\n * Copyright 2019 Google Inc. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express
 or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========================================================================\n
*/\n\nimport {Keypoint, Pose, TensorBuffer3D} from '../types';\n\nimport {buildPartWithScoreQueue} from './build_part_with_score_queue';\nimport {decodePose} from './decode_pose';\nimport {getImageCoords, squaredDistance} from './util';\n\nfunction withinNmsRadiusOfCorrespondingPoint(\n    poses: Pose[], squaredNmsRadius: number, {x, y}: {x: number, y: number},\n    keypointId: number): boolean {\n  return poses.some(({keypoints}) => {\n    const correspondingKeypoint = keypoints[keypointId].position;\n    return squaredDistance(\n               y, x, correspondingKeypoint.y, correspondingKeypoint.x) <=\n squaredNmsRadius;\n  });\n}\n\n/* Score the newly proposed object instance without taking into account\n * the scores of the parts that overlap with any previously detected\n
 * instance.\n */\nfunction getInstanceScore(\n    existingPoses: Pose[], squaredNmsRadius: number,\n instanceKeypoints: Keypoint[]): number {\n  let notOverlappedKeypointScores = instanceKeypoints.reduce(\n (result, {position, score}, keypointId): number => {\n      if (!withinNmsRadiusOfCorrespondingPoint(\n existingPoses, squaredNmsRadius, position, keypointId)) {\n        result += score;\n      }\n      return result;\n }, 0.0);\n\n  return notOverlappedKeypointScores /= instanceKeypoints.length;\n}\n\n// A point (y, x) is considered as root part candidate if its score is a\n// maximum in a window |y - y'| <= kLocalMaximumRadius, |x - x'| <=\n// kLocalMaximumRadius.\nconst kLocalMaximumRadius = 1;\n\n/**\n * Detects multiple poses and finds their parts from part scores and\n * displacement vectors. It returns up to `maxDetections` object instance\n * detections in decreasing root score order. It works as follows: We first\n * create a priority
 queue with local part score maxima above\n * `scoreThreshold`, considering all parts at the same time. Then we\n * iteratively pull the top  element of the queue (in decreasing score order)\n * and treat it as a root candidate for a new
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object instance. To avoid\n * duplicate detections, we reject the root candidate if it is within a disk\n * of `nmsRadius` pixels from the corresponding part of a previously detected\n * instance, which is a form of part-based non-maximum suppression (NMS). If\n * the root candidate passes the NMS check, we start a new object instance\n * detection, treating the corresponding part as root and finding the\n * positions of the remaining parts by following the displacement vectors\n * along the tree-structured part graph. We assign to the newly detected\n * instance a score equal to the sum of scores of its parts which have not\n * been claimed by a previous instance (i.e., those at least `nmsRadius`\n * pixels away from the corresponding part of all previously
detected\n * instances), divided by the total number of parts `numParts`.\n *\n * @param heatmapScores 3-D tensor with shape `[height, width, numParts]`.\n * The value of heatmapScores[y, x, k]` is the score of placing the `k`-th\n * object part at position `(y, x)`.\n *\n * @param offsets 3-D tensor with shape `[height, width, numParts * 2]`.\n * The value of [offsets[y, x, k], offsets[y, x, k + numParts]]` is the\n * short range offset vector of the `k`-th object part at heatmap\n * position `(y, x)`.\n *\n * @param displacementsFwd 3-D tensor of shape\n * `[height, width, 2 * num_edges]`, where `num_edges = num_parts - 1` is the\n * number of edges (parent-child pairs) in the tree. It contains the forward\n * displacements between consecutive part from the root towards the leaves.\n *\n * @param displacementsBwd 3-D tensor of shape\n * `[height, width, 2 * num_edges]`, where `num_edges = num_parts - 1` is the\n * number of edges (parent-child pairs) in the tree. It contains
the backward\n * displacements between consecutive part from the root towards the leaves.\n *\n * @param outputStride The output stride that was used when feed-forwarding\n * through the PoseNet model. Must be 32, 16, or 8.\n *\n * @param maxPoseDetections Maximum number of returned instance detections per\n * image.\n *\n * @param scoreThreshold Only return instance detections that have root part\n * score greater or equal to this value. Defaults to 0.5.\n *\n * @param nmsRadius Non-maximum suppression part distance. It needs to be\n * strictly positive. Two parts suppress each other if they are less than\n * `nmsRadius` pixels away. Defaults to 20.\n *\n * @return An array of poses and their scores, each containing keypoints and\n * the corresponding keypoint scores.\n */\nexport function decodeMultiplePoses(\n scoresBuffer: TensorBuffer3D, offsetsBuffer: TensorBuffer3D,\n displacementsFwdBuffer: TensorBuffer3D,\n displacementsBwdBuffer: TensorBuffer3D, outputStride: number,\n maxPoseDetections: number, scoreThreshold = 0.5, nmsRadius = 20): Pose[] {\n const poses: Pose[] = [];\n\n const queue = buildPartWithScoreQueue(\n scoreThreshold, kLocalMaximumRadius, scoresBuffer);\n\n const squaredNmsRadius = nmsRadius * nmsRadius;\n\n // Generate at most maxDetections object instances per image in\n // decreasing root part score order.\n while (poses.length < maxPoseDetections && !queue.empty()) {\n // The top element in the queue is the next root candidate.\n const root = queue.dequeue();\n\n // Part-based non-maximum suppression: We reject a root candidate if it\n // is within a disk of `nmsRadius` pixels from the corresponding part of\n // a previously detected instance.\n const rootImageCoords =\n getImageCoords(root.part, outputStride, offsetsBuffer);\n if (withinNmsRadiusOfCorrespondingPoint(\n poses, squaredNmsRadius, rootImageCoords, root.part.id)) {\n continue;\n }\n\n // Start a new detection instance at the position of the root.\n const keypoints = decodePose(\n root, scoresBuffer, offsetsBuffer, outputStride, displacementsFwdBuffer,\n displacementsBwdBuffer);\n\n const score = getInstanceScore(poses, squaredNmsRadius, keypoints);\n\n poses.push({keypoints, score});\n }\n\n return poses;\n}\n","/**\n * @license\n * Copyright 2019 Google Inc. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * https://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport * as tf from '@tensorflow/tfjs-core';\n\nimport {BaseModel} from './base_model';\n\nconst imageNetMean = [-123.15, -115.90, -103.06];\n\nexport class ResNet extends BaseModel {\n preprocessInput(input: tf.Tensor3D): tf.Tensor3D {\n return tf.add(input, imageNetMean);\n }\n\n nameOutputResults(results: tf.Tensor3D[]) {\n const [\n displacementBwd,\n displacementFwd,\n

heatmap,\n longOffsets,\n offsets,\n partHeatmaps,\n segmentation,\n partOffsets,\n] = results;\n return {\n offsets,\n segmentation,\n partHeatmaps,\n longOffsets,\n heatmap,\n displacementFwd,\n displacementBwd,\n partOffsets\n };\n }\n}\n","/**\n * @license\n * Copyright 2019 Google Inc. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * https://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nconst RESNET50_BASE_URL =\n 'https://storage.googleapis.com/tfjs-models/savedmodel/bodypix/resnet50/';\nconst MOBILENET_BASE_URL =\n 'https://storage.googleapis.com/tfjs-models/savedmodel/bodypix/mobilenet/';\n\n// The BodyPix 2.0 ResNet50 models use the latest TensorFlow.js 1.0 model\n// format.\nexport function resNet50SavedModel(stride: number, quantBytes: number): string {\n const graphJson = `model-stride${stride}.json`;\n // quantBytes=4 corresponding to the non-quantized full-precision SavedModel.\n if (quantBytes === 4) {\n return RESNET50_BASE_URL + `float/` + graphJson;\n } else {\n return RESNET50_BASE_URL + `quant${quantBytes}/` + graphJson;\n }\n}\n\n// The BodyPix 2.0 MobileNetV1 models use the latest TensorFlow.js 1.0 model\n// format.\nexport function mobileNetSavedModel(\n stride: number, multiplier: number, quantBytes: number): string {\n const toStr: {[key: number]: string} = {1.0: '100', 0.75: '075', 0.50: '050'};\n const graphJson = `model-stride${stride}.json`;\n // quantBytes=4 corresponding to the non-quantized full-precision SavedModel.\n if (quantBytes === 4) {\n return MOBILENET_BASE_URL + `float/${toStr[multiplier]}/` + graphJson;\n } else {\n return MOBILENET_BASE_URL + `quant${quantBytes}/${toStr[multiplier]}/` +\n graphJson;\n }\n}\n","/**\n * @license\n * Copyright 2020 Google Inc. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n * ==========\n */\n\nimport * as tf from '@tensorflow/tfjs-core';\n\nimport {BodyPixInput, BodyPixOutputStride, Padding} from './types';\nimport {Pose, TensorBuffer3D} from './types';\nimport {BodyPixInternalResolution} from './types';\n\nfunction getSizeFromImageLikeElement(input: HTMLImageElement|\n HTMLCanvasElement|\n OffscreenCanvas): [number, number] {\n if ('offsetHeight' in input && input.offsetHeight !== 0\n && 'offsetWidth' in input && input.offsetWidth !== 0) {\n return [input.offsetHeight, input.offsetWidth];\n } else if (input.height != null && input.width != null) {\n return [input.height, input.width];\n } else {\n throw new Error(\n `HTMLImageElement must have height and width attributes set.`);\n }\n}\n\nfunction getSizeFromVideoElement(input: HTMLVideoElement): [number, number] {\n if (input.hasAttribute('height') && input.hasAttribute('width')) {\n // Prioritizes user specified height and width.\n // We can't test the .height and .width properties directly,\n // because they evaluate to 0 if unset.\n return [input.height, input.width];\n } else {\n return [input.videoHeight, input.videoWidth];\n }\n}\n\nexport function getInputSize(input: BodyPixInput): [number, number] {\n if ((typeof (HTMLCanvasElement) !== 'undefined' &&\n input instanceof HTMLCanvasElement) ||\n (typeof (OffscreenCanvas) !== 'undefined' &&\n input instanceof OffscreenCanvas) ||\n (typeof (HTMLImageElement) !== 'undefined' &&\n input instanceof HTMLImageElement)) {\n return getSizeFromImageLikeElement(input);\n } else if (typeof (ImageData) !== 'undefined' && input instanceof ImageData) {\n return [input.height,

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input.width];\n  } else if (\n      typeof (HTMLVideoElement) !== 'undefined' &&\n      input instanceof
HTMLVideoElement) {\n    return getSizeFromVideoElement(input);\n  } else if (input instanceof tf.Tensor) {\n
return [input.shape[0], input.shape[1]];\n  } else {\n    throw new Error(`error: Unknown input type: ${input}.`);\n
}\n}\n\nfunction isValidInputResolution(\n    resolution: number, outputStride: number): boolean {\n  return
(resolution - 1) % outputStride === 0;\n}\n\nexport function toValidInputResolution(\n    inputResolution: number,
outputStride: BodyPixOutputStride): number {\n  if (isValidInputResolution(inputResolution, outputStride)) {\n
  return inputResolution;\n  }\n\n  return Math.floor(inputResolution / outputStride) * outputStride + 1;\n}\n\nconst
INTERNAL_RESOLUTION_STRING_OPTIONS = {\n  low: 'low',\n  medium: 'medium',\n  high: 'high',\n  full:
'full'\n};\n\nconst INTERNAL_RESOLUTION_PERCENTAGES = {\n
[INTERNAL_RESOLUTION_STRING_OPTIONS.low]: 0.25,\n
[INTERNAL_RESOLUTION_STRING_OPTIONS.medium]: 0.5,\n
[INTERNAL_RESOLUTION_STRING_OPTIONS.high]: 0.75,\n
[INTERNAL_RESOLUTION_STRING_OPTIONS.full]: 1.0\n};\n\nconst MIN_INTERNAL_RESOLUTION =
0.1;\nconst MAX_INTERNAL_RESOLUTION = 2.0;\n\nfunction toInternalResolutionPercentage(\n
internalResolution: BodyPixInternalResolution): number {\n  if (typeof internalResolution === 'string') {\n    const
result = INTERNAL_RESOLUTION_PERCENTAGES[internalResolution];\n\n    tf.util.assert(\n        typeof result
=== 'number',\n        () => `string value of inputResolution must be one of ${\n
Object.values(INTERNAL_RESOLUTION_STRING_OPTIONS)\n                .join(',')}
 but was ${internalResolution}.`);\n    return result;\n  } else {\n    tf.util.assert(\n        typeof internalResolution ===
'number' &&\n            internalResolution <= MAX_INTERNAL_RESOLUTION &&\n            internalResolution
>= MIN_INTERNAL_RESOLUTION,\n        () =>\n            `inputResolution must be a string or number between
${\n                MIN_INTERNAL_RESOLUTION} and ${MAX_INTERNAL_RESOLUTION}, but ` +\n
`was ${internalResolution}`);\n\n    return internalResolution;\n  }\n}\n\nexport function
toInputResolutionHeightAndWidth(\n    internalResolution: BodyPixInternalResolution,\n    outputStride:
BodyPixOutputStride,\n    [inputHeight, inputWidth]: [number, number]): [number, number] {\n  const
internalResolutionPercentage =\n      toInternalResolutionPercentage(internalResolution);\n\n  return [\n
toValidInputResolution(\n        inputHeight * internalResolutionPercentage, outputStride),\n
toValidInputResolution(\n        inputWidth * internalResolutionPercentage,
 outputStride)\n  ];\n}\n\nexport function toInputTensor(input: BodyPixInput) {\n  // TODO: tf.browser.fromPixels
types to support OffscreenCanvas\n  // @ts-ignore\n  return input instanceof tf.Tensor ? input :
tf.browser.fromPixels(input);\n}\n\nexport function resizeAndPadTo(\n    imageTensor: tf.Tensor3D, [targetH,
targetW]: [number, number],\n    flipHorizontal = false): {\n  resizedAndPadded: tf.Tensor3D,\n  paddedBy:
[[number, number], [number, number]]\n} {\n  const [height, width] = imageTensor.shape;\n\n  const targetAspect =
targetW / targetH;\n  const aspect = width / height;\n\n  let resizeW: number;\n  let resizeH: number;\n  let padL:
number;\n  let padR: number;\n  let padT: number;\n  let padB: number;\n\n  if (aspect > targetAspect) {\n    // resize
to have the larger dimension match the shape.\n    resizeW = targetW;\n    resizeH = Math.ceil(resizeW / aspect);\n\n
  const padHeight = targetH - resizeH;\n    padL = 0;\n    padR = 0;\n    padT = Math.floor(padHeight
 / 2);\n    padB = targetH - (resizeH + padT);\n  } else {\n    resizeH = targetH;\n    resizeW = Math.ceil(targetH *
aspect);\n\n    const padWidth = targetW - resizeW;\n    padL = Math.floor(padWidth / 2);\n    padR = targetW -
(resizeW + padL);\n    padT = 0;\n    padB = 0;\n  }\n\n  const resizedAndPadded = tf.tidy(() => {\n    // resize to
have largest dimension match image\n    let resized: tf.Tensor3D;\n    if (flipHorizontal) {\n      resized =
tf.image.resizeBilinear(\n          tf.reverse(imageTensor, 1), [resizeH, resizeW]);\n    } else {\n      resized =
tf.image.resizeBilinear(imageTensor, [resizeH, resizeW]);\n    }\n\n    const padded = tf.pad3d(resized, [[padT,
padB], [padL, padR], [0, 0]]);\n\n    return padded;\n  });\n\n  return {resizedAndPadded, paddedBy: [[padT, padB],
[padL, padR]]};\n}\n\nexport function scaleAndCropToInputTensorShape(\n    tensor: tf.Tensor3D,\n
[inputTensorHeight, inputTensorWidth]: [number, number],\n    [resizedAndPaddedHeight,
 resizedAndPaddedWidth]: [number, number],\n    [[padT, padB], [padL, padR]]: [[number, number], [number,
number]],\n    applySigmoidActivation = false): tf.Tensor3D {\n  return tf.tidy(() => {\n    let inResizedAndPadded:
```

tf.Tensor3D = tf.image.resizeBilinear(tensor,\n [resizedAndPaddedHeight, resizedAndPaddedWidth], true);\n\n if (applySigmoidActivation) {\n inResizedAndPadded = tf.sigmoid(inResizedAndPadded);\n }\n\n return removePaddingAndResizeBack(\n inResizedAndPadded, [inputTensorHeight, inputTensorWidth],\n [[padT, padB], [padL, padR]]);\n });\n}\n\nexport function removePaddingAndResizeBack(\n resizedAndPadded: tf.Tensor3D,\n [originalHeight, originalWidth]: [number, number],\n [[padT, padB], [padL, padR]]: [[number, number], [number, number]]):\n tf.Tensor3D {\n return tf.tidy(() => {\n const batchedImage: tf.Tensor4D = tf.expandDims(resizedAndPadded);\n return tf.squeeze(tf.image\n .cropAndResize(\n batchedImage, [[\n padT / (originalHeight + padT + padB - 1.0),\n padL / (originalWidth + padL + padR - 1.0),\n (padT + originalHeight - 1.0) /\n (originalHeight + padT + padB - 1.0),\n (padL + originalWidth - 1.0) / (originalWidth + padL + padR - 1.0)\n]],\n [0], [originalHeight, originalWidth]), [0]);\n });\n}\n\nexport function resize2d(\n tensor: tf.Tensor2D, resolution: [number, number],\n nearestNeighbor?: boolean): tf.Tensor2D {\n return tf.tidy(() => {\n const batchedImage: tf.Tensor4D = tf.expandDims(tensor, 2);\n return tf.squeeze(\n tf.image.resizeBilinear(batchedImage, resolution, nearestNeighbor));\n });\n}\n\nexport function padAndResizeTo(\n input: BodyPixInput, [targetH, targetW]: [number, number]):\n {resized: tf.Tensor3D, padding: Padding} {\n const [height, width] = getInputSize(input);\n const targetAspect = targetW / targetH;\n const aspect = width / height;\n let [padT, padB, padL, padR] = [0, 0, 0, 0];\n if (aspect < targetAspect) {\n // pads the width\n padT = 0;\n padB = 0;\n padL = Math.round(0.5 * (targetAspect * height - width));\n padR = Math.round(0.5 * (targetAspect * height - width));\n } else {\n // pads the height\n padT = Math.round(0.5 * ((1.0 / targetAspect) * width - height));\n padB = Math.round(0.5 * ((1.0 / targetAspect) * width - height));\n padL = 0;\n padR = 0;\n }\n\n const resized: tf.Tensor3D = tf.tidy(() => {\n let imageTensor = toInputTensor(input);\n imageTensor = tf.pad3d(imageTensor, [[padT, padB], [padL, padR], [0, 0]]);\n\n return tf.image.resizeBilinear(imageTensor, [targetH, targetW]);\n });\n\n return {resized, padding: {top: padT, left: padL, right: padR, bottom: padB}};\n}\n\nexport async function toTensorBuffers3D(tensors: tf.Tensor3D[]):\n Promise<TensorBuffer3D[]> {\n return Promise.all(tensors.map(tensor => tensor.buffer()));\n}\n\nexport function scalePose(\n pose: Pose, scaleY: number, scaleX: number, offsetY = 0,\n offsetX = 0): Pose {\n return {\n score: pose.score,\n keypoints: pose.keypoints.map(({score, part, position}) => ({\n score,\n part,\n position: {\n x: position.x * scaleX + offsetX,\n y: position.y * scaleY + offsetY\n }\n }))\n };\n}\n\nexport function scalePoses(\n poses: Pose[], scaleY: number, scaleX: number, offsetY = 0, offsetX = 0) {\n if (scaleX === 1 && scaleY === 1 && offsetY === 0 && offsetX === 0) {\n return poses;\n }\n return poses.map(pose => scalePose(pose, scaleY, scaleX, offsetY, offsetX));\n}\n\nexport function flipPoseHorizontal(pose: Pose, imageWidth: number): Pose {\n return {\n score: pose.score,\n keypoints: pose.keypoints.map(\n ({score, part, position}) => ({\n score,\n part,\n position: {x: imageWidth - 1 - position.x, y: position.y}\n }))\n };\n}\n\nexport function flipPosesHorizontal(poses: Pose[], imageWidth: number) {\n if (imageWidth <= 0) {\n return poses;\n }\n return poses.map(pose => flipPoseHorizontal(pose, imageWidth));\n}\n\nexport function scaleAndFlipPoses(\n poses: Pose[], [height, width]: [number, number],\n [inputResolutionHeight, inputResolutionWidth]: [number, number],\n padding: Padding, flipHorizontal: boolean): Pose[] {\n const scaleY =\n (height + padding.top + padding.bottom) / (inputResolutionHeight);\n const scaleX =\n (width + padding.left + padding.right) / (inputResolutionWidth);\n\n const scaledPoses =\n scalePoses(poses, scaleY, scaleX, -padding.top, -padding.left);\n\n if (flipHorizontal) {\n return flipPosesHorizontal(scaledPoses, width);\n } else {\n return scaledPoses;\n }\n}\n","\n/**\n * @license\n * Copyright 2019 Google Inc. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the

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License for the specific language governing permissions and\n * limitations under the License.\n * ==========
==========\n */\n\nimport * as tfconv from '@tensorflow/tfjs-converter';\nimport * as tf from '@tensorflow/tfjs-core';\n\nimport {BaseModel} from './base_model';\nimport {decodeOnlyPartSegmentation, decodePartSegmentation, toMaskTensor} from './decode_part_map';\nimport {MobileNet} from './mobilenet';\nimport {decodePersonInstanceMasks, decodePersonInstancePartMasks} from './multi_person/decode_instance_masks';\nimport {decodeMultiplePoses} from './multi_person/decode_multiple_poses';\nimport {ResNet} from './resnet';\nimport {mobileNetSavedModel, resNet50SavedModel} from './saved_models';\nimport {BodyPixArchitecture, BodyPixInput, BodyPixInternalResolution, BodyPixMultiplier, BodyPixOutputStride, BodyPixQuantBytes, Padding} from './types';\nimport {PartSegmentation, PersonSegmentation, SemanticPartSegmentation, SemanticPersonSegmentation} from './types';\nimport {getInputSize, padAndResizeTo, scaleAndCropToInputTensorShape, scaleAndFlipPoses, toInputResolutionHeightAndWidth, toTensorBuffers3D} from './util';\n\nconst APPLY_SIGMOID_ACTIVATION = true;\nconst FLIP_POSES_AFTER_SCALING = false;\n\n/**\n * BodyPix model loading is configurable using the following config dictionary.\n *\n * `architecture`: BodyPixArchitecture. It determines which BodyPix architecture\n * to load. The supported architectures are: MobileNetV1 and ResNet50.\n *\n * `outputStride`: Specifies the output stride of the BodyPix model.\n * The smaller the value, the larger the output resolution, and more accurate\n * the model at the cost of speed. Set this to a larger value to increase speed\n * at the cost of accuracy. Stride 32 is supported for ResNet and\n * stride 8,16,32 are supported for various MobileNetV1 models.\n *\n * `multiplier`: An optional number with values: 1.01, 1.0, 0.75, or\n * 0.50. The value is used only by MobileNet architecture. It is the float\n * multiplier for the depth (number of channels) for all convolution ops.\n * The larger the value, the larger the size of the layers, and more accurate\n * the model at the cost of speed. Set this to a smaller value to increase speed\n * at the cost of accuracy.\n *\n * `modelUrl`: An optional string that specifies custom url of the model. This\n * is useful for area/countries that don't have access to the model hosted on\n * GCP.\n *\n * `quantBytes`: An optional number with values: 1, 2, or 4.  This parameter\n * affects weight quantization in the models. The available options are\n * 1 byte, 2 bytes, and 4 bytes. The higher the value, the larger the model size\n * and thus the longer the loading time, the lower the value, the shorter the\n * loading time but lower the accuracy.\n */\nexport interface ModelConfig {\n  architecture: BodyPixArchitecture;\n  outputStride: BodyPixOutputStride;\n  multiplier?: BodyPixMultiplier;\n  modelUrl?: string;\n  quantBytes?: BodyPixQuantBytes;\n}\n\n// The default configuration for loading MobileNetV1 based BodyPix.\n//\n// (And for references, the default configuration for loading ResNet\n// based PoseNet is also included).\n//\n// ```\n// const RESNET_CONFIG = {\n//   architecture: 'ResNet50',\n//   outputStride: 32,\n//   quantBytes: 4,\n// } as ModelConfig;\n// ```\n\nconst MOBILENET_V1_CONFIG = {\n  architecture: 'MobileNetV1',\n  outputStride: 16,\n  quantBytes: 4,\n  multiplier: 0.75,\n} as ModelConfig;\n\nconst VALID_ARCHITECTURE: BodyPixArchitecture[] = ['MobileNetV1', 'ResNet50'];\nconst VALID_STRIDE: {[id: string]: BodyPixOutputStride[]} = {\n  'MobileNetV1': [8, 16, 32],\n  'ResNet50': [32, 16]\n};\nconst VALID_MULTIPLIER: {[id: string]: BodyPixMultiplier[]} = {\n  'MobileNetV1': [0.50, 0.75, 1.0],\n  'ResNet50': [1.0]\n};\nconst VALID_QUANT_BYTES: BodyPixQuantBytes[] = [1, 2, 4];\n\nfunction validateModelConfig(config: ModelConfig): ModelConfig {\n  config = config || MOBILENET_V1_CONFIG;\n\n  if (config.architecture == null) {\n    config.architecture = 'MobileNetV1';\n  }\n  if (VALID_ARCHITECTURE.indexOf(config.architecture) < 0) {\n    throw new Error(\n        `Invalid architecture ${config.architecture}. ` +\n        `Should be one of ${VALID_ARCHITECTURE}`);\n  }\n  if (config.outputStride == null) {\n    config.outputStride = 16;\n  }\n  if (VALID_STRIDE[config.architecture].indexOf(config.outputStride) < 0) {\n    throw new Error(\n        `Invalid outputStride ${config.outputStride}. ` +\n        `Should be one of ${VALID_STRIDE[config.architecture]} ` +\n        `for architecture ${config.architecture}.`);\n  }\n\n  if
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(config.multiplier == null) {\n config.multiplier = 1.0;\n }\n if (VALID_MULTIPLIER[config.architecture].indexOf(config.multiplier) < 0) {\n throw new Error(\n `Invalid multiplier ${config.multiplier}. ` +\n `Should be one of ${VALID_MULTIPLIER[config.architecture]} ` +\n `for architecture ${config.architecture}.`);\n }\n\n if (config.quantBytes == null) {\n config.quantBytes = 4;\n }\n if (VALID_QUANT_BYTES.indexOf(config.quantBytes) < 0) {\n throw new Error(\n `Invalid quantBytes ${config.quantBytes}. ` +\n `Should be one of ${VALID_QUANT_BYTES} ` +\n `for architecture ${config.architecture}.`);\n }\n\n return config;\n}\n\n/**\n * BodyPix inference is configurable using the following config dictionary.\n *\n * `flipHorizontal`: If the left-right keypoint of poses/part segmentation\n * should be flipped/mirrored horizontally. This should be set to true for\n * videos where the video is by default flipped horizontally (i.e. a webcam),\n * and you want the person & body part segmentation to be returned in the proper\n * orientation.\n *\n * `internalResolution`: Defaults to 'medium'. The internal resolution\n * percentage that the input is resized to before inference. The larger the\n * internalResolution the more accurate the model at the cost of slower\n * prediction times. Available values are 'low', 'medium', 'high', 'full', or a\n * percentage value between 0 and 1. The values 'low', 'medium', 'high', and\n * 'full' map to 0.25, 0.5, 0.75, and 1.0 correspondingly.\n *\n * `segmentationThreshold`: The minimum that segmentation values must\n * have to be considered part of the person. Affects the generation of the\n * segmentation mask. More specifically, it is the threshold
used to binarize\n * the intermediate person segmentation probability. The probability of each\n * pixel belongs to a person is in range [0, 1]. If the probability is greater\n * than the `segmentationThreshold`, it will be set to 1 otherwise 0.\n *\n */\nexport interface InferenceConfig {\n flipHorizontal?: boolean;\n internalResolution?: BodyPixInternalResolution;\n segmentationThreshold?: number;\n}\n\n/**\n * Person Inference Config\n *\n * `maxDetections`: Defaults to 10. Maximum number of person pose detections per\n * image.\n *\n * `scoreThreshold`: Defaults to 0.4. Only return person pose that have root\n * part score greater or equal to this value.\n *\n * `nmsRadius`: Defaults to 20. Non-maximum suppression part distance in pixels.\n * It needs to be strictly positive. Two pose keypoints suppress each other if\n * they are less than `nmsRadius` pixels away.\n */\nexport interface PersonInferenceConfig extends InferenceConfig {\n maxDetections?: number;\n scoreThreshold?:
number;\n nmsRadius?: number;\n}\n\n/**\n * Multiple Person Instance Inference Config\n *\n * `maxDetections`: Defaults to 10. Maximum number of returned instance\n * segmentation and pose detections per image.\n *\n * `scoreThreshold`: Defaults to 0.4. Only returns and uses person\n * poses for instance segmentation assignment when the pose has root part score\n * greater or equal to this value.\n *\n * `nmsRadius`: Defaults to 20. Non-maximum suppression part distance in pixels.\n * It needs to be strictly positive. Two parts suppress each other if they are\n * less than `nmsRadius` pixels away.\n *\n * `minKeypointScore`: Default to 0.3. Keypoints above the score are used\n * for matching and assigning segmentation mask to each person.\n *\n * `refineSteps`: Default to 10. The number of refinement steps used when\n * assigning the instance segmentation. It needs to be strictly positive. The\n * larger the higher the accuracy and slower the inference.\n *\n */\nexport interface MultiPersonInstanceInferenceConfig
extends InferenceConfig {\n maxDetections?: number;\n scoreThreshold?: number;\n nmsRadius?: number;\n minKeypointScore?: number;\n refineSteps?: number;\n}\n\nexport const PERSON_INFERENCE_CONFIG: PersonInferenceConfig = {\n flipHorizontal: false,\n internalResolution: 'medium',\n segmentationThreshold: 0.7,\n maxDetections: 10,\n scoreThreshold: 0.4,\n nmsRadius: 20,\n};\n\nexport const MULTI_PERSON_INSTANCE_INFERENCE_CONFIG:\n MultiPersonInstanceInferenceConfig = {\n flipHorizontal: false,\n internalResolution: 'medium',\n segmentationThreshold: 0.7,\n maxDetections: 10,\n scoreThreshold: 0.4,\n nmsRadius: 20,\n minKeypointScore: 0.3,\n refineSteps: 10\n};\n\nfunction validatePersonInferenceConfig(config: PersonInferenceConfig) {\n const {segmentationThreshold, maxDetections, scoreThreshold, nmsRadius} =\n config;\n\n if (segmentationThreshold < 0.0 || segmentationThreshold > 1.0) {\n

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  throw new Error(\n      `segmentationThreshold ${segmentationThreshold}. ` +\n      `Should be in range [0.0, 1.0]`);\n  }\n\n  if (maxDetections <= 0) {\n    throw new Error(\n        `Invalid maxDetections ${maxDetections}. ` +\n        `Should be > 0`);\n  }\n\n  if (scoreThreshold < 0.0 || scoreThreshold > 1.0) {\n    throw new Error(\n `Invalid scoreThreshold ${scoreThreshold}. ` +\n      `Should be in range [0.0, 1.0]`);\n  }\n\n  if (nmsRadius <= 0) {\n    throw new Error(`Invalid nmsRadius ${nmsRadius}.`);\n  }\n}\n\nfunction validateMultiPersonInstanceInferenceConfig(\n    config: MultiPersonInstanceInferenceConfig) {\n  const {\n segmentationThreshold,\n    maxDetections,\n    scoreThreshold,\n    nmsRadius,\n    minKeypointScore,\n refineSteps\n  } = config;\n\n  if (segmentationThreshold < 0.0 || segmentationThreshold > 1.0) {\n    throw new Error(\n      `segmentationThreshold ${segmentationThreshold}. ` +\n      `Should be in range [0.0, 1.0]`);\n  }\n\n  if (maxDetections <= 0) {\n    throw new Error(\n        `Invalid maxDetections ${maxDetections}. ` +\n `Should be > 0`);\n  }\n\n  if (scoreThreshold < 0.0 || scoreThreshold > 1.0) {\n    throw new Error(\n        `Invalid scoreThreshold ${scoreThreshold}. ` +\n      `Should be in range [0.0, 1.0]`);\n  }\n\n  if (nmsRadius <= 0) {\n    throw new Error(`Invalid nmsRadius ${nmsRadius}.`);\n  }\n\n  if (minKeypointScore < 0 || minKeypointScore > 1) {\n    throw new Error(\n        `Invalid minKeypointScore ${minKeypointScore}.` +\n        `Should be in range [0.0, 1.0]`);\n  }\n\n  if (refineSteps <= 0 || refineSteps > 20) {\n    throw new Error(\n        `Invalid refineSteps ${refineSteps}.` +\n        `Should be in range [1, 20]`);\n  }\n}\n\nexport class BodyPix {\n  baseModel: BaseModel;\n\n  constructor(net: BaseModel) {\n    this.baseModel = net;\n  }\n\n  private predictForPersonSegmentation(input: tf.Tensor3D): {\n    segmentLogits: tf.Tensor3D,\n    heatmapScores: tf.Tensor3D,\n    offsets: tf.Tensor3D,\n    displacementFwd: tf.Tensor3D,\n    displacementBwd: tf.Tensor3D,\n  } {\n    const {\n      segmentation,\n      heatmapScores,\n      offsets,\n      displacementFwd,\n      displacementBwd,\n    } = this.baseModel.predict(input);\n    return {\n      segmentLogits: segmentation,\n      heatmapScores,\n      offsets,\n      displacementFwd,\n      displacementBwd,\n    };\n  }\n\n  private predictForPersonSegmentationAndPart(input: tf.Tensor3D): {\n    segmentLogits: tf.Tensor3D,\n    partHeatmapLogits: tf.Tensor3D,\n    heatmapScores: tf.Tensor3D,\n    offsets: tf.Tensor3D,\n    displacementFwd: tf.Tensor3D,\n    displacementBwd: tf.Tensor3D,\n  } {\n    const {\n      segmentation,\n      partHeatmaps,\n      heatmapScores,\n      offsets,\n      displacementFwd,\n      displacementBwd\n    } = this.baseModel.predict(input);\n    return {\n      segmentLogits: segmentation,\n      partHeatmapLogits: partHeatmaps,\n      heatmapScores,\n      offsets,\n      displacementFwd,\n      displacementBwd,\n    };\n  }\n\n  private predictForMultiPersonInstanceSegmentationAndPart(input: tf.Tensor3D):\n      {\n        segmentLogits: tf.Tensor3D,\n        longOffsets: tf.Tensor3D,\n        heatmapScores: tf.Tensor3D,\n        offsets: tf.Tensor3D,\n        displacementFwd: tf.Tensor3D,\n        displacementBwd: tf.Tensor3D,\n        partHeatmaps: tf.Tensor3D\n      } {\n    const {\n      segmentation,\n      longOffsets,\n      heatmapScores,\n      offsets,\n      displacementFwd,\n      displacementBwd,\n      partHeatmaps,\n    } = this.baseModel.predict(input);\n    return {\n      segmentLogits: segmentation,\n      longOffsets,\n      heatmapScores,\n      offsets,\n      displacementFwd,\n      displacementBwd,\n      partHeatmaps\n    };\n  }\n\n  /**\n   * Given an image with people, returns a dictionary of all intermediate\n   * tensors including: 1) a binary array with 1 for the pixels that are part of\n   * the person, and 0 otherwise, 2) heatmapScores, 3) offsets, and 4) paddings.\n   *\n   * @param input ImageData|HTMLImageElement|HTMLCanvasElement|HTMLVideoElement)\n   * The input image to feed through the network.\n   *\n   * @param internalResolution Defaults to 'medium'. The internal resolution\n   * that the input is resized to before inference. The larger the\n   * internalResolution the more accurate the model at the cost of slower\n   * prediction times. Available values are 'low', 'medium', 'high', 'full', or\n   * a percentage value between 0 and 1. The values 'low', 'medium', 'high', and\n   * 'full' map to 0.25, 0.5, 0.75, and 1.0 correspondingly.\n   *\n   * @param segmentationThreshold The minimum that segmentation values must have\n   * to be considered part of the person. Affects the generation of the\n   * segmentation mask.\n   *\n   * @return A dictionary containing `segmentation`, `heatmapScores`, `offsets`,\n   * and `padding`:\n   * - `segmentation`: A 2d Tensor with 1 for the pixels that are part of the\n   * person, and 0 otherwise. The width and height correspond to the same\n   * dimensions of the input image.\n   * - `heatmapScores`: A 3d Tensor of the keypoint heatmaps used by\n   * pose estimation decoding.\n   * - `offsets`: A 3d Tensor of the keypoint offsets used by pose\n   * estimation decoding.\n
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* - `displacementFwd`: A 3d Tensor of the keypoint forward displacement used\n   * by pose estimation decoding.\n   * - `displacementBwd`: A 3d Tensor of the keypoint backward displacement used\n   * by pose estimation decoding.\n   * - `padding`: The padding (unit pixels) being applied to the input image\n   * before it is fed into the model.\n   */\n  segmentPersonActivation(\n      input: BodyPixInput, internalResolution:
BodyPixInternalResolution,\n      segmentationThreshold = 0.5): {\n    segmentation: tf.Tensor2D,\n
heatmapScores: tf.Tensor3D,\n    offsets: tf.Tensor3D,\n    displacementFwd: tf.Tensor3D,\n    displacementBwd:
tf.Tensor3D,\n
    padding: Padding,\n    internalResolutionHeightAndWidth: [number, number]\n  } {\n    const [height, width] =
getInputSize(input);\n    const internalResolutionHeightAndWidth = toInputResolutionHeightAndWidth(\n
internalResolution, this.baseModel.outputStride, [height, width]);\n    const {resized, padding} =\n
padAndResizeTo(input, internalResolutionHeightAndWidth);\n\n    const {\n      segmentation,\n
heatmapScores,\n      offsets,\n      displacementFwd,\n      displacementBwd\n    } = tf.tidy(() => {\n      const {\n
segmentLogits,\n      heatmapScores,\n      offsets,\n      displacementFwd,\n      displacementBwd\n    } =
this.predictForPersonSegmentation(resized);\n\n      const [resizedHeight, resizedWidth] = resized.shape;\n\n
const scaledSegmentScores = scaleAndCropToInputTensorShape(\n          segmentLogits, [height, width],
[resizedHeight, resizedWidth],\n          [[padding.top, padding.bottom], [padding.left, padding.right]],\n
          APPLY_SIGMOID_ACTIVATION);\n\n      return {\n        segmentation: toMaskTensor(\n
tf.squeeze(scaledSegmentScores), segmentationThreshold),\n        heatmapScores,\n        offsets,\n
displacementFwd,\n        displacementBwd,\n      };\n    });\n    resized.dispose();\n    return {\n      segmentation,\n
heatmapScores,\n      offsets,\n      displacementFwd,\n      displacementBwd,\n      padding,\n
internalResolutionHeightAndWidth\n    };\n  }\n\n  /**\n   * Given an image with many people, returns a
PersonSegmentation dictionary\n   * that contains the segmentation mask for all people and a single pose.\n   *\n   *
Note: The segmentation mask returned by this method covers all people but\n   * the pose works well for one
person. If you want to estimate instance-level\n   * multiple person segmentation & pose for each person, use\n   *
`segmentMultiPerson` instead.\n   *\n   * @param input
ImageData|HTMLImageElement|HTMLCanvasElement|HTMLVideoElement)\n
  * The input image to feed through the network.\n   *\n   * @param config PersonInferenceConfig object that
contains\n   * parameters for the BodyPix inference using person decoding.\n   *\n   * @return A
SemanticPersonSegmentation dictionary that contains height,\n   * width, the flattened binary segmentation mask
and the poses for all people.\n   * The width and height correspond to the same dimensions of the input image.\n   * -
`height`: The height of the segmentation data in pixel unit.\n   * - `width`: The width of the segmentation data in
pixel unit.\n   * - `data`: The flattened Uint8Array of segmentation data. 1 means the pixel\n   * belongs to a person
and 0 means the pixel doesn't belong to a person. The\n   * size of the array is equal to `height` x `width` in row-
major order.\n   * - `allPoses`: The 2d poses of all people.\n   */\n  async segmentPerson(\n      input:
BodyPixInput,\n      config: PersonInferenceConfig = PERSON_INFERENCE_CONFIG):\n
 Promise<SemanticPersonSegmentation> {\n    config = {...PERSON_INFERENCE_CONFIG, ...config};\n\n
validatePersonInferenceConfig(config);\n\n    const {\n      segmentation,\n      heatmapScores,\n      offsets,\n
displacementFwd,\n      displacementBwd,\n      padding,\n      internalResolutionHeightAndWidth\n    } =\n
this.segmentPersonActivation(\n          input, config.internalResolution, config.segmentationThreshold);\n\n
const [height, width] = segmentation.shape;\n\n    const result = await segmentation.data() as Uint8Array;\n
segmentation.dispose();\n\n    const tensorBuffers = await toTensorBuffers3D(\n        [heatmapScores, offsets,
displacementFwd, displacementBwd]);\n    const [scoresBuf, offsetsBuf, displacementsFwdBuf,
displacementsBwdBuf] =\n        tensorBuffers;\n\n    let poses = decodeMultiplePoses(\n        scoresBuf, offsetsBuf,
displacementsFwdBuf, displacementsBwdBuf,\n        this.baseModel.outputStride, config.maxDetections,\n
config.scoreThreshold,
 config.nmsRadius);\n\n    poses = scaleAndFlipPoses(\n        poses, [height, width],
internalResolutionHeightAndWidth, padding,\n        FLIP_POSES_AFTER_SCALING);\n\n
heatmapScores.dispose();\n    offsets.dispose();\n    displacementFwd.dispose();\n    displacementBwd.dispose();\n\n
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return {height, width, data: result, allPoses: poses};\n  }\n\n  /**\n   * Given an image with multiple people, returns an *array* of\n   * PersonSegmentation object. Each element in the array corresponding to one\n   * of the people in the input image. In other words, it predicts\n   * instance-level multiple person segmentation & pose for each person.\n   *\n   * The model does standard ImageNet pre-processing before inferring through\n   * the model. The image pixels should have values [0-255].\n   *\n   * @param input\n   * ImageData|HTMLImageElement|HTMLCanvasElement|HTMLVideoElement) The input\n   * image to feed through the network.\n   *\n   * @param config MultiPersonInferenceConfig
 object that contains\n   * parameters for the BodyPix inference using multi-person decoding.\n   *\n   * @return An array of PersonSegmentation object, each containing a width,\n   * height, a binary array (1 for the pixels that are part of the\n   * person, and 0 otherwise) and 2D pose. The array size corresponds to the\n   * number of pixels in the image. The width and height correspond to the\n   * dimensions of the image the binary array is shaped to, which are the same\n   * dimensions of the input image.\n   */\n  async segmentMultiPerson(\n      input: BodyPixInput,\n  config: MultiPersonInstanceInferenceConfig =\n          MULTI_PERSON_INSTANCE_INFERENCE_CONFIG):\n      Promise<PersonSegmentation[]> {\n    config = {...MULTI_PERSON_INSTANCE_INFERENCE_CONFIG, ...config};\n    validateMultiPersonInstanceInferenceConfig(config);\n    const [height, width] = getInputSize(input);\n    const internalResolutionHeightAndWidth = toInputResolutionHeightAndWidth(\n  config.internalResolution, this.baseModel.outputStride,\n        [height, width]);\n\n    const {resized, padding} =\n      padAndResizeTo(input, internalResolutionHeightAndWidth);\n    const {\n      segmentation,\n      longOffsets,\n  heatmapScoresRaw,\n      offsetsRaw,\n      displacementFwdRaw,\n      displacementBwdRaw,\n    } = tf.tidy(() => {\n      const {\n        segmentLogits,\n        longOffsets,\n        heatmapScores,\n        offsets,\n  displacementFwd,\n        displacementBwd,\n      } =
this.predictForMultiPersonInstanceSegmentationAndPart(resized);\n      const scaledSegmentScores =
scaleAndCropToInputTensorShape(\n          segmentLogits, [height, width], internalResolutionHeightAndWidth,\n
    [[padding.top, padding.bottom], [padding.left, padding.right]],\n          APPLY_SIGMOID_ACTIVATION);\n
const longOffsetsResized = false;\n      let scaledLongOffsets;\n      if (longOffsetsResized) {\n
scaledLongOffsets = scaleAndCropToInputTensorShape(\n
          longOffsets, [height, width], internalResolutionHeightAndWidth,\n          [[padding.top, padding.bottom],
[padding.left, padding.right]],\n          APPLY_SIGMOID_ACTIVATION);\n      } else {\n        scaledLongOffsets
= longOffsets;\n      }\n\n      const segmentation = toMaskTensor(\n          tf.squeeze(scaledSegmentScores),
config.segmentationThreshold);\n\n      return {\n        segmentation,\n        longOffsets: scaledLongOffsets,\n
heatmapScoresRaw: heatmapScores,\n        offsetsRaw: offsets,\n        displacementFwdRaw: displacementFwd,\n
  displacementBwdRaw: displacementBwd,\n      };\n    });\n\n    const tensorBuffers = await toTensorBuffers3D(\n
    [heatmapScoresRaw, offsetsRaw, displacementFwdRaw, displacementBwdRaw]);\n    const [scoresBuf,
offsetsBuf, displacementsFwdBuf, displacementsBwdBuf] =\n        tensorBuffers;\n\n    let poses =
decodeMultiplePoses(\n        scoresBuf, offsetsBuf, displacementsFwdBuf, displacementsBwdBuf,\n
      this.baseModel.outputStride, config.maxDetections,\n        config.scoreThreshold, config.nmsRadius);\n\n
poses = scaleAndFlipPoses(\n        poses, [height, width], internalResolutionHeightAndWidth, padding,\n
FLIP_POSES_AFTER_SCALING);\n\n    const instanceMasks = await decodePersonInstanceMasks(\n
segmentation, longOffsets, poses, height, width,\n        this.baseModel.outputStride,
internalResolutionHeightAndWidth, padding,\n        config.scoreThreshold, config.refineSteps,
config.minKeypointScore,\n        config.maxDetections);\n\n    resized.dispose();\n    segmentation.dispose();\n
longOffsets.dispose();\n    heatmapScoresRaw.dispose();\n    offsetsRaw.dispose();\n
displacementFwdRaw.dispose();\n    displacementBwdRaw.dispose();\n\n    return instanceMasks;\n  }\n\n  /**\n   *
Given an image with many people, returns a dictionary containing: height,\n   * width, a tensor with a part id from 0-
24 for the pixels that are\n   * part of a
 corresponding body part, and -1 otherwise. This does standard\n   * ImageNet pre-processing before inferring
through the model.  The image\n   * should pixels should have values [0-255].\n   *\n   * @param input
ImageData|HTMLImageElement|HTMLCanvasElement|HTMLVideoElement)\n   * The input image to feed
```

```
through the network.\n   *\n   * @param internalResolution Defaults to 'medium'. The internal resolution\n   * percentage that the input is resized to before inference. The larger the\n   * internalResolution the more accurate the model at the cost of slower\n   * prediction times. Available values are 'low', 'medium', 'high', 'full', or\n   * a percentage value between 0 and 1. The values 'low', 'medium', 'high', and\n   * 'full' map to 0.25, 0.5, 0.75, and 1.0 correspondingly.\n   *\n   * @param segmentationThreshold The minimum that segmentation values must have\n   * to be considered part of the person.  Affects the clipping of the colored\n   * part image.\n   *\n   * @return  A dictionary
 containing `partSegmentation`, `heatmapScores`,\n   * `offsets`, and `padding`:\n   * - `partSegmentation`: A 2d Tensor with a part id from 0-24 for\n   * the pixels that are part of a corresponding body part, and -1 otherwise.\n   * - `heatmapScores`: A 3d Tensor of the keypoint heatmaps used by\n   * single-person pose estimation decoding.\n   * - `offsets`: A 3d Tensor of the keypoint offsets used by single-person pose\n   * estimation decoding.\n   * - `displacementFwd`: A 3d Tensor of the keypoint forward displacement\n   * used by pose estimation decoding.\n   * - `displacementBwd`: A 3d Tensor of the keypoint backward displacement used\n   * by pose estimation decoding.\n   * - `padding`: The padding (unit pixels) being applied to the input image\n   * before it is fed into the model.\n   */\n segmentPersonPartsActivation(\n     input: BodyPixInput, internalResolution: BodyPixInternalResolution,\n segmentationThreshold = 0.5): {\n   partSegmentation: tf.Tensor2D,\n
   heatmapScores: tf.Tensor3D,\n   offsets: tf.Tensor3D,\n   displacementFwd: tf.Tensor3D,\n   displacementBwd: tf.Tensor3D,\n   padding: Padding,\n   internalResolutionHeightAndWidth: [number, number]\n  } {\n   const [height, width] = getInputSize(input);\n   const internalResolutionHeightAndWidth = toInputResolutionHeightAndWidth(\n       internalResolution, this.baseModel.outputStride, [height, width]);\n   const {\n     resized,\n     padding,\n   } = padAndResizeTo(input, internalResolutionHeightAndWidth);\n\n   const {\n     partSegmentation,\n     heatmapScores,\n     offsets,\n     displacementFwd,\n     displacementBwd\n   } = tf.tidy(() => {\n     const {\n       segmentLogits,\n       partHeatmapLogits,\n       heatmapScores,\n       offsets,\n
     displacementFwd,\n       displacementBwd\n     } = this.predictForPersonSegmentationAndPart(resized);\n\n     const [resizedHeight, resizedWidth] = resized.shape;\n\n     const scaledSegmentScores
 = scaleAndCropToInputTensorShape(\n         segmentLogits, [height, width], [resizedHeight, resizedWidth],\n [[padding.top, padding.bottom], [padding.left, padding.right]],\n         APPLY_SIGMOID_ACTIVATION);\n\n     const scaledPartHeatmapScore = scaleAndCropToInputTensorShape(\n         partHeatmapLogits, [height, width], [resizedHeight, resizedWidth],\n         [[padding.top, padding.bottom], [padding.left, padding.right]],\n APPLY_SIGMOID_ACTIVATION);\n     const segmentation =\n toMaskTensor(tf.squeeze(scaledSegmentScores), segmentationThreshold);\n     return {\n       partSegmentation:\n       decodePartSegmentation(segmentation, scaledPartHeatmapScore),\n       heatmapScores,\n       offsets,\n displacementFwd,\n       displacementBwd,\n     };\n   });\n   resized.dispose();\n   return {\n partSegmentation,\n     heatmapScores,\n     offsets,\n     displacementFwd,\n     displacementBwd,\n padding,\n     internalResolutionHeightAndWidth\n
   };\n }\n\n  /**\n   * Given an image with many people, returns a PartSegmentation dictionary that\n   * contains the body part segmentation mask for all people and a single pose.\n   *\n   * Note: The body part segmentation mask returned by this method covers all\n   * people but the pose works well when there is one person. If you want to\n   * estimate instance-level multiple person body part segmentation & pose for\n   * each person, use `segmentMultiPersonParts` instead.\n   *\n   * @param input ImageData|HTMLImageElement|HTMLCanvasElement|HTMLVideoElement)\n   * The input image to feed through the network.\n   *\n   * @param config PersonInferenceConfig object that contains\n   * parameters for the BodyPix inference using single person decoding.\n   *\n   * @return A SemanticPartSegmentation dictionary that contains height, width,\n   * the flattened binary segmentation mask and the pose for the person. The\n   * width and height correspond to
 the same dimensions of the input image.\n   * - `height`: The height of the person part segmentation data in pixel unit.\n   * - `width`: The width of the person part segmentation data in pixel unit.\n   * - `data`: The flattened Int32Array of person part segmentation data with a\n   * part id from 0-24 for the pixels that are part of a
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corresponding body\n   * part, and -1 otherwise. The size of the array is equal to `height` x\n   * `width` in row-major order.\n   * - `allPoses`: The 2d poses of all people.\n   */\n  async segmentPersonParts(\n      input: BodyPixInput,\n      config: PersonInferenceConfig = PERSON_INFERENCE_CONFIG):\n Promise<SemanticPartSegmentation> {\n    config = {...PERSON_INFERENCE_CONFIG, ...config};\n\n validatePersonInferenceConfig(config);\n    const {\n      partSegmentation,\n      heatmapScores,\n      offsets,\n displacementFwd,\n      displacementBwd,\n      padding,\n      internalResolutionHeightAndWidth\n    } =\n this.segmentPersonPartsActivation(\n
        input, config.internalResolution, config.segmentationThreshold);\n\n    const [height, width] = partSegmentation.shape;\n    const data = await partSegmentation.data() as Int32Array;\n partSegmentation.dispose();\n\n    const tensorBuffers = await toTensorBuffers3D(\n        [heatmapScores, offsets, displacementFwd, displacementBwd]);\n    const [scoresBuf, offsetsBuf, displacementsFwdBuf, displacementsBwdBuf] =\n        tensorBuffers;\n\n    let poses = decodeMultiplePoses(\n        scoresBuf, offsetsBuf, displacementsFwdBuf, displacementsBwdBuf,\n        this.baseModel.outputStride, config.maxDetections,\n config.scoreThreshold, config.nmsRadius);\n\n    poses = scaleAndFlipPoses(\n        poses, [height, width], internalResolutionHeightAndWidth, padding,\n        FLIP_POSES_AFTER_SCALING);\n\n heatmapScores.dispose();\n    offsets.dispose();\n    displacementFwd.dispose();\n    displacementBwd.dispose();\n\n
  return {height, width, data,
 allPoses: poses};\n  }\n\n  /**\n   * Given an image with multiple people, returns an *array* of PartSegmentation\n * object. Each element in the array corresponding to one\n   * of the people in the input image. In other words, it predicts\n   * instance-level multiple person body part segmentation & pose for each\n   * person.\n   *\n   * This does standard ImageNet pre-processing before inferring through\n   * the model. The image pixels should have values [0-255].\n   *\n   * @param input\n   * ImageData|HTMLImageElement|HTMLCanvasElement|HTMLVideoElement) The input\n   * image to feed through the network.\n   *\n   * @param config MultiPersonInferenceConfig object that contains\n   * parameters for the BodyPix inference using multi-person decoding.\n   *\n   * @return An array of PartSegmentation object, each containing a width,\n   * height, a flattened array (with part id from 0-24 for the pixels that are\n   * part of a corresponding body part, and -1 otherwise) and 2D pose.
  The width\n   * and height correspond to the dimensions of the image. Each flattened part\n   * segmentation array size is equal to `height` x `width`.\n   */\n  async segmentMultiPersonParts(\n      input: BodyPixInput,\n      config: MultiPersonInstanceInferenceConfig =\n          MULTI_PERSON_INSTANCE_INFERENCE_CONFIG):
Promise<PartSegmentation[]> {\n    config = {...MULTI_PERSON_INSTANCE_INFERENCE_CONFIG, ...config};\n\n    validateMultiPersonInstanceInferenceConfig(config);\n    const [height, width] = getInputSize(input);\n    const internalResolutionHeightAndWidth = toInputResolutionHeightAndWidth(\n config.internalResolution, this.baseModel.outputStride,\n        [height, width]);\n    const {resized, padding} =\n padAndResizeTo(input, internalResolutionHeightAndWidth);\n    const {\n      segmentation,\n      longOffsets,\n heatmapScoresRaw,\n      offsetsRaw,\n      displacementFwdRaw,\n      displacementBwdRaw,\n partSegmentation,\n    } = tf.tidy(()
 => {\n      const {\n        segmentLogits,\n        longOffsets,\n        heatmapScores,\n        offsets,\n displacementFwd,\n        displacementBwd,\n        partHeatmaps\n      } =
this.predictForMultiPersonInstanceSegmentationAndPart(resized);\n\n      // decoding with scaling.\n      const scaledSegmentScores = scaleAndCropToInputTensorShape(\n          segmentLogits, [height, width], internalResolutionHeightAndWidth,\n          [[padding.top, padding.bottom], [padding.left, padding.right]],\n APPLY_SIGMOID_ACTIVATION);\n\n      // decoding with scaling.\n      const scaledPartSegmentationScores = scaleAndCropToInputTensorShape(\n          partHeatmaps, [height, width], internalResolutionHeightAndWidth,\n
    [[padding.top, padding.bottom], [padding.left, padding.right]],\n          APPLY_SIGMOID_ACTIVATION);\n\n
 const scaledLongOffsets = longOffsets;\n      const segmentation = toMaskTensor(\n tf.squeeze(scaledSegmentScores), config.segmentationThreshold);\n
```

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    const partSegmentation =\n        decodeOnlyPartSegmentation(scaledPartSegmentationScores);\n    return {\n      segmentation,\n      longOffsets: scaledLongOffsets,\n      heatmapScoresRaw: heatmapScores,\n      offsetsRaw: offsets,\n      displacementFwdRaw: displacementFwd,\n      displacementBwdRaw: displacementBwd,\n      partSegmentation\n    };\n  });\n\n  const tensorBuffers = await toTensorBuffers3D(\n    [heatmapScoresRaw, offsetsRaw, displacementFwdRaw, displacementBwdRaw]);\n  const [scoresBuf, offsetsBuf, displacementsFwdBuf, displacementsBwdBuf] =\n      tensorBuffers;\n\n  let poses = decodeMultiplePoses(\n      scoresBuf, offsetsBuf, displacementsFwdBuf, displacementsBwdBuf,\n      this.baseModel.outputStride, config.maxDetections,\n      config.scoreThreshold, config.nmsRadius);\n\n  poses = scaleAndFlipPoses(\n      poses, [height, width], internalResolutionHeightAndWidth, padding,\n      FLIP_POSES_AFTER_SCALING);\n\n\n  const instanceMasks = await decodePersonInstancePartMasks(\n      segmentation, longOffsets, partSegmentation, poses, height, width,\n      this.baseModel.outputStride, internalResolutionHeightAndWidth,\n      padding,\n      config.scoreThreshold, config.refineSteps, config.minKeypointScore,\n      config.maxDetections);\n\n  resized.dispose();\n  segmentation.dispose();\n  longOffsets.dispose();\n  heatmapScoresRaw.dispose();\n  offsetsRaw.dispose();\n  displacementFwdRaw.dispose();\n  displacementBwdRaw.dispose();\n  partSegmentation.dispose();\n\n  return instanceMasks;\n }\n\n public dispose() {\n  this.baseModel.dispose();\n }\n}\n\n/**\n * Loads the MobileNet BodyPix model.\n */\nasync function loadMobileNet(config: ModelConfig): Promise<BodyPix> {\n const outputStride = config.outputStride;\n const quantBytes = config.quantBytes;\n const multiplier = config.multiplier;\n if (tf == null) {\n  throw new Error(\n      `Cannot find TensorFlow.js. If you are using a <script> tag, please ` +\n      `also include @tensorflow/tfjs on the page before using this\n      model.`);\n }\n\n const url = mobileNetSavedModel(outputStride, multiplier, quantBytes);\n const graphModel = await tfconv.loadGraphModel(config.modelUrl || url);\n const mobilenet = new MobileNet(graphModel, outputStride);\n return new BodyPix(mobilenet);\n}\n\n/**\n * Loads the ResNet BodyPix model.\n */\nasync function loadResNet(config: ModelConfig): Promise<BodyPix> {\n const outputStride = config.outputStride;\n const quantBytes = config.quantBytes;\n if (tf == null) {\n  throw new Error(\n      `Cannot find TensorFlow.js. If you are using a <script> tag, please ` +\n      `also include @tensorflow/tfjs on the page before using this\n      model.`);\n }\n\n const url = resNet50SavedModel(outputStride, quantBytes);\n const graphModel = await tfconv.loadGraphModel(config.modelUrl || url);\n const resnet = new ResNet(graphModel, outputStride);\n return new BodyPix(resnet);\n}\n\n/**\n * Loads the BodyPix model instance from a checkpoint, with the ResNet\n * or MobileNet architecture. The model to be loaded is configurable using the\n * config dictionary ModelConfig. Please find more details in the\n * documentation of the ModelConfig.\n *\n * @param config ModelConfig dictionary that contains parameters for\n * the BodyPix loading process. Please find more details of each parameters\n * in the documentation of the ModelConfig interface. The predefined\n * `MOBILENET_V1_CONFIG` and `RESNET_CONFIG` can also be used as references\n * for defining your customized config.\n */\nexport async function load(config: ModelConfig = MOBILENET_V1_CONFIG):\n    Promise<BodyPix> {\n  config = validateModelConfig(config);\n  if (config.architecture === 'ResNet50') {\n    return loadResNet(config);\n  } else if (config.architecture === 'MobileNetV1') {\n    return loadMobileNet(config);\n  } else {\n    return null;\n  }\n}\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ========================================================================\n */\n\n// method copied from bGlur in https://codepen.io/zhaojun/pen/zZmRQe\nexport function cpuBlur(\n    canvas: HTMLCanvasElement|OffscreenCanvas,\n    image:
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```
HTMLImageElement|HTMLVideoElement|HTMLCanvasElement|OffscreenCanvas,\n    blur: number) {\n  const ctx = canvas.getContext('2d');\n\n
  let sum = 0;\n  const delta = 5;\n  const alphaLeft = 1 / (2 * Math.PI * delta * delta);\n  const step = blur < 3 ? 1 : 2;\n  for (let y = -blur; y <= blur; y += step) {\n    for (let x = -blur; x <= blur; x += step) {\n      const weight =\n  alphaLeft * Math.exp(-(x * x + y * y) / (2 * delta * delta));\n      sum += weight;\n    }\n  }\n  for (let y = -blur; y <= blur; y += step) {\n    for (let x = -blur; x <= blur; x += step) {\n      ctx.globalAlpha = alphaLeft *\n  Math.exp(-(x * x + y * y) / (2 * delta * delta)) / sum * blur;\n      ctx.drawImage(image, x, y);\n    }\n  }\n  ctx.globalAlpha = 1;\n}\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable
  law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
  ==========================================================================\n
  */\n\nimport {cpuBlur} from './blur';\nimport {Color, PartSegmentation, PersonSegmentation} from
  './types';\nimport {SemanticPartSegmentation, SemanticPersonSegmentation} from './types';\nimport {getInputSize}
  from './util';\n\nexport type Canvas = HTMLCanvasElement | OffscreenCanvas;\n\nconst offScreenCanvases:
  {[name: string]: Canvas} = {};\n\ntype ImageType = HTMLImageElement|HTMLVideoElement|Canvas;\ntype
  HasDimensions = {\n  width: number,\n  height: number\n};\n\nfunction isSafari() {\n  return
  (/^((?!chrome|android).)*safari/i.test(navigator.userAgent));\n}\n\nfunction assertSameDimensions(\n    {width:
  widthA,
  height: heightA}: HasDimensions,\n    {width: widthB, height: heightB}: HasDimensions, nameA: string,\n
  nameB: string) {\n  if (widthA !== widthB || heightA !== heightB) {\n    throw new Error(`error: dimensions must
  match. ${nameA} has dimensions ${\n        widthA}x${heightA}, ${nameB} has dimensions
  ${widthB}x${heightB}`);\n  }\n}\n\nfunction flipCanvasHorizontal(canvas: Canvas) {\n  const ctx =
  canvas.getContext('2d');\n  ctx.scale(-1, 1);\n  ctx.translate(-canvas.width, 0);\n}\n\nfunction
  drawWithCompositing(\n    ctx: CanvasRenderingContext2D|OffscreenCanvasRenderingContext2D,\n    image:
  Canvas|ImageType,\n    compositeOperation: string) {\n  ctx.globalCompositeOperation = compositeOperation;\n
  ctx.drawImage(image, 0, 0);\n}\n\nfunction createOffScreenCanvas(): Canvas {\n  if (typeof document !==
  'undefined' ) {\n    return document.createElement('canvas');\n  } else if (typeof OffscreenCanvas !== 'undefined')
  {\n    return new OffscreenCanvas(0, 0);\n  } else {\n    throw
  new Error('Cannot create a canvas in this context');\n  }\n}\n\nfunction ensureOffscreenCanvasCreated(id: string):
  Canvas {\n  if (!offScreenCanvases[id]) {\n    offScreenCanvases[id] = createOffScreenCanvas();\n  }\n  return
  offScreenCanvases[id];\n}\n\nfunction drawAndBlurImageOnCanvas(\n    image: ImageType, blurAmount:
  number, canvas: Canvas) {\n  const {height, width} = image;\n  const ctx = canvas.getContext('2d');\n  canvas.width
  = width;\n  canvas.height = height;\n  ctx.clearRect(0, 0, width, height);\n  ctx.save();\n  if (isSafari()) {\n
  cpuBlur(canvas, image, blurAmount);\n  } else {\n    // tslint:disable:no-any\n    (ctx as any).filter =
  `blur(${blurAmount}px)`;\n    ctx.drawImage(image, 0, 0, width, height);\n  }\n  ctx.restore();\n}\n\nfunction
  drawAndBlurImageOnOffScreenCanvas(\n    image: ImageType, blurAmount: number,\n    offscreenCanvasName:
  string): Canvas {\n  const canvas = ensureOffscreenCanvasCreated(offscreenCanvasName);\n  if (blurAmount ===
  0) {\n    renderImageToCanvas(image,
  canvas);\n  } else {\n    drawAndBlurImageOnCanvas(image, blurAmount, canvas);\n  }\n  return
  canvas;\n}\n\nfunction renderImageToCanvas(image: ImageType, canvas: Canvas) {\n  const {width, height} =
  image;\n  canvas.width = width;\n  canvas.height = height;\n  const ctx = canvas.getContext('2d');\n\n
  ctx.drawImage(image, 0, 0, width, height);\n}\n/**\n * Draw an image on a canvas\n */\nfunction
  renderImageDataToCanvas(image: ImageData, canvas: Canvas) {\n  canvas.width = image.width;\n  canvas.height
  = image.height;\n  const ctx = canvas.getContext('2d');\n\n  ctx.putImageData(image, 0, 0);\n}\n\nfunction
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renderImageDataToOffScreenCanvas(\n    image: ImageData, canvasName: string): Canvas {\n  const canvas =
ensureOffscreenCanvasCreated(canvasName);\n  renderImageDataToCanvas(image, canvas);\n\n  return
canvas;\n}\n\n/**\n * Given the output from estimating multi-person segmentation, generates an\n * image with
foreground and background color at each pixel determined
 by the\n * corresponding binary segmentation value at the pixel from the output.  In\n * other words, pixels where
there is a person will be colored with foreground\n * color and where there is not a person will be colored with
background color.\n *\n * @param personOrPartSegmentation The output from\n * `segmentPerson`,
`segmentMultiPerson`,\n * `segmentPersonParts` or `segmentMultiPersonParts`. They can\n * be
SemanticPersonSegmentation object, an array of PersonSegmentation object,\n * SemanticPartSegmentation object,
or an array of PartSegmentation object.\n *\n * @param foreground Default to {r:0, g:0, b:0, a: 0}. The foreground
color\n * (r,g,b,a) for visualizing pixels that belong to people.\n *\n * @param background Default to {r:0, g:0, b:0,
a: 255}. The background color\n * (r,g,b,a) for visualizing pixels that don't belong to people.\n *\n * @param
drawContour Default to false. Whether to draw the contour around each\n * person's segmentation mask or body
part mask.\n
 *\n * @param foregroundIds Default to [1]. The integer values that represent\n * foreground. For person
segmentation, 1 is the foreground. For body part\n * segmentation, it can be a subset of all body parts ids.\n *\n *
@returns An ImageData with the same width and height of\n * all the PersonSegmentation in
multiPersonSegmentation, with opacity and\n * transparency at each pixel determined by the corresponding binary\n
* segmentation value at the pixel from the output.\n */\nexport function toMask(\n    personOrPartSegmentation:
SemanticPersonSegmentation|\n    SemanticPartSegmentation|PersonSegmentation[]|PartSegmentation[],\n
foreground: Color = {\n      r: 0,\n      g: 0,\n      b: 0,\n      a: 0\n    },\n    background: Color = {\n      r: 0,\n      g: 0,\n
    b: 0,\n      a: 255\n    },\n    drawContour = false, foregroundIds: number[] = [1]): ImageData {\n  if
(Array.isArray(personOrPartSegmentation) &&\n      personOrPartSegmentation.length === 0) {\n    return null;\n
  }\n\n  let multiPersonOrPartSegmentation:\n      Array<SemanticPersonSegmentation|SemanticPartSegmentation|\n
        PersonSegmentation|PartSegmentation>;\n\n  if (!Array.isArray(personOrPartSegmentation)) {\n
multiPersonOrPartSegmentation = [personOrPartSegmentation];\n  } else {\n    multiPersonOrPartSegmentation =
personOrPartSegmentation;\n  }\n\n  const {width, height} = multiPersonOrPartSegmentation[0];\n  const bytes =
new Uint8ClampedArray(width * height * 4);\n\n  function drawStroke(\n      bytes: Uint8ClampedArray, row:
number, column: number, width: number,\n      radius: number, color: Color = {r: 0, g: 255, b: 255, a: 255}) {\n
for (let i = -radius; i <= radius; i++) {\n      for (let j = -radius; j <= radius; j++) {\n        if (i !== 0 && j !== 0) {\n
    const n = (row + i) * width + (column + j);\n          bytes[4 * n + 0] = color.r;\n          bytes[4 * n + 1] = color.g;\n
      bytes[4 * n + 2] = color.b;\n          bytes[4 * n + 3] = color.a;\n
        }\n      }\n    }\n  }\n\n  function isSegmentationBoundary(\n      segmentationData: Uint8Array|Int32Array,\n
row: number,\n      column: number,\n      width: number,\n      foregroundIds: number[] = [1],\n      radius = 1,\n
): boolean {\n    let numberBackgroundPixels = 0;\n    for (let i = -radius; i <= radius; i++) {\n      for (let j = -radius;
j <= radius; j++) {\n        if (i !== 0 && j !== 0) {\n          const n = (row + i) * width + (column + j);\n          if
(!foregroundIds.some(id => id === segmentationData[n])) {\n            numberBackgroundPixels += 1;\n          }\n
}\n      }\n    }\n    return numberBackgroundPixels > 0;\n  }\n\n  for (let i = 0; i < height; i += 1) {\n    for (let j = 0; j
< width; j += 1) {\n      const n = i * width + j;\n      bytes[4 * n + 0] = background.r;\n      bytes[4 * n + 1] =
background.g;\n      bytes[4 * n + 2] = background.b;\n      bytes[4 * n + 3] = background.a;\n      for (let k = 0; k <
multiPersonOrPartSegmentation.length;
 k++) {\n        if (foregroundIds.some(\n                id => id === multiPersonOrPartSegmentation[k].data[n])) {\n
 bytes[4 * n] = foreground.r;\n          bytes[4 * n + 1] = foreground.g;\n          bytes[4 * n + 2] = foreground.b;\n
bytes[4 * n + 3] = foreground.a;\n          const isBoundary = isSegmentationBoundary(\n
multiPersonOrPartSegmentation[k].data, i, j, width,\n              foregroundIds);\n          if (drawContour && i - 1 >= 0
&& i + 1 < height && j - 1 >= 0 &&\n              j + 1 < width && isBoundary) {\n            drawStroke(bytes, i, j,
width, 1);\n          }\n        }\n      }\n    }\n  }\n\n  return new ImageData(bytes, width, height);\n}\n\nconst
RAINBOW_PART_COLORS: Array<[number, number, number]> = [\n  [110, 64, 170], [143, 61, 178], [178, 60,
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178], [210, 62, 167],\n [238, 67, 149], [255, 78, 125], [255, 94, 99], [255, 115, 75],\n [255, 140, 56], [239, 167, 47], [217, 194, 49], [194, 219, 64],\n
 [175, 240, 91], [135, 245, 87], [96, 247, 96], [64, 243, 115],\n [40, 234, 141], [28, 219, 169], [26, 199, 194], [33, 176, 213],\n [47, 150, 224], [65, 125, 224], [84, 101, 214], [99, 81, 195]\n];\n\n/**\n * Given the output from person body part segmentation (or multi-person\n * instance body part segmentation) and an array of colors indexed by part id,\n * generates an image with the corresponding color for each part at each pixel,\n * and white pixels where there is no part.\n *\n * @param partSegmentation The output from segmentPersonParts\n * or segmentMultiPersonParts. The former is a SemanticPartSegmentation\n * object and later is an array of PartSegmentation object.\n *\n * @param partColors A multi-dimensional array of rgb colors indexed by\n * part id. Must have 24 colors, one for every part.\n *\n * @returns An ImageData with the same width and height of all the element in\n * multiPersonPartSegmentation, with the corresponding color for each part at\n * each pixel, and
 black pixels where there is no part.\n */\nexport function toColoredPartMask(\n partSegmentation: SemanticPartSegmentation|PartSegmentation[],\n partColors: Array<[number, number, number]> =\n RAINBOW_PART_COLORS): ImageData {\n if (Array.isArray(partSegmentation) && partSegmentation.length === 0) {\n return null;\n }\n\n let multiPersonPartSegmentation;\n if (!Array.isArray(partSegmentation)) {\n multiPersonPartSegmentation = [partSegmentation];\n } else {\n multiPersonPartSegmentation = partSegmentation;\n }\n const {width, height} = multiPersonPartSegmentation[0];\n const bytes = new Uint8ClampedArray(width * height * 4);\n\n for (let i = 0; i < height * width; ++i) {\n // invert mask. Invert the segmentation mask.\n const j = i * 4;\n bytes[j + 0] = 255;\n bytes[j + 1] = 255;\n bytes[j + 2] = 255;\n bytes[j + 3] = 255;\n for (let k = 0; k < multiPersonPartSegmentation.length; k++) {\n const partId = multiPersonPartSegmentation[k].data[i];\n
  if (partId !== -1) {\n const color = partColors[partId];\n if (!color) {\n throw new Error(`No color could be found for part id ${partId}`);\n }\n bytes[j + 0] = color[0];\n bytes[j + 1] = color[1];\n bytes[j + 2] = color[2];\n bytes[j + 3] = 255;\n }\n }\n }\n return new ImageData(bytes, width, height);\n}\n\nconst CANVAS_NAMES = {\n blurred: 'blurred',\n blurredMask: 'blurred-mask',\n mask: 'mask',\n lowresPartMask: 'lowres-part-mask',\n};\n\n/**\n * Given an image and a maskImage of type ImageData, draws the image with the\n * mask on top of it onto a canvas.\n *\n * @param canvas The canvas to be drawn onto.\n *\n * @param image The original image to apply the mask to.\n *\n * @param maskImage An ImageData containing the mask. Ideally this should be\n * generated by toMask or toColoredPartMask.\n *\n * @param maskOpacity The opacity of the mask when drawing it on top of the\n * image. Defaults
 to 0.7. Should be a float between 0 and 1.\n *\n * @param maskBlurAmount How many pixels to blur the mask by. Defaults to 0.\n * Should be an integer between 0 and 20.\n *\n * @param flipHorizontal If the result should be flipped horizontally. Defaults\n * to false.\n */\nexport function drawMask(\n canvas: Canvas, image: ImageType, maskImage: ImageData|null,\n maskOpacity = 0.7, maskBlurAmount = 0, flipHorizontal = false) {\n const [height, width] = getInputSize(image);\n canvas.width = width;\n canvas.height = height;\n\n const ctx = canvas.getContext('2d');\n ctx.save();\n if (flipHorizontal) {\n flipCanvasHorizontal(canvas);\n }\n\n ctx.drawImage(image, 0, 0);\n\n ctx.globalAlpha = maskOpacity;\n if (maskImage) {\n assertSameDimensions({width, height}, maskImage, 'image', 'mask');\n\n const mask = renderImageDataToOffScreenCanvas(maskImage, CANVAS_NAMES.mask);\n\n const blurredMask = drawAndBlurImageOnOffScreenCanvas(\n mask, maskBlurAmount,
 CANVAS_NAMES.blurredMask);\n ctx.drawImage(blurredMask, 0, 0, width, height);\n }\n ctx.restore();\n}\n\n/**\n * Given an image and a maskImage of type ImageData, draws the image with the\n * pixelated mask on top of it onto a canvas.\n *\n * @param canvas The canvas to be drawn onto.\n *\n * @param image The original image to apply the mask to.\n *\n * @param maskImage An ImageData containing the mask. Ideally this should be\n * generated by toColoredPartMask.\n *\n * @param maskOpacity The opacity of the mask when drawing it on top of the\n * image. Defaults to 0.7. Should be a float between 0 and 1.\n *\n * @param maskBlurAmount How many pixels to blur the mask by. Defaults to 0.\n * Should be an integer between 0 and 20.\n *\n * @param flipHorizontal If the result should be flipped horizontally. Defaults\n * to false.\n *\n * @param

pixelCellWidth The width of each pixel cell. Default to 10 px.\n */\nexport function drawPixelatedMask(\n canvas: Canvas, image: ImageType,
maskImage: ImageData,\n maskOpacity = 0.7, maskBlurAmount = 0, flipHorizontal = false,\n pixelCellWidth = 10.0) {\n const [height, width] = getInputSize(image);\n assertSameDimensions({width, height}, maskImage, 'image', 'mask');\n\n const mask = renderImageDataToOffScreenCanvas(maskImage, CANVAS_NAMES.mask);\n const blurredMask = drawAndBlurImageOnOffScreenCanvas(\n mask, maskBlurAmount, CANVAS_NAMES.blurredMask);\n\n canvas.width = blurredMask.width;\n canvas.height = blurredMask.height;\n\n const ctx = canvas.getContext('2d');\n ctx.save();\n if (flipHorizontal) {\n flipCanvasHorizontal(canvas);\n }\n\n const offscreenCanvas =\n ensureOffscreenCanvasCreated(CANVAS_NAMES.lowresPartMask);\n const offscreenCanvasCtx = offscreenCanvas.getContext('2d');\n offscreenCanvas.width = blurredMask.width * (1.0 / pixelCellWidth);\n offscreenCanvas.height = blurredMask.height * (1.0 / pixelCellWidth);\n offscreenCanvasCtx.drawImage(\n blurredMask, 0, 0, blurredMask.width,
blurredMask.height, 0, 0,\n offscreenCanvas.width, offscreenCanvas.height);\n ctx.imageSmoothingEnabled = false;\n ctx.drawImage(\n offscreenCanvas, 0, 0, offscreenCanvas.width, offscreenCanvas.height, 0,\n 0, canvas.width, canvas.height);\n\n // Draws vertical grid lines that are `pixelCellWidth` apart from each other.\n for (let i = 0; i < offscreenCanvas.width; i++) {\n ctx.beginPath();\n ctx.strokeStyle = '#ffffff';\n ctx.moveTo(pixelCellWidth * i, 0);\n ctx.lineTo(pixelCellWidth * i, canvas.height);\n ctx.stroke();\n }\n\n // Draws horizontal grid lines that are `pixelCellWidth` apart from each\n // other.\n for (let i = 0; i < offscreenCanvas.height; i++) {\n ctx.beginPath();\n ctx.strokeStyle = '#ffffff';\n ctx.moveTo(0, pixelCellWidth * i);\n ctx.lineTo(canvas.width, pixelCellWidth * i);\n ctx.stroke();\n }\n\n ctx.globalAlpha = 1.0 - maskOpacity;\n ctx.drawImage(image, 0, 0, blurredMask.width, blurredMask.height);\n ctx.restore();\n}\n\nfunction createPersonMask(\n multiPersonSegmentation: PersonSegmentation[]|SemanticPersonSegmentation,\n edgeBlurAmount: number): Canvas {\n const backgroundMaskImage = toMask(\n multiPersonSegmentation, {r: 0, g: 0, b: 0, a: 255},\n {r: 0, g: 0, b: 0, a: 0});\n\n const backgroundMask =\n renderImageDataToOffScreenCanvas(backgroundMaskImage, CANVAS_NAMES.mask);\n if (edgeBlurAmount === 0) {\n return backgroundMask;\n } else {\n return drawAndBlurImageOnOffScreenCanvas(\n backgroundMask, edgeBlurAmount, CANVAS_NAMES.blurredMask);\n }\n}\n\n/**\n * Given a personSegmentation and an image, draws the image with its background\n * blurred onto the canvas.\n *\n * @param canvas The canvas to draw the background-blurred image onto.\n *\n * @param image The image to blur the background of and draw.\n *\n * @param personSegmentation A SemanticPersonSegmentation or an array of\n * PersonSegmentation object.\n *\n * @param backgroundBlurAmount
How many pixels in the background blend into each\n * other. Defaults to 3. Should be an integer between 1 and 20.\n *\n * @param edgeBlurAmount How many pixels to blur on the edge between the person\n * and the background by. Defaults to 3. Should be an integer between 0 and 20.\n *\n * @param flipHorizontal If the output should be flipped horizontally. Defaults\n * to false.\n */\nexport function drawBokehEffect(\n canvas: Canvas, image: ImageType,\n multiPersonSegmentation: SemanticPersonSegmentation|PersonSegmentation[],\n backgroundBlurAmount = 3, edgeBlurAmount = 3, flipHorizontal = false) {\n const blurredImage = drawAndBlurImageOnOffScreenCanvas(\n image, backgroundBlurAmount, CANVAS_NAMES.blurred);\n canvas.width = blurredImage.width;\n canvas.height = blurredImage.height;\n\n const ctx = canvas.getContext('2d');\n\n if (Array.isArray(multiPersonSegmentation) &&\n multiPersonSegmentation.length === 0) {\n ctx.drawImage(blurredImage,
0, 0);\n return;\n }\n\n const personMask = createPersonMask(multiPersonSegmentation, edgeBlurAmount);\n\n ctx.save();\n if (flipHorizontal) {\n flipCanvasHorizontal(canvas);\n }\n // draw the original image on the final canvas\n const [height, width] = getInputSize(image);\n ctx.drawImage(image, 0, 0, width, height);\n\n // \"destination-in\" - \"The existing canvas content is kept where both the\n // new shape and existing canvas content overlap. Everything else is made\n // transparent.\"\n // crop what's not the person using the mask from the original

image\n drawWithCompositing(ctx, personMask, 'destination-in');\n // \"destination-over\" - \"The existing canvas content is kept where both the\n // new shape and existing canvas content overlap. Everything else is made\n // transparent.\"\n // draw the blurred background on top of the original image where it doesn't\n // overlap.\n drawWithCompositing(ctx, blurredImage, 'destination-over');\n ctx.restore();\n}\n\nfunction
 createBodyPartMask(\n   multiPersonPartSegmentation: SemanticPartSegmentation|PartSegmentation[],\n bodyPartIdsToMask: number[], edgeBlurAmount: number): Canvas {\n const backgroundMaskImage = toMask(\n
  multiPersonPartSegmentation, {r: 0, g: 0, b: 0, a: 0},\n   {r: 0, g: 0, b: 0, a: 255}, true, bodyPartIdsToMask);\n\n const backgroundMask =\n   renderImageDataToOffScreenCanvas(backgroundMaskImage,
CANVAS_NAMES.mask);\n if (edgeBlurAmount === 0) {\n   return backgroundMask;\n } else {\n   return drawAndBlurImageOnOffScreenCanvas(\n   backgroundMask, edgeBlurAmount,
CANVAS_NAMES.blurredMask);\n }\n}\n\n/**\n * Given a personSegmentation and an image, draws the image with its background\n * blurred onto the canvas.\n *\n * @param canvas The canvas to draw the background-blurred image onto.\n *\n * @param image The image to blur the background of and draw.\n *\n * @param partSegmentation A SemanticPartSegmentation or an array of\n * PartSegmentation
 object.\n *\n * @param bodyPartIdsToBlur Default to [0, 1] (left-face and right-face). An\n * array of body part ids to blur. Each must be one of the 24 body part ids.\n *\n * @param backgroundBlurAmount How many pixels in the background blend into each\n * other. Defaults to 3. Should be an integer between 1 and 20.\n *\n * @param edgeBlurAmount How many pixels to blur on the edge between the person\n * and the background by. Defaults to 3. Should be an integer between 0 and 20.\n *\n * @param flipHorizontal If the output should be flipped horizontally. Defaults\n * to false.\n */\nexport function blurBodyPart(\n   canvas: Canvas, image: ImageType,\n partSegmentation: SemanticPartSegmentation|PartSegmentation[],\n   bodyPartIdsToBlur = [0, 1], backgroundBlurAmount = 3, edgeBlurAmount = 3,\n   flipHorizontal = false) {\n const blurredImage = drawAndBlurImageOnOffScreenCanvas(\n   image, backgroundBlurAmount, CANVAS_NAMES.blurred);\n canvas.width = blurredImage.width;\n
  canvas.height = blurredImage.height;\n\n const ctx = canvas.getContext('2d');\n\n if (Array.isArray(partSegmentation) && partSegmentation.length === 0) {\n   ctx.drawImage(blurredImage, 0, 0);\n return;\n }\n const bodyPartMask =\n   createBodyPartMask(partSegmentation, bodyPartIdsToBlur, edgeBlurAmount);\n\n ctx.save();\n if (flipHorizontal) {\n   flipCanvasHorizontal(canvas);\n }\n // draw the original image on the final canvas\n const [height, width] = getInputSize(image);\n ctx.drawImage(image, 0, 0, width, height);\n\n // \"destination-in\" - \"The existing canvas content is kept where both the\n // new shape and existing canvas content overlap. Everything else is made\n // transparent.\"\n // crop what's not the person using the mask from the original image\n drawWithCompositing(ctx, bodyPartMask, 'destination-in');\n // \"destination-over\" - \"The existing canvas content is kept where both the\n // new shape and existing canvas content overlap. Everything else is made\n // transparent.\"\n // draw the blurred background on top of the original image where it doesn't\n // overlap.\n drawWithCompositing(ctx, blurredImage, 'destination-over');\n ctx.restore();\n}\n","/**\n * @license\n * Copyright 2020 Google Inc. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n * ==\n */\n\nexport const PART_CHANNELS: string[] = [\n
  'left_face',\n 'right_face',\n 'left_upper_arm_front',\n 'left_upper_arm_back',\n 'right_upper_arm_front',\n 'right_upper_arm_back',\n 'left_lower_arm_front',\n 'left_lower_arm_back',\n 'right_lower_arm_front',\n 'right_lower_arm_back',\n 'left_hand',\n 'right_hand',\n 'torso_front',\n 'torso_back',\n 'left_upper_leg_front',\n 'left_upper_leg_back',\n 'right_upper_leg_front',\n 'right_upper_leg_back',\n 'left_lower_leg_front',\n 'left_lower_leg_back',\n 'right_lower_leg_front',\n 'right_lower_leg_back',\n 'left_feet',\n 'right_feet'\n];\n","/**

@license See the LICENSE file. */\n\n// This code is auto-generated, do not modify this file!\nconst version = '2.2.0';\nexport {version};\n"],"names":["toFlattenedOneHotPartMap","partHeatmapScores","numParts","shape","partMapLocations","tf.argMax","partMapFlattened","tf.reshape","tf.oneHot","clipByMask2d","image","mask","tf.mul","toMaskTensor","segmentScores","threshold","tf.tidy","tf.cast","tf.greater","tf.scalar","decodePartSegmentation","segmentationMask","_a","partMapHeight","partMapWidth","flattenedMap","partNumbers","tf.expandDims","tf.range","tf.matMul","partMap","partMapShiftedUpForClipping","tf.add","tf.sub","decodeOnlyPartSegmentation","model","outputStride","this","inputShape","inputs","tf.util","assert","BaseModel","input","asFloat","_this","preprocessInput","asBatch","results3d","predict","map","y","tf.squeeze","namedResults","nameOutputResults","heatmapScores","tf.sigmoid","heatmap","offsets","displacementFwd","displacementBwd","segmentation","partHeatmaps","longOffsets","partOffsets","dispose","__extends","MobileNet","tf.div","results","PART_NAMES","NUM_KEYPOINTS","length","PART_IDS","reduce","result","jointName","i","CONNECTED_PART_NAMES","POSE_CHAIN","CONNECTED_PART_INDICES","jointNameA","jointNameB","getScale","_b","padding","height","width","inputResolutionY","inputResolutionX","padT","padB","getOffsetPoint","x","keypoint","get","getImageCoords","part","heatmapX","heatmapY","clamp","a","min","max","squaredDistance","y1","x1","y2","x2","dy","dx","addVectors","b","computeDistance","embedding","pose","minPartScore","distance","numKpt","p","keypoints","score","Math","position","Infinity","convertToPositionInOuput","stride","padL","scaleX","scaleY","round","getEmbedding","location","keypointIndex","convertToPosition","outputResolutionX","refineSteps","newLocation","nn","t","newPos","nn_1","matchEmbeddingToInstance","poses","numKptForMatching","_c","embed","pair","keypointsIndex","push","kMin","kMinDist","k","dist","getOutputResolution","decodeMultipleMasksCPU","posesAboveScore","inHeight","inWidth","dataArrays","Uint8Array","fill","j","n","decodeMultiplePartMasksCPU","partSegmentaion","Int32Array","decodeMultipleMasksWebGl","minKptScore","maxNumPeople","origHeight","origWidth","slice","outHeight","outWidth","shapedLongOffsets","poseVals","Float32Array","poseOffset","kp","offset","_d","posesTensor","tf.tensor","program","variableNames","outputShape","userCode","tf.backend","compileAndRun","toPersonKSegmentation","tf.equal","toPersonKPartSegmentation","bodyParts","isWebGlBackend","getBackend","decodePersonInstanceMasks","minPoseScore","minKeypointScore","filter","personSegmentations","masksTensorInfo","masksTensor","tf.engine","makeTensorFromDataId","dataId","dtype","_","Promise","all","data","personSegmentationsData","forEach","segmentationsData","longOffsetsData","decodePersonInstancePartMasks","partSegmentation","partSegmentations","partSegmentationsByPersonData","partSegmentaionData","half","floor","maxSize","getElementValue","priorityQueue","Array","numberOfElements","MaxHeap","swim","exchange","sink","less","getValueAt","scoreIsMaximumInLocalWindow","keypointId","localMaximumRadius","scores","localMaximum","yStart","yEnd","yCurrent","xStart","xEnd","xCurrent","buildPartWithScoreQueue","scoreThreshold","numKeypoints","queue","enqueue","id","parentChildrenTuples","parentJoinName","childJoinName","parentToChildEdges","childToParentEdges","getDisplacement","edgeId","point","displacements","numEdges","getStridedIndexNearPoint","traverseToTargetKeypoint","sourceKeypoint","targetKeypointId","scoresBuffer","offsetRefineStep","displacement","targetKeypoint","targetKeypointIndices","offsetPoint","targetKeyPointIndices","decodePose","root","displacementsFwd","displacementsBwd","instanceKeypoints","rootPart","rootScore","rootPoint","edge","sourceKeypointId","withinNmsRadiusOfCorrespondingPoint","squaredNmsRadius","some","correspondingKeypoint","getInstanceScore","existingPoses","kLocalMaximumRadius","decodeMultiplePoses","offsetsBuffer","displacementsFwdBuffer","displacementsBwdBuffer","maxPoseDetections","nmsRadius","empty","dequeue","imageNetMean","ResNet","RESNET50_BASE_URL","MOBILENET_BASE_URL","resNet50SavedModel","quantBytes","graphJson","mobileNetSavedModel","multiplier","toStr","1","0.75","0.5","getSizeFromImageLikeElement","offsetHeight","offsetWidth","Error","getSizeFromVideoElement","hasAttribute","videoHeight","videoWidth","getInputSize","HTMLCanvasElement","OffscreenCanvas","HTMLImageElement","ImageData","HTMLVideoElement","tf.Tensor","isValidInputResolution","resolution","toValidInputResolution","inputResolution","INTERNAL_RESOLUTION_STRING_OPTIONS","low","medium","high","full","INTERNAL_RESOLUTION_PERCENTAGES","MIN_INTERNAL_RESOLUTION","MAX_INTERNAL_RESOLUTION","toInternalResolutionPercentage","internalResolution","Object","values","join","toInputResolutionHeightAndWidth","inputHeight","inputWidth","internalResolutionPercentage","toInputTensor","tf.browser","fromPixels","resizeAndPadTo"

,"imageTensor","flipHorizontal","targetH","targetW","resizeW","resizeH","padR","aspect","padHeight","ceil","pad
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pToInputTensorShape","tensor","applySigmoidActivation","inputTensorHeight","inputTensorWidth","resizedAndP
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nInferenceConfig","validateMultiPersonInstanceInferenceConfig","net","baseModel","BodyPix","segmentLogits","
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AndPart","heatmapScoresRaw","offsetsRaw","displacementFwdRaw","displacementBwdRaw","instanceMasks","pr
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entationScores","loadMobileNet","tf","url","tfconv.loadGraphModel","modelUrl","graphModel","mobilenet","load
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AndBlurImageOnOffScreenCanvas","offscreenCanvasName","renderImageToCanvas","renderImageDataToCanvas
","putImageData","renderImageDataToOffScreenCanvas","canvasName","toMask","personOrPartSegmentation","f
oreground","background","drawContour","foregroundIds","r","g","isArray","multiPersonOrPartSegmentation","byt
es","Uint8ClampedArray","drawStroke","row","column","radius","color","isSegmentationBoundary","segmentation
Data","numberBackgroundPixels","n_1","isBoundary","RAINBOW_PART_COLORS","toColoredPartMask","part
Colors","multiPersonPartSegmentation","partId","CANVAS_NAMES","blurred","blurredMask","lowresPartMask",
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Found in path(s):
* /tensorflow-models-zip/@tensorflow-models/body-pix/dist/multi_person/decode_instance_masks.js
* /tensorflow-models-zip/@tensorflow-models/body-pix/dist/mobilenet.d.ts
* /tensorflow-models-zip/@tensorflow-models/body-pix/dist/multi_person/decode_multiple_masks_webgl.js
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/tensorflow-models-zip/@tensorflow-models/body-pix/dist/multi_person/decode_multiple_poses.js
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No license file was found, but licenses were detected in source scan.

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,GAAiB,OAG7Ca,EAAAA,QAAU,GACZxc,EAAAA,KAAK,KAAKiU,UAAW,SAAS7I,EAAS/K,GACnCmc,EAAAA,QAAQnc,GAAO+K,EAAQ4L,kBAG3B9U,GAGH,KAAA,WACC,KAAKsS,KAAK4E,aACR5E,KAAAA,KAAK4E,WAAa,IAGpB5E,KAAAA,KAAK4E,WAAW,KAAK3E,QAAUkH,GAAiB,MAClC,GAAAA,MAAM,GACpB1E,KAAAA,gCAGC,OAAA,SAAS8D,GACV,KAAKvG,KAAK4E,aAER5E,KAAAA,KAAK4E,WAAW,KAAK3E,QAAUkH,GAAiB,MAAIC,GAAAA,MAAM,GAAAC,B5E,KAAAA,KAAK4E,WAAW5F,GAAA+K+BmI,GAAiB,MAAM,IAAGxEnH,KAAAA,KAAK4E,WAAW2B,GAAAcY,GAAiB,MAAC/ClH,KAAAA,OAASsG,EACACE,GAAAA,KAAAA,MAAGA,GAAAY,GAAC7B9D,KAAAA,gCAGC,OAAA,SAAS8D,GACV,KAAKvG,KAAK4E,aAASC,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWsS,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWuS,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWwS,kBAACFA,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWyS,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAW0S,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAW2S,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAW4S,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAW6S,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAW8S,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAW+S,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWgT,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWiT,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWkT,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWmT,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWoT,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWqT,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWsT,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWuT,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWwT,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWyT,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAW0T,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAW2T,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAW4T,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAW6T,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAW8T,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAW+T,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWgU,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWiU,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWkU,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWmU,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWoU,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWqU,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWsU,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWuU,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWwU,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWyU,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAW0U,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAW2U,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAW4U,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAW6U,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAW8U,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAW+U,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWgV,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWiV,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWkV,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWmV,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWoV,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWqV,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWsV,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWuV,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWwV,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWyV,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAW0V,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAW2V,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAW4V,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAW6V,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAW8V,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAW+V,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWgW,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWiW,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWkW,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWmW,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWoW,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWqW,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWsW,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWuW,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWwW,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWyW,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAW0W,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAW2W,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAW4W,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAW6W,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAW8W,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAW+W,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWgX,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWiX,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWkX,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWmX,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWoX,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWqX,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWsX,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWuX,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWwX,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWyX,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAW0X,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAW2X,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAW4X,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAW6X,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAW8X,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAW+X,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWgY,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWiY,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWkY,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWmY,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWoY,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWqY,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWsY,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWuY,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWwY,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWyY,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAW0Y,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAW2Y,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAW4Y,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAW6Y,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAW8Y,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAW+Y,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWgZ,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWiZ,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWkZ,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWmZ,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWoZ,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWqZ,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWsZ,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWuZ,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWwZ,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWyZ,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAW0a,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAW2a,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAW4a,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAW6a,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAW8a,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAW+a,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWgb,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWib,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWkb,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWmb,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWob,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWqb,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWsb,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWub,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWwb,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWyb,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAW0b,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAW2b,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAW4b,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAW6b,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAW8b,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAW+b,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWgc,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWic,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWkc,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWmc,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWoc,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWqc,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWsc,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWuc,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWwc,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWyc,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAW0c,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAW2c,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAW4c,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAW6c,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAW8c,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAW+c,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWgd,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWid,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWkd,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWmd,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWod,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWqd,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWsd,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWud,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWwd,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWyd,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAW0d,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAW2d,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAW4d,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAW6d,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAW8d,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAW+d,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWge,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWie,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWke,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWme,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWoe,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWqe,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWse,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWue,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWwe,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAWye,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAW0e,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAW2e,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAW4e,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAW6e,GAAAA,KAAAA,KAAGA,GAAAC,GAAClX,KAAAA,KAAK4E,WAAW8e,GAAAA,KAA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TensorStorage, Backend, BackendTimer {\n refCount(dataId: DataId): number {\n   return notYetImplemented('refCount');\n }\n incRef(dataId: DataId): void {\n   return notYetImplemented('incRef');\n }\n timerAvailable(): boolean {\n   return true;\n }\n time(f: () => void): Promise<BackendTimingInfo> {\n   return notYetImplemented('time');\n }\n read(dataId: object): Promise<BackendValues> {\n   return notYetImplemented('read');\n }\n readSync(dataId: object): BackendValues {\n   return notYetImplemented('readSync');\n }\n numDataIds(): number {\n   return notYetImplemented('numDataIds');\n }\n disposeData(dataId: object, force?: boolean): boolean {\n   return notYetImplemented('disposeData');\n }\n write(values: BackendValues, shape: number[], dtype: DataType): DataId {\n   return notYetImplemented('write');\n }\n move(\n   dataId: DataId, values: BackendValues, shape: number[], dtype: DataType,\n   refCount: number): void {\n   return notYetImplemented('move');\n }\n memory(): {unreliable: boolean; reasons?: string[]} {\n   return notYetImplemented('memory');\n }\n /** Returns the highest precision for floats in bits (e.g. 16 or 32) */\n floatPrecision(): 16|32 {\n   return notYetImplemented('floatPrecision');\n }\n /** Returns the smallest representable number. */\n epsilon(): number {\n   return this.floatPrecision() === 32 ? EPSILON_FLOAT32 : EPSILON_FLOAT16;\n }\n dispose(): void {\n   return notYetImplemented('dispose');\n }\n}\n\nfunction notYetImplemented(kernelName: string): never {\n throw new Error(\n   `'${kernelName}' not yet implemented or not found in the registry. ` +\n   `This kernel may not be supported by the tfjs backend you have chosen`);\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n * ===\n */\n\nimport {DataType, DataTypeMap, FlatVector, NumericDataType, RecursiveArray, TensorLike, TypedArray} from\n './types';\n\n/**\n * Shuffles the array in-place using Fisher-Yates algorithm.\n *\n * ```js\n * const a = [1, 2, 3, 4, 5];\n * tf.util.shuffle(a);\n * console.log(a);\n * ```\n *\n * @param array The array to shuffle in-place.\n *\n * @doc {heading: 'Util', namespace: 'util'}\n */\n// tslint:disable-next-line:no-any\nexport function shuffle(array: any[]|Uint32Array|Int32Array|\n   Float32Array): void {\n let counter = array.length;\n let temp = 0;\n let index = 0;\n // While there are elements in the array\n while (counter > 0) {\n   // Pick a random index\n   index = (Math.random() * counter) | 0;\n   // Decrease counter by 1\n   counter--;\n   // And swap the last element with it\n   temp = array[counter];\n   array[counter] = array[index];\n   array[index] = temp;\n }\n}\n\n/**\n * Shuffles two arrays in-place the same way using Fisher-Yates algorithm.\n *\n * ```js\n * const a = [1,2,3,4,5];\n * const b = [11,22,33,44,55];\n * tf.util.shuffleCombo(a,\n b);\n * console.log(a, b);\n * ```\n *\n * @param array The first array to shuffle in-place.\n * @param array2 The second array to shuffle in-place with the same permutation\n *   as the first array.\n *\n * @doc {heading: 'Util', namespace: 'util'}\n */\n// tslint:disable-next-line:no-any\nexport function shuffleCombo(array: any[]|Uint32Array|Int32Array|Float32Array,\n// tslint:disable-next-line:no-any\n   array2: any[]|Uint32Array|Int32Array|Float32Array): void {\n\n if (array.length !== array2.length) {\n   throw Error(\n`Array sizes must match to be shuffled together ` +\n   `First array length was ${array.length}` +\n   `Second array length was ${array2.length}`);\n }\n let counter = array.length;\n let temp, temp2;\n let index = 0;\n // While there are elements in the array\n while (counter > 0) {\n   // Pick a random index\n   index = (Math.random() * counter) | 0;\n   // Decrease counter by 1\n   counter--;\n   // And swap the\n last element of each array with it\n   temp = array[counter];\n   temp2 = array2[counter];\n   array[counter] = array[index];\n   array2[counter] = array2[index];\n   array[index] = temp;\n   array2[index] = temp2;\n }\n}\n\n/** Clamps a value to a specified range. */\nexport function clamp(min: number, x: number, max: number): number {\n return Math.max(min, Math.min(x, max));\n}\n\nexport function nearestLargerEven(val: number):

number {\n return val % 2 === 0 ? val : val + 1;\n}\n\nexport function sum(arr: number[]): number {\n let sum = 0;\n for (let i = 0; i < arr.length; i++) {\n   sum += arr[i];\n }\n return sum;\n}\n\n/**\n * Returns a sample from a uniform [a, b) distribution.\n *\n * @param a The minimum support (inclusive).\n * @param b The maximum support (exclusive).\n * @return A pseudorandom number on the half-open interval [a,b).\n */\nexport function randUniform(a: number, b: number) {\n const r = Math.random();\n return (b * r) + (1 - r) * a;\n}\n\n/**\n Returns the squared Euclidean distance between two vectors. */\nexport function distSquared(a: FlatVector, b: FlatVector): number {\n let result = 0;\n for (let i = 0; i < a.length; i++) {\n   const diff = Number(a[i]) - Number(b[i]);\n   result += diff * diff;\n }\n return result;\n}\n\n/**\n * Asserts that the expression is true. Otherwise throws an error with the\n * provided message.\n *\n * ```js\n * const x = 2;\n * tf.util.assert(x === 2, 'x is not 2');\n * ```\n *\n * @param expr The expression to assert (as a boolean).\n * @param msg A function that returns the message to report when throwing an\n *   error. We use a function for performance reasons.\n *\n * @doc {heading: 'Util', namespace: 'util'}\n */\nexport function assert(expr: boolean, msg: () => string) {\n if (!expr) {\n   throw new Error(typeof msg === 'string' ? msg : msg());\n }\n}\n\nexport function assertShapesMatch(\n   shapeA: number[], shapeB: number[], errorMessagePrefix = ''): void {\n assert(\n   arraysEqual(shapeA, shapeB),\n   () => errorMessagePrefix + ` Shapes ${shapeA} and ${shapeB} must match`);\n}\n\nexport function assertNonNull(a: TensorLike): void {\n assert(\n   a != null,\n   () => `The input to the tensor constructor must be a non-null value.`);\n}\n\n// NOTE: We explicitly type out what T extends instead of any so that\n// util.flatten on a nested array of number doesn't try to infer T as a\n// number[][], causing us to explicitly type util.flatten<number>().\n/**\n * Flattens an arbitrarily nested array.\n *\n * ```js\n * const a = [[1, 2], [3, 4], [5, [6, [7]]]];\n * const flat = tf.util.flatten(a);\n * console.log(flat);\n * ```\n *\n * @param arr The nested array to flatten.\n * @param result The destination array which holds the elements.\n * @param skipTypedArray If true, avoids flattening the typed arrays. Defaults\n *   to false.\n *\n * @doc {heading: 'Util', namespace: 'util'}\n */\nexport function\nflatten<T extends number|boolean|string|Promise<number>|TypedArray>(\n   arr: T|RecursiveArray<T>, result: T[] = [], skipTypedArray = false): T[] {\n if (result == null) {\n   result = [];\n }\n if (Array.isArray(arr) || isTypedArray(arr) && !skipTypedArray) {\n   for (let i = 0; i < arr.length; ++i) {\n   flatten(arr[i], result, skipTypedArray);\n   }\n } else {\n   result.push(arr as T);\n }\n return result;\n}\n\n/**\n * Returns the size (number of elements) of the tensor given its shape.\n *\n * ```js\n * const shape = [3, 4, 2];\n * const size = tf.util.sizeFromShape(shape);\n * console.log(size);\n * ```\n *\n * @doc {heading: 'Util', namespace: 'util'}\n */\nexport function sizeFromShape(shape: number[]): number {\n if (shape.length === 0) {\n   // Scalar.\n   return 1;\n }\n let size = shape[0];\n for (let i = 1; i < shape.length; i++) {\n   size *= shape[i];\n }\n return size;\n}\n\nexport function isScalarShape(shape: number[]): boolean {\n return shape.length === 0;\n}\n\nexport function\n arraysEqual(n1: FlatVector, n2: FlatVector) {\n if (n1 === n2) {\n   return true;\n }\n if (n1 == null || n2 == null) {\n   return false;\n }\n\n if (n1.length !== n2.length) {\n   return false;\n }\n for (let i = 0; i < n1.length; i++) {\n if (n1[i] !== n2[i]) {\n   return false;\n   }\n }\n return true;\n}\n\nexport function isInt(a: number): boolean {\n return a % 1 === 0;\n}\n\nexport function tanh(x: number): number {\n // tslint:disable-next-line:no-any\n if ((Math as any).tanh != null) {\n   // tslint:disable-next-line:no-any\n   return (Math as any).tanh(x);\n }\n if (x === Infinity) {\n   return 1;\n } else if (x === -Infinity) {\n   return -1;\n } else {\n   const e2x = Math.exp(2 * x);\n   return (e2x - 1) / (e2x + 1);\n }\n}\n\nexport function sizeToSquarishShape(size: number): [number, number] {\n const width = Math.ceil(Math.sqrt(size));\n return [width, Math.ceil(size / width)];\n}\n\n/**\n * Creates a new array with randomized\n indicies to a given quantity.\n *\n * ```js\n * const randomTen = tf.util.createShuffledIndices(10);\n * console.log(randomTen);\n * ```\n *\n * @param number Quantity of how many shuffled indicies to create.\n *\n * @doc {heading: 'Util', namespace: 'util'}\n */\nexport function createShuffledIndices(n: number): Uint32Array {\n const shuffledIndices = new Uint32Array(n);\n for (let i = 0; i < n; ++i) {\n   shuffledIndices[i] = i;\n }\n shuffle(shuffledIndices);\n return shuffledIndices;\n}\n\nexport function rightPad(a: string, size: number): string {\n if (size <= a.length) {\n   return a;\n }\n return a + ' '.repeat(size - a.length);\n}\n\nexport function repeatedTry(\n   checkFn: () => boolean, delayFn = (counter: number) => 0,\n   maxCounter?: number): Promise<void> {\n return

```
new Promise<void>((resolve, reject) => {\n    let tryCount = 0;\n\n    const tryFn = () => {\n      if (checkFn()) {\n        resolve();\n        return;\n      }\n\n      tryCount++;\n\n      const nextBackoff = delayFn(tryCount);\n\n      if (maxCounter != null && tryCount >= maxCounter) {\n        reject();\n        return;\n      }\n      setTimeout(tryFn, nextBackoff);\n    };\n\n    tryFn();\n  });\n}\n\n/**\n * Given the full size of the array and a shape that may contain -1 as the\n * implicit dimension, returns the inferred shape where -1 is replaced.\n * E.g. For shape=[2, -1, 3] and size=24, it will return [2, 4, 3].\n *\n * @param shape The shape, which may contain -1 in some dimension.\n * @param size The full size (number of elements) of the array.\n * @return The inferred shape where -1 is replaced with the inferred size.\n */\nexport function inferFromImplicitShape(\n    shape: number[], size: number): number[] {\n  let shapeProd = 1;\n  let implicitIdx = -1;\n\n  for (let i = 0; i < shape.length; ++i) {\n    if (shape[i] >= 0) {\n      shapeProd *= shape[i];\n    } else if (shape[i] === -1) {\n      if (implicitIdx !== -1) {\n        throw Error(\n            `Shapes can only have 1 implicit size. ` +\n            `Found -1 at dim ${implicitIdx} and dim ${i}`);\n      }\n      implicitIdx = i;\n    } else if (shape[i] < 0) {\n      throw Error(`Shapes can not be < 0. Found ${shape[i]} at dim ${i}`);\n    }\n  }\n\n  if (implicitIdx === -1) {\n    if (size > 0 && size !== shapeProd) {\n      throw Error(`Size(${size}) must match the product of shape ${shape}`);\n    }\n    return shape;\n  }\n\n  if (shapeProd === 0) {\n    throw Error(\n        `Cannot infer the missing size in [${shape}] when ` +\n        `there are 0 elements`);\n  }\n  if (size % shapeProd !== 0) {\n    throw Error(\n        `The implicit shape can't be a fractional number. ` +\n        `Got ${size} / ${shapeProd}`);\n  }\n\n  const newShape = shape.slice();\n  newShape[implicitIdx] = size / shapeProd;\n  return newShape;\n}\n\nexport function parseAxisParam(\n    axis: number|number[], shape: number[]): number[] {\n  const rank = shape.length;\n\n  // Normalize input\n  axis = axis == null ? shape.map((s, i) => i) : [].concat(axis);\n\n  // Check for valid range\n  assert(\n      axis.every(ax => ax >= -rank && ax < rank),\n      () =>\n          `All values in axis param must be in range [-${rank}, ${rank}) but ` +\n          `got axis ${axis}`);\n\n  // Check for only integers\n  assert(\n      axis.every(ax => isInt(ax)),\n      () => `All values in axis param must be integers but ` +\n          `got axis ${axis}`);\n\n  // Handle negative axis.\n  return axis.map(a => a < 0 ? rank + a : a);\n}\n\n/** Reduces the shape by removing all dimensions of shape 1. */\nexport function squeezeShape(shape: number[], axis?: number[]):\n    {newShape: number[], keptDims: number[]} {\n  const newShape: number[] = [];\n  const keptDims: number[] = [];\n  const isEmptyArray = axis != null && Array.isArray(axis) && axis.length === 0;\n  const axes = (axis == null || isEmptyArray) ?\n      null :\n      parseAxisParam(axis, shape).sort();\n  let j = 0;\n  for (let i = 0; i < shape.length; ++i) {\n    if (axes != null) {\n      if (axes[j] === i && shape[i] !== 1) {\n        throw new Error(\n            `Can't squeeze axis ${i} since its dim '${shape[i]}' is not 1`);\n      }\n      if ((axes[j] == null || axes[j] > i) && shape[i] === 1) {\n        newShape.push(shape[i]);\n        keptDims.push(i);\n      }\n      if (axes[j] <= i) {\n        j++;\n      }\n    }\n    if (shape[i] !== 1) {\n      newShape.push(shape[i]);\n      keptDims.push(i);\n    }\n  }\n  return {newShape, keptDims};\n}\n\nexport function getTypedArrayFromDType<D extends NumericDataType>(\n    dtype: D, size: number): DataTypeMap[D] {\n  let values = null;\n  if (dtype == null || dtype === 'float32') {\n    values = new Float32Array(size);\n  } else if (dtype === 'int32') {\n    values = new Int32Array(size);\n  } else if (dtype === 'bool') {\n    values = new Uint8Array(size);\n  } else {\n    throw new Error(`Unknown data type ${dtype}`);\n  }\n  return values as DataTypeMap[D];\n}\n\nexport function getArrayFromDType<D extends DataType>(\n    dtype: D, size: number): DataTypeMap[D] {\n  let values = null;\n  if (dtype == null || dtype === 'float32') {\n    values = new Float32Array(size);\n  } else if (dtype === 'int32') {\n    values = new Int32Array(size);\n  } else if (dtype === 'bool') {\n    values = new Uint8Array(size);\n  } else if (dtype === 'string') {\n    values = new Array<'string'>(size);\n  } else {\n    throw new Error(`Unknown data type ${dtype}`);\n  }\n  return values as DataTypeMap[D];\n}\n\nexport function checkConversionForErrors<D extends DataType>(\n    vals: DataTypeMap[D]|number[], dtype: D): void {\n  for (let i = 0; i < vals.length; i++) {\n    const num = vals[i] as number;\n    if (isNaN(num) || !isFinite(num)) {\n      throw Error(`A tensor of type ${dtype} being uploaded contains ${num}.`);\n    }\n  }\n}\n\n/** Returns true if the dtype is valid. */\nexport function isValidDtype(dtype: DataType): boolean {\n  return
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 dtype === 'bool' || dtype === 'complex64' || dtype === 'float32' ||\n      dtype === 'int32' || dtype ===
'string';\n}\n\n/**\n * Returns true if the new type can't encode the old type without loss of\n * precision.\n
*/\nexport function hasEncodingLoss(oldType: DataType, newType: DataType): boolean {\n  if (newType ===
'complex64') {\n    return false;\n  }\n  if (newType === 'float32' && oldType !== 'complex64') {\n    return false;\n
}\n  if (newType === 'int32' && oldType !== 'float32' && oldType !== 'complex64') {\n    return false;\n  }\n  if
(newType === 'bool' && oldType === 'bool') {\n    return false;\n  }\n  return true;\n}\n\nexport function
isTypedArray(a: {}): a is Float32Array|Int32Array|Uint8Array {\n  return a instanceof Float32Array || a instanceof
Int32Array ||\n      a instanceof Uint8Array;\n}\n\nexport function bytesPerElement(dtype: DataType): number {\n
if (dtype === 'float32' || dtype === 'int32') {\n    return 4;\n  } else if (dtype === 'complex64') {\n
 return 8;\n  } else if (dtype === 'bool') {\n    return 1;\n  } else {\n    throw new Error(`Unknown dtype
${dtype}`);\n  }\n}\n\n/**\n * Returns the approximate number of bytes allocated in the string array - 2\n * bytes per
character. Computing the exact bytes for a native string in JS is\n * not possible since it depends on the encoding of
the html page that serves\n * the website.\n */\nexport function bytesFromStringArray(arr: Uint8Array[]): number
{\n  if (arr == null) {\n    return 0;\n  }\n  let bytes = 0;\n  arr.forEach(x => bytes += x.length);\n  return
bytes;\n}\n\n/** Returns true if the value is a string. */\nexport function isString(value: {}): value is string {\n
return typeof value === 'string' || value instanceof String;\n}\n\nexport function isBoolean(value: {}): boolean {\n
return typeof value === 'boolean';\n}\n\nexport function isNumber(value: {}): boolean {\n  return typeof value ===
'number';\n}\n\nexport function inferDtype(values: TensorLike): DataType {\n  if
 (Array.isArray(values)) {\n    return inferDtype(values[0]);\n  }\n  if (values instanceof Float32Array) {\n    return
'float32';\n  } else if (values instanceof Int32Array || values instanceof Uint8Array) {\n    return 'int32';\n  } else if
(isNumber(values)) {\n    return 'float32';\n  } else if (isString(values)) {\n    return 'string';\n  } else if
(isBoolean(values)) {\n    return 'bool';\n  }\n  return 'float32';\n}\n\nexport function isFunction(f: Function) {\n
return !!(f && f.constructor && f.call && f.apply);\n}\n\nexport function nearestDivisor(size: number, start:
number): number {\n  for (let i = start; i < size; ++i) {\n    if (size % i === 0) {\n      return i;\n    }\n  }\n  return
size;\n}\n\nexport function computeStrides(shape: number[]): number[] {\n  const rank = shape.length;\n  if (rank <
2) {\n    return [];\n  }\n\n  // Last dimension has implicit stride of 1, thus having D-1 (instead of D)\n  // strides.\n
const strides = new Array(rank - 1);\n  strides[rank
 - 2] = shape[rank - 1];\n  for (let i = rank - 3; i >= 0; --i) {\n    strides[i] = strides[i + 1] * shape[i + 1];\n  }\n  return
strides;\n}\n\nfunction createNestedArray(offset: number, shape: number[], a: TypedArray) {\n  const ret = new
Array();\n  if (shape.length === 1) {\n    const d = shape[0];\n    for (let i = 0; i < d; i++) {\n      ret[i] = a[offset +
i];\n    }\n  } else {\n    const d = shape[0];\n    const rest = shape.slice(1);\n    const len = rest.reduce((acc, c) => acc
* c);\n    for (let i = 0; i < d; i++) {\n      ret[i] = createNestedArray(offset + i * len, rest, a);\n    }\n  }\n  return
ret;\n}\n\n// Provide a nested array of TypedArray in given shape.\nexport function toNestedArray(shape: number[],
a: TypedArray) {\n  if (shape.length === 0) {\n    // Scalar type should return a single number.\n    return a[0];\n  }\n
const size = shape.reduce((acc, c) => acc * c);\n  if (size === 0) {\n    // A tensor with shape zero should be turned
into empty list.\n    return
 [];\n  }\n  if (size !== a.length) {\n    throw new Error(`[${shape}] does not match the input size ${a.length}.`);\n
}\n\n  return createNestedArray(0, shape, a);\n}\n\nexport function makeOnesTypedArray<D extends DataType>(\n
  size: number, dtype: D): DataTypeMap[D] {\n  const array = makeZerosTypedArray(size, dtype);\n  for (let i = 0; i
< array.length; i++) {\n    array[i] = 1;\n  }\n  return array;\n}\n\nexport function makeZerosTypedArray<D extends
DataType>(\n    size: number, dtype: D): DataTypeMap[D] {\n  if (dtype == null || dtype === 'float32' || dtype ===
'complex64') {\n    return new Float32Array(size) as DataTypeMap[D];\n  } else if (dtype === 'int32') {\n    return
new Int32Array(size) as DataTypeMap[D];\n  } else if (dtype === 'bool') {\n    return new Uint8Array(size) as
DataTypeMap[D];\n  } else {\n    throw new Error(`Unknown data type ${dtype}`);\n  }\n}\n\n/**\n * Make nested
`TypedArray` filled with zeros.\n * @param shape The shape information for the nested
 array.\n * @param dtype dtype of the array element.\n */\nexport function makeZerosNestedTypedArray<D
extends DataType>(\n    shape: number[], dtype: D) {\n  const size = shape.reduce((prev, curr) => prev * curr, 1);\n
if (dtype == null || dtype === 'float32') {\n    return toNestedArray(shape, new Float32Array(size));\n  } else if
```

(dtype === 'int32') {\n   return toNestedArray(shape, new Int32Array(size));\n } else if (dtype === 'bool') {\n return toNestedArray(shape, new Uint8Array(size));\n } else {\n   throw new Error(`Unknown data type ${dtype}`);\n }\n}\n\nexport function assertNonNegativeIntegerDimensions(shape: number[]) {\n shape.forEach(dimSize => {\n   assert(\n   Number.isInteger(dimSize) && dimSize >= 0,\n   () =>\n `Tensor must have a shape comprised of positive integers but got ` +\n   `shape [${shape}].`);\n });\n}\n\n/**\n * Computes flat index for a given location (multidimentionsal index) in a\n * Tensor/multidimensional
 array.\n *\n * @param locs Location in the tensor.\n * @param rank Rank of the tensor.\n * @param strides Tensor strides.\n */\nexport function locToIndex(\n   locs: number[], rank: number, strides: number[]): number {\n if (rank === 0) {\n   return 0;\n } else if (rank === 1) {\n   return locs[0];\n }\n let index = locs[locs.length - 1];\n for (let i = 0; i < locs.length - 1; ++i) {\n   index += strides[i] * locs[i];\n }\n return index;\n}\n\n/**\n * Computes the location (multidimensional index) in a tensor/multidimentional\n * array for a given flat index.\n *\n * @param index Index in flat array.\n * @param rank Rank of tensor.\n * @param strides Strides of tensor.\n */\nexport function indexToLoc(\n   index: number, rank: number, strides: number[]): number[] {\n if (rank === 0) {\n return [];\n } else if (rank === 1) {\n   return [index];\n }\n const locs: number[] = new Array(rank);\n for (let i = 0; i < locs.length - 1; ++i) {\n   locs[i] = Math.floor(index
 / strides[i]);\n   index -= locs[i] * strides[i];\n }\n locs[locs.length - 1] = index;\n return locs;\n}\n\n/**\n * This method asserts whether an object is a Promise instance.\n * @param object\n */\n// tslint:disable-next-line: no-any\nexport function isPromise(object: any) {\n // We chose to not use 'obj instanceOf Promise' for two reasons:\n // 1. It only reliably works for es6 Promise, not other Promise\n // implementations.\n // 2. It doesn't work with framework that uses zone.js. zone.js monkey patch\n // the async calls, so it is possible the obj (patched) is comparing to a\n // pre-patched Promise.\n return object && object.then && typeof object.then ===
 'function';\n}\n","/**\n * @license\n * Copyright 2017 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n
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 ==\n
 */\n\nimport {Platform} from './platforms/platform';\nimport {isPromise} from './util_base';\n\n// Expects flags from URL in the format ?tfjsflags=FLAG1:1,FLAG2:true.\nconst TENSORFLOWJS_FLAGS_PREFIX =
 'tfjsflags';\n\ntype FlagValue = number|boolean;\ntype FlagEvaluationFn = (() => FlagValue)|(() => Promise<FlagValue>);\nexport type Flags = {\n [featureName: string]: FlagValue\n};\nexport type FlagRegistryEntry = {\n evaluationFn: FlagEvaluationFn;\n setHook?: (value: FlagValue) => void;\n};\n\n/**\n * The environment contains evaluated flags as well as the registered
 platform.\n * This is always used as a global singleton and can be retrieved with\n * `tf.env()`.\n *\n * @doc {heading: 'Environment'}\n */\nexport class Environment {\n private flags: Flags = {};\n private flagRegistry: {[flagName: string]: FlagRegistryEntry} = {};\n\n private urlFlags: Flags = {};\n\n platformName: string;\n platform: Platform;\n\n // tslint:disable-next-line: no-any\n constructor(public global: any) {\n this.populateURLFlags();\n }\n\n setPlatform(platformName: string, platform: Platform) {\n   if (this.platform != null) {\n   console.warn(\n   `Platform ${this.platformName} has already been set. ` +\n   `Overwriting the platform with ${platform}.`);\n   }\n   this.platformName = platformName;\n   this.platform = platform;\n }\n\n registerFlag(\n   flagName: string, evaluationFn: FlagEvaluationFn,\n   setHook?: (value: FlagValue) => void) {\n   this.flagRegistry[flagName] = {evaluationFn, setHook};\n\n   // Override
 the flag value from the URL. This has to happen here because the\n   // environment is initialized before flags get registered.\n   if (this.urlFlags[flagName] != null) {\n   const flagValue = this.urlFlags[flagName];\n console.warn(\n   `Setting feature override from URL ${flagName}: ${flagValue}.`);\n   this.set(flagName,

flagValue);\n }\n }\n\n async getAsync(flagName: string): Promise<FlagValue> {\n if (flagName in this.flags) {\n return this.flags[flagName];\n }\n\n this.flags[flagName] = await this.evaluateFlag(flagName);\n return this.flags[flagName];\n }\n\n get(flagName: string): FlagValue {\n if (flagName in this.flags) {\n return this.flags[flagName];\n }\n\n const flagValue = this.evaluateFlag(flagName);\n if (isPromise(flagValue)) {\n throw new Error(\n `Flag ${flagName} cannot be synchronously evaluated. ` +\n `Please use getAsync() instead.`);\n }\n\n this.flags[flagName] = flagValue
 as number | boolean;\n\n return this.flags[flagName];\n }\n\n getNumber(flagName: string): number {\n return this.get(flagName) as number;\n }\n\n getBool(flagName: string): boolean {\n return this.get(flagName) as boolean;\n }\n\n getFlags(): Flags {\n return this.flags;\n }\n // For backwards compatibility.\n get features(): Flags {\n return this.flags;\n }\n\n set(flagName: string, value: FlagValue): void {\n if (this.flagRegistry[flagName] == null) {\n throw new Error(\n `Cannot set flag ${flagName} as it has not been registered.`);\n }\n this.flags[flagName] = value;\n if (this.flagRegistry[flagName].setHook != null) {\n this.flagRegistry[flagName].setHook(value);\n }\n }\n\n private evaluateFlag(flagName: string): FlagValue|Promise<FlagValue> {\n if (this.flagRegistry[flagName] == null) {\n throw new Error(\n `Cannot evaluate flag '${flagName}': no evaluation function found.`);\n }\n return this.flagRegistry[flagName].evaluationFn();\n
 }\n\n setFlags(flags: Flags) {\n this.flags = Object.assign({}, flags);\n }\n\n reset() {\n this.flags = {};\n this.urlFlags = {};\n this.populateURLFlags();\n }\n\n private populateURLFlags(): void {\n if (typeof this.global === 'undefined' ||\n typeof this.global.location === 'undefined' ||\n typeof this.global.location.search === 'undefined') {\n return;\n }\n\n const urlParams = getQueryParams(this.global.location.search);\n if (TENSORFLOWJS_FLAGS_PREFIX in urlParams) {\n const keyValues = urlParams[TENSORFLOWJS_FLAGS_PREFIX].split(',');\n keyValues.forEach(keyValue => {\n const [key, value] = keyValue.split(':') as [string, string];\n this.urlFlags[key] = parseValue(key, value);\n });\n }\n }\n}\n\nexport function getQueryParams(queryString: string): {[key: string]: string} {\n const params = {};\n queryString.replace(/[?&]([^=?&]+)(?:=([^&]*))?/g, (s, ...t)
 => {\n decodeParam(params, t[0], t[1]);\n return t.join('=');\n });\n return params;\n}\n\nfunction decodeParam(\n params: {[key: string]: string}, name: string, value?: string) {\n params[decodeURIComponent(name)] = decodeURIComponent(value || '');\n}\n\nfunction parseValue(flagName: string, value: string): FlagValue {\n value = value.toLowerCase();\n if (value === 'true' || value === 'false') {\n return value === 'true';\n } else if (`${+ value}` === value) {\n return +value;\n }\n throw new Error(\n `Could not parse value flag value ${value} for flag ${flagName}.`);\n}\n\n/**\n * Returns the current environment (a global singleton).\n *\n * The environment object contains the evaluated feature values as well as the\n * active platform.\n *\n * @doc {heading: 'Environment'}\n */\nexport function env() {\n return ENV;\n}\n\nexport let ENV: Environment = null;\nexport function setEnvironmentGlobal(environment: Environment) {\n ENV = environment;\n}\n","//
 shim for using process in browser\nvar process = module.exports = {};\n\n// cached from whatever global is present so that test runners that stub it\n// don't break things. But we need to wrap it in a try catch in case it is\n// wrapped in strict mode code which doesn't define any globals. It's inside a\n// function because try/catches deoptimize in certain engines.\n\nvar cachedSetTimeout;\nvar cachedClearTimeout;\n\nfunction defaultSetTimout() {\n throw new Error('setTimeout has not been defined');\n}\nfunction defaultClearTimeout () {\n throw new Error('clearTimeout has not been defined');\n}\n(function () {\n try {\n if (typeof setTimeout === 'function') {\n cachedSetTimeout = setTimeout;\n } else {\n cachedSetTimeout = defaultSetTimout;\n }\n } catch (e) {\n cachedSetTimeout = defaultSetTimout;\n }\n try {\n if (typeof clearTimeout === 'function') {\n cachedClearTimeout = clearTimeout;\n
  } else {\n cachedClearTimeout = defaultClearTimeout;\n }\n } catch (e) {\n cachedClearTimeout = defaultClearTimeout;\n }\n} ())\nfunction runTimeout(fun) {\n if (cachedSetTimeout === setTimeout) {\n //normal enviroments in sane situations\n return setTimeout(fun, 0);\n }\n // if setTimeout wasn't available but was latter defined\n if ((cachedSetTimeout === defaultSetTimout ||

!cachedSetTimeout) && setTimeout) {\n cachedSetTimeout = setTimeout;\n return setTimeout(fun, 0);\n }\n try {\n // when when somebody has screwed with setTimeout but no I.E. maddness\n return cachedSetTimeout(fun, 0);\n } catch(e){\n try {\n // When we are in I.E. but the script has been evaled so I.E. doesn't trust the global object when called normally\n return cachedSetTimeout.call(null, fun, 0);\n } catch(e){\n // same as above but when it's a version of I.E. that must have the global object for 'this', hopfully our context correct otherwise it will throw a global error\n return cachedSetTimeout.call(this, fun, 0);\n }\n }\n\n\n}\nfunction runClearTimeout(marker) {\n if (cachedClearTimeout === clearTimeout) {\n //normal enviroments in sane situations\n return clearTimeout(marker);\n }\n // if clearTimeout wasn't available but was latter defined\n if ((cachedClearTimeout === defaultClearTimeout || !cachedClearTimeout) && clearTimeout) {\n cachedClearTimeout = clearTimeout;\n return clearTimeout(marker);\n }\n try {\n // when when somebody has screwed with setTimeout but no I.E. maddness\n return cachedClearTimeout(marker);\n } catch (e){\n try {\n // When we are in I.E. but the script has been evaled so I.E. doesn't trust the global object when called normally\n return cachedClearTimeout.call(null, marker);\n } catch (e){\n // same as above but when it's a version of I.E. that must have the global object for 'this', hopfully our context correct otherwise it will throw a global error.\n // Some versions of I.E. have different rules for clearTimeout vs setTimeout\n return cachedClearTimeout.call(this, marker);\n }\n }\n\n\n\n}\nvar queue = [];\nvar draining = false;\nvar currentQueue;\nvar queueIndex = -1;\n\nfunction cleanUpNextTick() {\n if (!draining || !currentQueue) {\n return;\n }\n draining = false;\n if (currentQueue.length) {\n queue = currentQueue.concat(queue);\n } else {\n queueIndex = -1;\n }\n if (queue.length) {\n drainQueue();\n }\n}\n\nfunction drainQueue() {\n if (draining) {\n return;\n }\n var timeout = runTimeout(cleanUpNextTick);\n draining = true;\n\n var len = queue.length;\n while(len) {\n currentQueue = queue;\n queue = [];\n while (++queueIndex < len) {\n if (currentQueue) {\n currentQueue[queueIndex].run();\n }\n }\n queueIndex = -1;\n len = queue.length;\n }\n currentQueue = null;\n draining = false;\n runClearTimeout(timeout);\n}\n\nprocess.nextTick = function (fun) {\n var args = new Array(arguments.length - 1);\n if (arguments.length > 1) {\n for (var i = 1; i < arguments.length; i++) {\n args[i - 1] = arguments[i];\n }\n }\n queue.push(new Item(fun, args));\n if (queue.length === 1 && !draining) {\n runTimeout(drainQueue);\n }\n};\n\n// v8 likes predictible objects\nfunction Item(fun, array) {\n this.fun = fun;\n this.array = array;\n}\nItem.prototype.run = function () {\n this.fun.apply(null, this.array);\n};\nprocess.title = 'browser';\nprocess.browser = true;\nprocess.env = {};\nprocess.argv = [];\nprocess.version = ''; // empty string to avoid regexp issues\nprocess.versions = {};\n\nfunction noop() {}\n\nprocess.on = noop;\nprocess.addListener = noop;\nprocess.once = noop;\nprocess.off = noop;\nprocess.removeListener = noop;\nprocess.removeAllListeners = noop;\nprocess.emit = noop;\nprocess.prependListener = noop;\nprocess.prependOnceListener = noop;\n\nprocess.listeners = function (name) { return [] }\n\nprocess.binding = function (name) {\n throw new Error('process.binding is not supported');\n};\n\nprocess.cwd = function () { return '/' };\nprocess.chdir = function (dir) {\n throw new Error('process.chdir is not supported');\n};\nprocess.umask = function() { return 0; };\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\n// Note that the identifier globalNameSpace is scoped to this module, but will\n// always resolve to the same global object regardless of how the module is\n// resolved.\n// tslint:disable-next-line:no-any\nlet globalNameSpace:

{_tfGlobals: Map<string, any>};\n// tslint:disable-next-line:no-any\nexport function getGlobalNamespace(): {_tfGlobals: Map<string, any>} {\n if (globalNameSpace == null) {\n   // tslint:disable-next-line:no-any\n   let ns: any;\n   if (typeof (window) !== 'undefined') {\n   ns = window;\n   } else if (typeof (global) !== 'undefined') {\n   ns = global;\n   } else if (typeof (process) !== 'undefined') {\n   ns = process;\n   } else if (typeof (self) !== 'undefined') {\n   ns = self;\n   } else {\n   throw new Error('Could not find a global object');\n   }\n   globalNameSpace = ns;\n }\n return globalNameSpace;\n}\n\n// tslint:disable-next-line:no-any\nfunction getGlobalMap(): Map<string, any> {\n const ns = getGlobalNamespace();\n if (ns._tfGlobals == null) {\n   ns._tfGlobals = new Map();\n }\n return ns._tfGlobals;\n}\n\n/**\n * Returns a globally accessible 'singleton' object.\n *\n * @param key the name of the object\n * @param init a function to initialize to initialize this object\n *   the first time it is fetched.\n */\nexport function getGlobal<T>(key: string, init: () => T): T {\n const globalMap = getGlobalMap();\n if (globalMap.has(key)) {\n   return globalMap.get(key);\n } else {\n   const singleton = init();\n   globalMap.set(key, singleton);\n   return globalMap.get(key);\n }\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n
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==\n */\n//
Allow UpperCamelCase variable names\n// tslint:disable: variable-name\n// Unfortunately just enabling PascalCase per file (tslint:enable:\n// allow-pascal-case) doesn't work.\nimport {NamedTensorInfoMap, TensorInfo} from './kernel_registry';\nimport {ExplicitPadding} from './ops/conv_util';\nimport {Activation} from './ops/fused_types';\nimport
 {DataType, PixelData} from './types';\n\nexport const Abs = 'Abs';\nexport type AbsInputs = UnaryInputs;\n\nexport const Acos = 'Acos';\nexport type AcosInputs = UnaryInputs;\n\nexport const Acosh = 'Acosh';\nexport type AcoshInputs = UnaryInputs;\n\nexport const Add = 'Add';\nexport type AddInputs = BinaryInputs;\n\nexport const AddN = 'AddN';\nexport type AddNInputs = TensorInfo[];\n\nexport const All = 'All';\nexport type AllInputs = Pick<NamedTensorInfoMap, 'x'>;\nexport interface AllAttrs {\n axis: number|number[];\n keepDims: boolean;\n}\n\nexport const Any = 'Any';\nexport type AnyInputs = Pick<NamedTensorInfoMap, 'x'>;\nexport interface AnyAttrs {\n axis: number|number[];\n keepDims: boolean;\n}\n\nexport const ArgMax = 'ArgMax';\nexport type ArgMaxInputs = Pick<NamedTensorInfoMap, 'x'>;\nexport interface ArgMaxAttrs {\n axis: number;\n}\n\nexport const ArgMin = 'ArgMin';\nexport type ArgMinInputs = Pick<NamedTensorInfoMap, 'x'>;\nexport interface ArgMinAttrs {\n axis:
 number;\n}\n\nexport const Asin = 'Asin';\nexport type AsinInputs = UnaryInputs;\n\nexport const Asinh = 'Asinh';\nexport type AsinhInputs = UnaryInputs;\n\nexport const Atan = 'Atan';\nexport type AtanInputs = UnaryInputs;\n\nexport const Atanh = 'Atanh';\nexport type AtanhInputs = UnaryInputs;\n\nexport const Atan2 = 'Atan2';\nexport type Atan2Inputs = BinaryInputs;\n\nexport const AvgPool = 'AvgPool';\nexport type AvgPoolInputs = Pick<NamedTensorInfoMap, 'x'>;\nexport interface AvgPoolAttrs {\n filterSize: [number, number]|number;\n strides: [number, number]|number;\n pad: 'valid'|'same'|number;\n dimRoundingMode?: 'floor'|'round'|'ceil';\n}\n\nexport const AvgPoolGrad = 'AvgPoolGrad';\nexport type AvgPoolGradInputs = Pick<NamedTensorInfoMap, 'dy'|'input'>;\nexport interface AvgPoolGradAttrs {\n filterSize: [number, number]|number;\n strides: [number, number]|number;\n pad: 'valid'|'same'|number;\n}\n\nexport const AvgPool3D = 'AvgPool3D';\nexport type AvgPool3DInputs = Pick<NamedTensorInfoMap,
 'x'>;\nexport interface AvgPool3DAttrs {\n filterSize: [number, number, number]|number;\n strides: [number, number, number]|number;\n pad: 'valid'|'same'|number;\n dimRoundingMode?: 'floor'|'round'|'ceil';\n dataFormat: 'NDHWC'|'NCDHW';\n}\n\nexport const AvgPool3DGrad = 'AvgPool3DGrad';\nexport type AvgPool3DGradInputs = Pick<NamedTensorInfoMap, 'dy'|'input'>;\nexport interface AvgPool3DGradAttrs {\n

filterSize: [number, number, number]|number;\n strides: [number, number, number]|number;\n pad: 'valid'|'same'|number;\n dimRoundingMode?: 'floor'|'round'|'ceil';\n}\n\nexport const BatchMatMul = 'BatchMatMul';\nexport type BatchMatMulInputs = Pick<NamedTensorInfoMap, 'a'|'b'>;\nexport interface BatchMatMulAttrs {\n transposeA: boolean;\n transposeB: boolean;\n}\n\nexport const BatchToSpaceND = 'BatchToSpaceND';\nexport type BatchToSpaceNDInputs = Pick<NamedTensorInfoMap, 'x'>;\nexport interface BatchToSpaceNDAttrs {\n blockShape: number[];\n crops: number[][];\n}\n\nexport type BinaryInputs = Pick<NamedTensorInfoMap, 'a'|'b'>;\n\nexport const Bincount = 'Bincount';\nexport type BincountInputs = Pick<NamedTensorInfoMap, 'x'|'weights'>;\nexport interface BincountAttrs {\n size: number;\n}\n\nexport const BroadcastTo = 'BroadcastTo';\nexport type BroadcastToInputs = Pick<NamedTensorInfoMap, 'x'>;\nexport interface BroadCastToAttrs {\n shape: number[];\n inputShape: number[]; // for gradient\n}\n\nexport const Cast = 'Cast';\nexport type CastInputs = UnaryInputs;\nexport interface CastAttrs {\n dtype: DataType;\n}\n\nexport const Ceil = 'Ceil';\nexport type CeilInputs = UnaryInputs;\n\nexport const ClipByValue = 'ClipByValue';\nexport type ClipByValueInputs = UnaryInputs;\nexport interface ClipByValueAttrs {\n clipValueMin: number;\n clipValueMax: number;\n}\n\nexport const Complex = 'Complex';\nexport type ComplexInputs = Pick<NamedTensorInfoMap, 'real'|'imag'>;\n\nexport const ComplexAbs = 'ComplexAbs';\nexport type ComplexAbsInputs = UnaryInputs;\n\nexport const Concat = 'Concat';\nexport type ConcatInputs = TensorInfo[];\nexport interface ConcatAttrs {\n axis: number;\n}\n\nexport const Conv2D = 'Conv2D';\nexport type Conv2DInputs = Pick<NamedTensorInfoMap, 'x'|'filter'>;\nexport interface Conv2DAttrs {\n strides: [number, number]|number;\n pad: 'valid'|'same'|number|ExplicitPadding;\n dataFormat: 'NHWC'|'NCHW';\n dilations: [number, number]|number;\n dimRoundingMode?: 'floor'|'round'|'ceil';\n}\n\nexport const Conv2DBackpropFilter = 'Conv2DBackpropFilter';\nexport type Conv2DBackpropFilterInputs = Pick<NamedTensorInfoMap, 'x'|'dy'>;\nexport interface Conv2DBackpropFilterAttrs {\n strides: [number, number]|number;\n pad: 'valid'|'same'|number|ExplicitPadding;\n dataFormat: 'NHWC'|'NCHW';\n dimRoundingMode?: 'floor'|'round'|'ceil';\n filterShape: [number, number, number, number];\n}\n\nexport const Conv2DBackpropInput = 'Conv2DBackpropInput';\nexport type Conv2DBackpropInputInputs = Pick<NamedTensorInfoMap, 'dy'|'filter'>;\nexport interface Conv2DBackpropInputAttrs {\n strides: [number, number]|number;\n pad: 'valid'|'same'|number|ExplicitPadding;\n dataFormat: 'NHWC'|'NCHW';\n dimRoundingMode?: 'floor'|'round'|'ceil';\n inputShape: [number, number, number, number];\n}\n\nexport const Conv3D = 'Conv3D';\nexport type Conv3DInputs = Pick<NamedTensorInfoMap, 'x'|'filter'>;\nexport interface Conv3DAttrs {\n strides: [number, number, number]|number;\n pad: 'valid'|'same';\n dataFormat: 'NDHWC'|'NCDHW';\n dilations: [number, number, number]|number;\n}\n\nexport const Conv3DBackpropFilterV2 = 'Conv3DBackpropFilterV2';\nexport type Conv3DBackpropFilterV2Inputs = Pick<NamedTensorInfoMap, 'x'|'dy'>;\n\nexport interface Conv3DBackpropFilterV2Attrs {\n strides: [number, number, number]|number;\n pad: 'valid'|'same';\n filterShape: [number, number, number, number, number];\n}\n\nexport const Conv3DBackpropInputV2 = 'Conv3DBackpropInputV2';\nexport type Conv3DBackpropInputV2Inputs =\n   Pick<NamedTensorInfoMap, 'dy'|'filter'>;\nexport interface Conv3DBackpropInputV2Attrs {\n strides: [number, number, number]|number;\n pad: 'valid'|'same';\n inputShape: [number, number, number, number, number];\n}\n\nexport const Cos = 'Cos';\nexport type CosInputs = UnaryInputs;\n\nexport const Cosh = 'Cosh';\nexport type CoshInputs = UnaryInputs;\n\nexport const Cumsum = 'Cumsum';\nexport type CumsumInputs = Pick<NamedTensorInfoMap, 'x'>;\nexport interface CumsumAttrs {\n axis: number;\n exclusive: boolean;\n reverse: boolean;\n}\n\nexport const CropAndResize = 'CropAndResize';\nexport type CropAndResizeInputs =\n Pick<NamedTensorInfoMap, 'image'|'boxes'|'boxInd'>;\nexport interface CropAndResizeAttrs {\n cropSize: [number, number];\n method: 'bilinear'|'nearest';\n extrapolationValue: number;\n}\n\nexport const DenseBincount = 'DenseBincount';\nexport type DenseBincountInputs = Pick<NamedTensorInfoMap, 'x'|'weights'>;\nexport interface DenseBincountAttrs {\n size: number;\n binaryOutput?: boolean;\n}\n\nexport const DepthToSpace = 'DepthToSpace';\nexport type DepthToSpaceInputs = Pick<NamedTensorInfoMap, 'x'>;\nexport interface DepthToSpaceAttrs {\n blockSize:

number;\n dataFormat: 'NHWC'|'NCHW';\n}\n\nexport const DepthwiseConv2dNative = 'DepthwiseConv2dNative';\nexport type DepthwiseConv2dNativeInputs =\n   Pick<NamedTensorInfoMap, 'x'|'filter'>;\nexport interface DepthwiseConv2dNativeAttrs {\n strides: [number, number]|number;\n pad: 'valid'|'same'|number;\n dataFormat: 'NHWC'|'NCHW';\n dilations: [number, number]|number;\n dimRoundingMode?: 'floor'|'round'|'ceil';\n}\n\nexport const DepthwiseConv2dNativeBackpropFilter =\n 'DepthwiseConv2dNativeBackpropFilter';\nexport type DepthwiseConv2dNativeBackpropFilterInputs =\n Pick<NamedTensorInfoMap, 'x'|'dy'>;\nexport interface DepthwiseConv2dNativeBackpropFilterAttrs {\n strides: [number, number]|number;\n dilations: [number, number]|number;\n pad: 'valid'|'same'|number;\n dimRoundingMode?:
 'floor'|'round'|'ceil';\n filterShape: [number, number, number, number];\n}\n\nexport const DepthwiseConv2dNativeBackpropInput =\n   'DepthwiseConv2dNativeBackpropInput';\nexport type DepthwiseConv2dNativeBackpropInputInputs =\n   Pick<NamedTensorInfoMap, 'dy'|'filter'>;\nexport interface DepthwiseConv2dNativeBackpropInputAttrs {\n strides: [number, number]|number;\n dilations: [number, number]|number;\n pad: 'valid'|'same'|number;\n dimRoundingMode?: 'floor'|'round'|'ceil';\n inputShape: [number, number, number, number];\n}\n\nexport const Diag = 'Diag';\nexport type DiagInputs = Pick<NamedTensorInfoMap, 'x'>;\n\nexport const Dilation2D = 'Dilation2D';\nexport type Dilation2DInputs = Pick<NamedTensorInfoMap, 'x'|'filter'>;\nexport interface Dilation2DAttrs {\n strides: [number, number]|number;\n pad: 'valid'|'same'|number;\n dilations: [number, number]|number;\n}\n\nexport const Dilation2DBackpropInput = 'Dilation2DBackpropInput';\nexport type Dilation2DBackpropInputInputs
 =\n   Pick<NamedTensorInfoMap, 'x'|'filter'|'dy'>;\n\nexport const Dilation2DBackpropFilter = 'Dilation2DBackpropFilter';\nexport type Dilation2DBackpropFilterInputs =\n   Pick<NamedTensorInfoMap, 'x'|'filter'|'dy'>;\n\nexport const RealDiv = 'RealDiv';\nexport type RealDivInputs = BinaryInputs;\n\nexport const Elu = 'Elu';\nexport type EluInputs = Pick<NamedTensorInfoMap, 'x'>;\n\nexport const EluGrad = 'EluGrad';\nexport type EluGradInputs = Pick<NamedTensorInfoMap, 'dy'|'y'>;\n\nexport const Erf = 'Erf';\nexport type ErfInputs = UnaryInputs;\n\nexport const Equal = 'Equal';\nexport type EqualInputs = BinaryInputs;\n\nexport const Exp = 'Exp';\nexport type ExpInputs = UnaryInputs;\n\nexport const ExpandDims = 'ExpandDims';\nexport type ExpandDimsInputs = Pick<NamedTensorInfoMap, 'input'>;\nexport interface ExpandDimsAttrs {\n dim: number;\n}\n\nexport const Expm1 = 'Expm1';\nexport type Expm1Inputs = UnaryInputs;\n\nexport const FFT = 'FFT';\nexport type FFTInputs =
 Pick<NamedTensorInfoMap, 'input'>;\n\nexport const Fill = 'Fill';\nexport interface FillAttrs {\n shape: number[];\n value: number|string;\n dtype: DataType;\n}\n\nexport const FlipLeftRight = 'FlipLeftRight';\nexport type FlipLeftRightInputs = Pick<NamedTensorInfoMap, 'image'>;\n\nexport const Floor = 'Floor';\nexport type FloorInputs = UnaryInputs;\n\nexport const FloorDiv = 'FloorDiv';\nexport type FloorDivInputs = BinaryInputs;\n\nexport const FusedBatchNorm = 'FusedBatchNorm';\nexport type FusedBatchNormInputs =\n Pick<NamedTensorInfoMap, 'x'|'scale'|'offset'|'mean'|'variance'>;\nexport interface FusedBatchNormAttrs {\n varianceEpsilon: number;\n}\n\nexport const GatherV2 = 'GatherV2';\nexport type GatherV2Inputs = Pick<NamedTensorInfoMap, 'x'|'indices'>;\nexport interface GatherV2Attrs {\n axis: number;\n batchDims: number;\n}\n\nexport const GatherNd = 'GatherNd';\nexport type GatherNdInputs = Pick<NamedTensorInfoMap, 'params'|'indices'>;\n\nexport const Greater = 'Greater';\nexport
 type GreaterInputs = BinaryInputs;\n\nexport const GreaterEqual = 'GreaterEqual';\nexport type GreaterEqualInputs = BinaryInputs;\n\nexport const Identity = 'Identity';\nexport type IdentityInputs = Pick<NamedTensorInfoMap, 'x'>;\n\nexport const IFFT = 'IFFT';\nexport type IFFTInputs = Pick<NamedTensorInfoMap, 'input'>;\n\nexport const Imag = 'Imag';\nexport type ImagInputs = Pick<NamedTensorInfoMap, 'input'>;\n\nexport const IsFinite = 'IsFinite';\nexport type IsFiniteInputs = UnaryInputs;\n\nexport const IsInf = 'IsInf';\nexport type IsInfInputs = UnaryInputs;\n\nexport const IsNan = 'IsNan';\nexport type IsNanInputs = UnaryInputs;\n\nexport const LeakyRelu = 'LeakyRelu';\nexport type LeakyReluInputs = Pick<NamedTensorInfoMap, 'x'>;\nexport interface LeakyReluAttrs {\n alpha: number;\n}\n\nexport const Less = 'Less';\nexport type LessInputs = BinaryInputs;\n\nexport const LessEqual = 'LessEqual';\nexport type LessEqualInputs = BinaryInputs;\n\nexport const LinSpace =

'LinSpace';\nexport interface LinSpaceAttrs {\n start: number;\n stop: number;\n num: number;\n}\nexport const Log = 'Log';\nexport type LogInputs = UnaryInputs;\n\nexport const Log1p = 'Log1p';\nexport type Log1pInputs = UnaryInputs;\n\nexport const LogicalAnd = 'LogicalAnd';\nexport type LogicalAndInputs = BinaryInputs;\n\nexport const LogicalNot = 'LogicalNot';\nexport type LogicalNotInputs = Pick<NamedTensorInfoMap, 'x'>;\n\nexport const LogicalOr = 'LogicalOr';\nexport type LogicalOrInputs = BinaryInputs;\n\nexport const LogSoftmax = 'LogSoftmax';\nexport type LogSoftmaxInputs = Pick<NamedTensorInfoMap, 'logits'>;\nexport interface LogSoftmaxAttrs {\n axis: number;\n}\n\nexport const LRN = 'LRN';\nexport type LRNInputs = Pick<NamedTensorInfoMap, 'x'>;\nexport interface LRNAttrs {\n depthRadius: number;\n bias: number;\n alpha: number;\n beta: number;\n}\n\nexport const LRNGrad = 'LRNGrad';\nexport type LRNGradInputs = Pick<NamedTensorInfoMap, 'x'|'y'|'dy'>;\nexport interface
LRNGradAttrs {\n depthRadius: number;\n bias: number;\n alpha: number;\n beta: number;\n}\n\nexport const Max = 'Max';\nexport type MaxInputs = Pick<NamedTensorInfoMap, 'x'>;\nexport interface MaxAttrs {\n reductionIndices: number|number[];\n keepDims: boolean;\n}\n\nexport const Maximum = 'Maximum';\nexport type MaximumInputs = BinaryInputs;\n\nexport const MaxPool = 'MaxPool';\nexport type MaxPoolInputs = Pick<NamedTensorInfoMap, 'x'>;\nexport interface MaxPoolAttrs {\n filterSize: [number, number]|number;\n strides: [number, number]|number;\n pad: 'valid'|'same'|number;\n dimRoundingMode?: 'floor'|'round'|'ceil';\n}\n\nexport const MaxPoolGrad = 'MaxPoolGrad';\nexport type MaxPoolGradInputs = Pick<NamedTensorInfoMap, 'dy'|'input'|'output'>;\nexport interface MaxPoolGradAttrs {\n filterSize: [number, number]|number;\n strides: [number, number]|number;\n pad: 'valid'|'same'|number;\n dimRoundingMode?: 'floor'|'round'|'ceil';\n}\n\nexport const MaxPool3D = 'MaxPool3D';\nexport
type MaxPool3DInputs = Pick<NamedTensorInfoMap, 'x'>;\nexport interface MaxPool3DAttrs {\n filterSize: [number, number, number]|number;\n strides: [number, number, number]|number;\n pad: 'valid'|'same'|number;\n dataFormat: 'NDHWC'|'NCDHW';\n dimRoundingMode?: 'floor'|'round'|'ceil';\n}\n\nexport const MaxPool3DGrad = 'MaxPool3DGrad';\nexport type MaxPool3DGradInputs =\n   Pick<NamedTensorInfoMap, 'dy'|'input'|'output'>;\nexport interface MaxPool3DGradAttrs {\n filterSize: [number, number, number]|number;\n strides: [number, number, number]|number;\n pad: 'valid'|'same'|number;\n dimRoundingMode?: 'floor'|'round'|'ceil';\n}\n\nexport const MaxPoolWithArgmax = 'MaxPoolWithArgmax';\nexport type MaxPoolWithArgmaxInputs = Pick<NamedTensorInfoMap, 'x'>;\nexport interface MaxPoolWithArgmaxAttrs {\n filterSize: [number, number]|number;\n strides: [number, number]|number;\n pad: 'valid'|'same'|number;\n includeBatchInIndex: boolean;\n}\n\nexport const Mean = 'Mean';\nexport
type MeanInputs = Pick<NamedTensorInfoMap, 'x'>;\nexport interface MeanAttrs {\n axis: number|number[];\n keepDims: boolean;\n}\n\nexport const Min = 'Min';\nexport type MinInputs = Pick<NamedTensorInfoMap, 'x'>;\nexport interface MinAttrs {\n axis: number|number[];\n keepDims: boolean;\n}\n\nexport const Minimum = 'Minimum';\nexport type MinimumInputs = BinaryInputs;\n\nexport const MirrorPad = 'MirrorPad';\nexport type MirrorPadInputs = Pick<NamedTensorInfoMap, 'x'>;\nexport interface MirrorPadAttrs {\n paddings: Array<[number, number]>;\n mode: 'reflect'|'symmetric';\n}\n\nexport const Mod = 'Mod';\nexport type ModInputs = BinaryInputs;\n\nexport const Multinomial = 'Multinomial';\nexport type MultinomialInputs = Pick<NamedTensorInfoMap, 'logits'>;\nexport interface MultinomialAttrs {\n numSamples: number;\n seed: number;\n normalized: boolean;\n}\n\nexport const Multiply = 'Multiply';\nexport type MultiplyInputs = BinaryInputs;\n\nexport const Neg = 'Neg';\nexport type
NegInputs = UnaryInputs;\n\nexport const NotEqual = 'NotEqual';\nexport type NotEqualInputs = BinaryInputs;\n\nexport const NonMaxSuppressionV3 = 'NonMaxSuppressionV3';\nexport type NonMaxSuppressionV3Inputs =\n   Pick<NamedTensorInfoMap, 'boxes'|'scores'>;\nexport interface NonMaxSuppressionV3Attrs {\n maxOutputSize: number;\n iouThreshold: number;\n scoreThreshold: number;\n}\n\nexport const NonMaxSuppressionV4 = 'NonMaxSuppressionV4';\nexport type NonMaxSuppressionV4Inputs =\n   Pick<NamedTensorInfoMap, 'boxes'|'scores'>;\nexport interface NonMaxSuppressionV4Attrs {\n maxOutputSize: number;\n iouThreshold: number;\n scoreThreshold: number;\n padToMaxOutputSize: boolean;\n}\n\nexport const NonMaxSuppressionV5 = 'NonMaxSuppressionV5';\nexport

type NonMaxSuppressionV5Inputs =\n Pick<NamedTensorInfoMap, 'boxes'|'scores'>;\nexport interface NonMaxSuppressionV5Attrs {\n maxOutputSize: number;\n iouThreshold: number;\n scoreThreshold: number;\n softNmsSigma: number;\n}\n\nexport
 const OnesLike = 'OnesLike';\nexport type OnesLikeInputs = UnaryInputs;\n\nexport const OneHot = 'OneHot';\nexport type OneHotInputs = Pick<NamedTensorInfoMap, 'indices'>;\nexport interface OneHotAttrs {\n depth: number;\n onValue: number;\n offValue: number;\n}\n\nexport const Pack = 'Pack';\nexport type PackInputs = TensorInfo[];\nexport interface PackAttrs {\n axis: number;\n}\n\nexport const PadV2 = 'PadV2';\nexport type PadV2Inputs = Pick<NamedTensorInfoMap, 'x'>;\nexport interface PadV2Attrs {\n paddings: Array<[number, number]>;\n constantValue: number;\n}\n\nexport const Pool = 'Pool';\nexport type PoolInputs = Pick<NamedTensorInfoMap, 'input'>;\n\nexport const Pow = 'Pow';\nexport type PowInputs = BinaryInputs;\n\nexport const Prelu = 'Prelu';\nexport type PreluInputs = Pick<NamedTensorInfoMap, 'x'|'alpha'>;\n\nexport const Prod = 'Prod';\nexport type ProdInputs = Pick<NamedTensorInfoMap, 'x'>;\nexport interface ProdAttrs {\n axis: number|number[];\n keepDims: boolean;\n}\n\nexport
 const Range = 'Range';\nexport interface RangeAttrs {\n start: number;\n stop: number;\n step: number;\n dtype: 'float32'|'int32';\n}\n\nexport const Real = 'Real';\nexport type RealInputs = Pick<NamedTensorInfoMap, 'input'>;\n\nexport const Reciprocal = 'Reciprocal';\nexport type ReciprocalInputs = UnaryInputs;\n\nexport const Relu = 'Relu';\nexport type ReluInputs = Pick<NamedTensorInfoMap, 'x'>;\n\nexport const Reshape = 'Reshape';\nexport type ReshapeInputs = Pick<NamedTensorInfoMap, 'x'>;\nexport interface ReshapeAttrs {\n shape: number[];\n}\n\nexport const ResizeNearestNeighbor = 'ResizeNearestNeighbor';\nexport type ResizeNearestNeighborInputs = Pick<NamedTensorInfoMap, 'images'>;\nexport interface ResizeNearestNeighborAttrs {\n alignCorners: boolean;\n halfPixelCenters: boolean;\n size: [number, number];\n}\n\nexport const ResizeNearestNeighborGrad = 'ResizeNearestNeighborGrad';\nexport type ResizeNearestNeighborGradInputs =\n Pick<NamedTensorInfoMap,
 'images'|'dy'>;\nexport type ResizeNearestNeighborGradAttrs = ResizeNearestNeighborAttrs;\n\nexport const ResizeBilinear = 'ResizeBilinear';\nexport type ResizeBilinearInputs = Pick<NamedTensorInfoMap, 'images'>;\nexport interface ResizeBilinearAttrs {\n alignCorners: boolean;\n halfPixelCenters: boolean;\n size: [number, number];\n}\n\nexport const ResizeBilinearGrad = 'ResizeBilinearGrad';\nexport type ResizeBilinearGradInputs = Pick<NamedTensorInfoMap, 'images'|'dy'>;\nexport type ResizeBilinearGradAttrs = ResizeBilinearAttrs;\n\nexport const Relu6 = 'Relu6';\nexport type Relu6Inputs = Pick<NamedTensorInfoMap, 'x'>;\n\nexport const Reverse = 'Reverse';\nexport type ReverseInputs = Pick<NamedTensorInfoMap, 'x'>;\nexport interface ReverseAttrs {\n dims: number|number[];\n}\n\nexport const Round = 'Round';\nexport type RoundInputs = UnaryInputs;\n\nexport const Rsqrt = 'Rsqrt';\nexport type RsqrtInputs = UnaryInputs;\n\nexport const ScatterNd = 'ScatterNd';\nexport type ScatterNdInputs
 = Pick<NamedTensorInfoMap, 'indices'|'updates'>;\nexport interface ScatterNdAttrs {\n shape: number[];\n}\n\nexport const Select = 'Select';\nexport type SelectInputs = Pick<NamedTensorInfoMap, 'condition'|'t'|'e'>;\n\nexport const Selu = 'Selu';\nexport type SeluInputs = Pick<NamedTensorInfoMap, 'x'>;\n\nexport const Slice = 'Slice';\nexport type SliceInputs = Pick<NamedTensorInfoMap, 'x'>;\nexport interface SliceAttrs {\n begin: number|number[];\n size: number|number[];\n}\nexport const Sin = 'Sin';\nexport type SinInputs = UnaryInputs;\n\nexport const Sinh = 'Sinh';\nexport type SinhInputs = UnaryInputs;\n\nexport const Sign = 'Sign';\nexport type SignInputs = UnaryInputs;\n\nexport const Sigmoid = 'Sigmoid';\nexport type SigmoidInputs = UnaryInputs;\n\nexport const Softplus = 'Softplus';\nexport type SoftplusInputs = UnaryInputs;\n\nexport const Sqrt = 'Sqrt';\nexport type SqrtInputs = UnaryInputs;\n\nexport const Sum = 'Sum';\nexport type SumInputs = Pick<NamedTensorInfoMap,
 'x'>;\nexport interface SumAttrs {\n axis: number|number[];\n keepDims: boolean;\n}\n\nexport const SpaceToBatchND = 'SpaceToBatchND';\nexport type SpaceToBatchNDInputs = Pick<NamedTensorInfoMap, 'x'>;\nexport interface SpaceToBatchNDAttrs {\n blockShape: number[];\n paddings: number[][];\n}\n\nexport const SplitV = 'SplitV';\nexport type SplitVInputs = Pick<NamedTensorInfoMap, 'x'>;\nexport interface SplitVAttrs {\n numOrSizeSplits: number[]|number;\n axis: number;\n}\n\nexport const Softmax = 'Softmax';\nexport type

SoftmaxInputs = Pick<NamedTensorInfoMap, 'logits'>;\nexport interface SoftmaxAttrs {\n dim: number;\n}\n\nexport const SquaredDifference = 'SquaredDifference';\nexport type SquaredDifferenceInputs = BinaryInputs;\n\nexport const Square = 'Square';\nexport type SquareInputs = Pick<NamedTensorInfoMap, 'x'>;\n\nexport const Sub = 'Sub';\nexport type SubInputs = BinaryInputs;\n\nexport const SparseToDense = 'SparseToDense';\nexport type SparseToDenseInputs =\n Pick<NamedTensorInfoMap, 'sparseIndices'|'sparseValues'|'defaultValue'>;\nexport interface SparseToDenseAttrs {\n outputShape: number[];\n}\n\nexport const StridedSlice = 'StridedSlice';\nexport type StridedSliceInputs = Pick<NamedTensorInfoMap, 'x'>;\nexport interface StridedSliceAttrs {\n begin: number[];\n end: number[];\n strides: number[];\n beginMask: number;\n endMask: number;\n ellipsisMask: number;\n newAxisMask: number;\n shrinkAxisMask: number;\n}\n\nexport const Tan = 'Tan';\nexport type TanInputs = UnaryInputs;\n\nexport const Tanh = 'Tanh';\nexport type TanhInputs = UnaryInputs;\n\nexport const Tile = 'Tile';\nexport type TileInputs = Pick<NamedTensorInfoMap, 'x'>;\nexport interface TileAttrs {\n reps: number[];\n}\n\nexport const TopK = 'TopK';\nexport type TopKInputs = Pick<NamedTensorInfoMap, 'x'>;\nexport interface TopKAttrs {\n k: number;\n sorted: boolean;\n}\n\nexport const Transpose = 'Transpose';\nexport type TransposeInputs = Pick<NamedTensorInfoMap, 'x'>;\nexport interface TransposeAttrs {\n perm: number[];\n}\n\nexport const Unique = 'Unique';\nexport type UniqueInputs = Pick<NamedTensorInfoMap, 'x'>;\nexport interface UniqueAttrs {\n axis: number;\n}\n\nexport type UnaryInputs = Pick<NamedTensorInfoMap, 'x'>;\n\nexport const Unpack = 'Unpack';\nexport type UnpackInputs = Pick<NamedTensorInfoMap, 'value'>;\nexport interface UnpackAttrs {\n axis: number;\n}\n\nexport const UnsortedSegmentSum = 'UnsortedSegmentSum';\nexport type UnsortedSegmentSumInputs =\n   Pick<NamedTensorInfoMap, 'x'|'segmentIds'>;\nexport interface UnsortedSegmentSumAttrs {\n numSegments: number;\n}\n\nexport const ZerosLike = 'ZerosLike';\nexport type ZerosLikeInputs = UnaryInputs;\n\n/**\n * TensorFlow.js-only kernels\n */\nexport const Step = 'Step';\nexport type StepInputs = UnaryInputs;\nexport interface StepAttrs {\n alpha: number;\n}\n\nexport const FromPixels = 'FromPixels';\nexport interface FromPixelsInputs {\n pixels: PixelData|ImageData|HTMLImageElement|HTMLCanvasElement|\n   HTMLVideoElement|ImageBitmap;\n}\nexport interface FromPixelsAttrs {\n numChannels: number;\n}\n\nexport const RotateWithOffset = 'RotateWithOffset';\nexport type RotateWithOffsetInputs = Pick<NamedTensorInfoMap, 'image'>;\nexport interface RotateWithOffsetAttrs {\n radians: number;\n fillValue: number|[number, number, number];\n center: number|[number, number];\n}\n\nexport const _FusedMatMul = '_FusedMatMul';\n// tslint:disable-next-line: class-name\nexport interface _FusedMatMulInputs extends NamedTensorInfoMap {\n a: TensorInfo;\n b: TensorInfo;\n bias?: TensorInfo;\n preluActivationWeights?: TensorInfo;\n}\n\n// tslint:disable-next-line: class-name\nexport interface _FusedMatMulAttrs {\n transposeA: boolean;\n transposeB: boolean;\n activation: Activation;\n leakyreluAlpha?: number;\n}\n\nexport const FusedConv2D = 'FusedConv2D';\nexport interface FusedConv2DInputs extends NamedTensorInfoMap {\n x: TensorInfo;\n filter: TensorInfo;\n bias?: TensorInfo;\n preluActivationWeights?: TensorInfo;\n}\nexport interface FusedConv2DAttrs {\n strides: [number, number]|number;\n pad: 'valid'|'same'|number|ExplicitPadding;\n dataFormat: 'NHWC'|'NCHW';\n dilations: [number, number]|number;\n dimRoundingMode: 'floor'|'round'|'ceil';\n activation: Activation;\n leakyreluAlpha?: number;\n}\n\nexport const FusedDepthwiseConv2D = 'FusedDepthwiseConv2D';\nexport interface FusedDepthwiseConv2DInputs extends NamedTensorInfoMap {\n x: TensorInfo;\n filter: TensorInfo;\n bias?: TensorInfo;\n preluActivationWeights?: TensorInfo;\n}\nexport interface FusedDepthwiseConv2DAttrs {\n strides: [number, number]|number;\n pad: 'valid'|'same'|number;\n dataFormat: 'NHWC'|'NCHW';\n dilations: [number, number]|number;\n dimRoundingMode: 'floor'|'round'|'ceil';\n activation: Activation;\n leakyreluAlpha?: number;\n}\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License,
Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by

applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\nimport {env} from './environment';\n\nimport {getGlobal} from './global_util';\nimport {NamedGradientMap} from './tape';\nimport {Tensor} from './tensor';\nimport {DataType, RecursiveArray} from './types';\n\nconst kernelRegistry =\n getGlobal('kernelRegistry', () => new Map<string, KernelConfig>());\nconst gradRegistry =\n getGlobal('gradRegistry', () => new Map<string, GradConfig>());\n\nexport type DataId = object;\n\ntype AttributeValue =\n number|number[]|boolean|boolean[]|string|string[]|NamedAttrMap;\n\n/** These are extra non-tensor/primitive params passed to kernel functions. */\nexport type Attribute = AttributeValue|RecursiveArray<AttributeValue>;\n\n/** Specifies the code to run when executing a kernel. */\nexport type KernelFunc = (params: {\n inputs: NamedTensorInfoMap,\n backend: {},\n attrs?: NamedAttrMap,\n}) => TensorInfo|TensorInfo[];\n\n/** The function to run when computing a gradient during backprop. */\nexport type GradFunc =\n (dy: Tensor|Tensor[], saved: Tensor[], attrs: NamedAttrMap) =>\n NamedGradientMap;\n\n/** Function that gets called after the backend initializes. */\nexport type KernelSetupFunc = (backend: {}) => void;\n/** Function that gets called right before the backend is disposed. */\nexport type KernelDisposeFunc = KernelSetupFunc;\n\n/** Config object for registering a kernel in the global registry. */\nexport interface KernelConfig {\n kernelName: string;\n backendName: string;\n kernelFunc: KernelFunc;\n setupFunc?: KernelSetupFunc;\n disposeFunc?: KernelDisposeFunc;\n}\n\n/** Config object for registering a gradient in the global registry. */\nexport interface GradConfig {\n kernelName: string;\n inputsToSave?: string[];\n // When saveAllInputs is true, all inputs will be saved. Only use this flag\n // if inputs is an array of Tensors.\n saveAllInputs?: boolean;\n outputsToSave?: boolean[];\n gradFunc: GradFunc;\n}\n\n/** Holds metadata for a given tensor. */\nexport interface TensorInfo {\n dataId: DataId;\n shape: number[];\n dtype: DataType;\n}\n\nexport interface NamedTensorInfoMap {\n [name: string]: TensorInfo;\n}\n\nexport interface NamedAttrMap {\n [name: string]: Attribute;\n}\n\n/**\n * Returns the kernel function (code) associated with the provided names.\n *\n * @param kernelName The official name of the kernel.\n * @param backendName The official name of the backend.\n */\nexport function getKernel(\n kernelName: string, backendName: string): KernelConfig {\n const key = makeKey(kernelName, backendName);\n return kernelRegistry.get(key);\n}\n\n/**\n * Returns the registered gradient info associated with the provided kernel.\n * @param kernelName The official TF kernel name.\n */\nexport function getGradient(kernelName: string): GradConfig {\n return gradRegistry.get(kernelName);\n}\n\nexport function getKernelsForBackend(backendName: string): KernelConfig[] {\n const it = kernelRegistry.entries();\n const result: KernelConfig[] = [];\n\n while (true) {\n const {done, value} = it.next();\n if (done) {\n break;\n }\n const [key, config] = value;\n const [backend,] = key.split('_');\n if (backend === backendName) {\n result.push(config);\n }\n }\n return result;\n}\n\n/**\n * Registers the function (forward pass) for the kernel in a global registry.\n *\n * @param config A config object with the following properties:\n * - `kernelName` The official name of the kernel.\n * - `backendName` The official name of the backend.\n * - `kernelFunc` The function to run during the forward pass of the kernel.\n * - `setupFunc` Optional. Gets called once, after the backend initializes.\n * - `disposeFunc` Optional. Gets called once, right before the backend is\n * disposed.\n */\nexport function registerKernel(config: KernelConfig) {\n const {kernelName, backendName} = config;\n const key = makeKey(kernelName, backendName);\n if (kernelRegistry.has(key)) {\n console.warn(\n `The kernel '${kernelName}' for backend ` +\n `'${backendName}' is already registered`);\n }\n kernelRegistry.set(key, config);\n}\n\n/**\n * Registers a gradient function for a given kernel in the global registry,\n * to be used during the back-propagation of that kernel.\n *\n * @param config An object with the following properties:\n * - `kernelName` The name of the kernel that the gradient function is for.\n * - `gradFunc` The function to run during back-propagation.\n */\nexport function registerGradient(config: GradConfig) {\n const {kernelName} = config;\n\n if (gradRegistry.has(kernelName)) {\n

// TODO (yassogba) after 3.0 assess whether we need to keep this gated\n // to debug mode.\n if (env().getBool('DEBUG')) {\n console.warn(`Overriding the gradient for '${kernelName}'`);\n }\n }\n gradRegistry.set(kernelName, config);\n}\n\n/**\n * Removes the kernel function from the registry.\n *\n * @param kernelName The official name of the kernel.\n * @param backendName The official name of the backend.\n *\n */\nexport function unregisterKernel(\n kernelName: string, backendName: string): void {\n const key = makeKey(kernelName, backendName);\n if (!kernelRegistry.has(key)) {\n throw new Error(\n `The kernel '${kernelName}' for backend ` +\n `'${backendName}' is not registered`);\n }\n kernelRegistry.delete(key);\n}\n\n/**
Removes the registered gradient from the global registry. */\nexport function unregisterGradient(kernelName: string): void {\n if (!gradRegistry.has(kernelName)) {\n throw new Error(\n `The gradient '${kernelName}' for backend is not registered`);\n }\n gradRegistry.delete(kernelName);\n}\n\n/**\n * Finds kernels that have already been registered to a backend and re-registers\n * them for a new backend. Useful for registering custom backends.\n * @param registeredBackendName Already registered backend.\n * @param newBackendName New backend.\n */\nexport function copyRegisteredKernels(\n registeredBackendName: string, newBackendName: string): void {\n const kernels = getKernelsForBackend(registeredBackendName);\n kernels.forEach(kernelConfig => {\n const newKernelConfig =\n Object.assign({}, kernelConfig, {backendName: newBackendName});\n registerKernel(newKernelConfig);\n });\n}\n\nfunction makeKey(kernelName: string, backendName: string) {\n return `${backendName}_${kernelName}`;\n}\n","/**\n
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==\n */\n\nimport {env} from './environment';\nimport {BackendValues, DataType, TensorLike, TypedArray} from './types';\nimport * as base from './util_base';\nexport * from './util_base';\n\n/**\n * Create typed array for scalar value. Used for storing
in `DataStorage`.\n */\nexport function createScalarValue(\n value: DataType, dtype: DataType): BackendValues {\n if (dtype === 'string') {\n return encodeString(value);\n }\n\n return toTypedArray([value], dtype);\n}\n\nfunction noConversionNeeded(a: TensorLike, dtype: DataType): boolean {\n return (a instanceof Float32Array && dtype === 'float32') ||\n (a instanceof Int32Array && dtype === 'int32') ||\n (a instanceof Uint8Array && dtype === 'bool');\n}\n\nexport function toTypedArray(a: TensorLike, dtype: DataType): TypedArray {\n if (dtype === 'string') {\n throw new Error('Cannot convert a string[] to a TypedArray');\n }\n if (Array.isArray(a)) {\n a = base.flatten(a);\n }\n\n if (env().getBool('DEBUG')) {\n base.checkConversionForErrors(a as number[], dtype);\n }\n if (noConversionNeeded(a, dtype)) {\n return a as TypedArray;\n }\n if (dtype == null || dtype === 'float32' || dtype === 'complex64') {\n return new Float32Array(a as number[]);\n
} else if (dtype === 'int32') {\n return new Int32Array(a as number[]);\n } else if (dtype === 'bool') {\n const bool = new Uint8Array((a as number[]).length);\n for (let i = 0; i < bool.length; ++i) {\n if (Math.round((a as number[])[i]) !== 0) {\n bool[i] = 1;\n }\n }\n return bool;\n } else {\n throw new Error(`Unknown data type ${dtype}`);\n }\n}\n\n/**\n * Returns the current high-resolution time in milliseconds relative to an\n * arbitrary time in the past. It works across different platforms (node.js,\n * browsers).\n *\n * ```js\n * console.log(tf.util.now());\n * ```\n *\n * @doc {heading: 'Util', namespace: 'util'}\n */\nexport function now(): number {\n return env().platform.now();\n}\n\n/**\n * Returns a platform-specific implementation of\n * [`fetch`](https://developer.mozilla.org/en-US/docs/Web/API/Fetch_API).\n *\n * If `fetch` is defined on the global object (`window`, `process`, etc.),\n * `tf.util.fetch` returns that

function.\n *\n * If not, `tf.util.fetch` returns a platform-specific solution.\n *\n * ```js\n * const resource = await tf.util.fetch('https://unpkg.com/@tensorflow/tfjs');\n * // handle response\n * ```\n *\n * @doc {heading: 'Util'}\n */\nexport function fetch(\n path: string, requestInits?: RequestInit): Promise<Response> {\n return env().platform.fetch(path, requestInits);\n}\n\n/**\n * Encodes the provided string into bytes using the provided encoding scheme.\n *\n * @param s The string to encode.\n * @param encoding The encoding scheme. Defaults to utf-8.\n *\n * @doc {heading: 'Util'}\n */\nexport function encodeString(s: string, encoding = 'utf-8'): Uint8Array {\n encoding = encoding || 'utf-8';\n return env().platform.encode(s, encoding);\n}\n\n/**\n * Decodes the provided bytes into a string using the provided encoding scheme.\n * @param bytes The bytes to decode.\n *\n * @param encoding The encoding scheme. Defaults to utf-8.\n *\n * @doc {heading: 'Util'}\n */\nexport function decodeString(bytes: Uint8Array, encoding = 'utf-8'): string {\n encoding = encoding || 'utf-8';\n return env().platform.decode(bytes, encoding);\n}\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ===\n */\n\nimport {BackendTimer, BackendTimingInfo} from './backends/backend';\nimport {env} from './environment';\nimport {Tensor} from './tensor';\nimport {NamedTensorMap} from './tensor_types';\nimport {DataType, DataTypeMap, TypedArray} from './types';\nimport * as util from './util';\n\nexport type KernelProfile = {\n kernelName: string,\n outputs: Tensor[],\n inputs: NamedTensorMap,\n timeMs: Promise<number|{error: string}>,\n extraInfo: Promise<string>\n};\n\nexport class Profiler {\n constructor(private backendTimer: BackendTimer, private logger?: Logger) {\n if (logger == null) {\n this.logger = new Logger();\n }\n }\n\n profileKernel(kernelName: string, inputs: NamedTensorMap, f: () => Tensor[]):\n KernelProfile {\n let outputs: Tensor[];\n const holdResultWrapperFn = () => {\n outputs = f();\n };\n let timer: Promise<BackendTimingInfo>;\n const start = util.now();\n if (this.backendTimer.timerAvailable()) {\n timer = this.backendTimer.time(holdResultWrapperFn);\n } else {\n holdResultWrapperFn();\n outputs.map(output => output.dataSync());\n timer = Promise.resolve({kernelMs: util.now() - start});\n }\n if (env().getBool('CHECK_COMPUTATION_FOR_ERRORS')) {\n for (let i = 0; i < outputs.length; i++) {\n const output = outputs[i];\n // Dangling promise here because we don't want to propagate up\n // asynchronicity.\n output.data().then(tensorVals => {\n checkComputationForErrors(tensorVals, output.dtype, kernelName);\n });\n }\n }\n\n const kernelProfile = {\n kernelName,\n outputs,\n inputs,\n timeMs: timer.then(timing => timing.kernelMs),\n extraInfo: timer.then(\n timing => timing.getExtraProfileInfo != null ?\n timing.getExtraProfileInfo() :\n '')\n };\n return kernelProfile;\n }\n\n logKernelProfile(kernelProfile: KernelProfile): void {\n const {kernelName, outputs, timeMs, inputs, extraInfo} = kernelProfile;\n\n outputs.forEach(result => {\n Promise.all([result.data(), timeMs, extraInfo]).then(valueContainer => {\n this.logger.logKernelProfile(\n kernelName, result, valueContainer[0], valueContainer[1], inputs,\n valueContainer[2]);\n });\n });\n }\n}\n\nexport function checkComputationForErrors<D extends DataType>(\n vals: DataTypeMap[D], dtype: D, kernelName: string): boolean {\n if (dtype !== 'float32') {\n // Only floating point computations will generate NaN values\n return false;\n }\n for (let i = 0; i < vals.length; i++) {\n const num = vals[i] as number;\n if (isNaN(num) || !isFinite(num)) {\n // Throwing custom exception so behavior is testable.\n console.warn(`Found ${num} in the result of '${kernelName}'`);\n return true;\n }\n }\n return false;\n}\n\nexport class Logger {\n logKernelProfile(\n name: string, result: Tensor, vals: TypedArray,\n timeMs: number|{error: string}, inputs: NamedTensorMap,\n extraInfo?: string) {\n const time

```
 = typeof timeMs === 'number' ? util.rightPad(`${timeMs}ms`, 9) :\n                                    timeMs['error'];\n
 const paddedName = util.rightPad(name, 25);\n    const rank = result.rank;\n    const size = result.size;\n    const
shape = util.rightPad(result.shape.toString(), 14);\n    let inputShapesDescription = '';\n\n    for (const name in
inputs) {\n      const input = inputs[name];\n      if (input != null) {\n        // The input might be a non-tensor (e.g
HTMLImageElement), in which case\n        // we claim the output shape as input shape.\n        const inputShape =
input.shape || result.shape;\n        const inputRank = inputShape.length;\n        inputShapesDescription +=\n
`${name}: ${inputRank}D ${inputRank > 0 ? inputShape : ''} `;\n      }\n    }\n\n    console.log(\n
`%c${paddedName}\\t%c${time}\\t%c${rank}D ${shape}\\t%c${size}\\t%c${\n
inputShapesDescription}\\t%c${extraInfo}`,\n        'font-weight:bold', 'color:red',
 'color:blue', 'color: orange',\n        'color: green', 'color: steelblue');\n  }\n}\n","/**\n * @license\n * Copyright 2017
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OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language
governing permissions and\n * limitations under the License.\n *
==========================================================================\n
*/\n\nimport {Tensor} from './tensor';\nimport {NamedTensorMap} from './tensor_types';\nimport * as util from
'./util';\n\nexport interface TapeNode {\n  id: number;\n  kernelName: string;\n
  outputs: Tensor[];\n  inputs: NamedTensorMap;\n  // Optional params, defined only for ops with gradient impl.\n
gradient?: (dys: Tensor[]) => NamedGradientMap;\n  saved?: Tensor[];\n}\n\nexport type NamedGradientMap = {\n
[inputName: string]: () => Tensor;\n};\n\n/**\n * Computes a list of TapeNodes that connect x to y, filtering
everything else\n * out and preserving the order of the original tape elements.\n *\n * @param tape The tape
elements to filter.\n * @param xs The input Tensors.\n * @param y The output Tensor.\n */\nexport function
getFilteredNodesXToY(\n    tape: TapeNode[], xs: Tensor[], y: Tensor): TapeNode[] {\n  // Forward pass to
compute all the nodes and Tensors that are transitively a\n  // function of x.\n  const tensorsFromX: {[tensorId:
number]: boolean} = {};\n  const nodesFromX: {[nodeId: number]: boolean} = {};\n  for (let i = 0; i < xs.length;
i++) {\n    tensorsFromX[xs[i].id] = true;\n  }\n\n  for (let i = 0; i < tape.length; i++) {\n    const node = tape[i];\n
    const nodeInputs = node.inputs;\n    for (const inputName in nodeInputs) {\n      const input =
nodeInputs[inputName];\n\n      let anyInputFromX = false;\n      for (let j = 0; j < xs.length; j++) {\n        if
(tensorsFromX[input.id]) {\n          node.outputs.forEach(output => tensorsFromX[output.id] = true);\n
anyInputFromX = true;\n          nodesFromX[node.id] = true;\n          break;\n        }\n      }\n\n      if
(anyInputFromX) {\n        break;\n      }\n    }\n  }\n\n  // Backward pass to find all of the nodes and Tensors that
lead to y.\n  const tensorsLeadToY: {[tensorId: number]: boolean} = {};\n  tensorsLeadToY[y.id] = true;\n  const
nodesToY: {[nodeId: number]: boolean} = {};\n\n  for (let i = tape.length - 1; i >= 0; i--) {\n    const node =
tape[i];\n    const nodeInputs = node.inputs;\n\n    // If any of the outputs lead to y, mark all of the inputs as leading
to y.\n    for (let j = 0; j < node.outputs.length; j++) {\n      if (tensorsLeadToY[node.outputs[j].id])
 {\n        for (const inputName in nodeInputs) {\n          tensorsLeadToY[nodeInputs[inputName].id] = true;\n
nodesToY[node.id] = true;\n        }\n        break;\n      }\n    }\n  }\n\n  // Return the paths that come from x and lead
to y.\n  const filteredTape: TapeNode[] = [];\n  for (let i = 0; i < tape.length; i++) {\n    const node = tape[i];\n\n    if
(nodesFromX[node.id] && nodesToY[node.id]) {\n      // Prune the inputs from the node that aren't a function of
x.\n      const prunedInputs: {[inputName: string]: Tensor} = {};\n      for (const inputName in node.inputs) {\n
const nodeInput = node.inputs[inputName];\n        if (tensorsFromX[nodeInput.id]) {\n
prunedInputs[inputName] = nodeInput;\n        }\n      }\n\n      // Copy the node and overwrite inputsAndArgs to the
pruned version.\n      const prunedNode = Object.assign({}, node);\n      prunedNode.inputs = prunedInputs;\n
prunedNode.outputs = node.outputs;\n\n      filteredTape.push(prunedNode);\n
   }\n  }\n\n  return filteredTape;\n}\n\n/**\n * Backpropagate gradients through the filtered TapeNodes.\n *\n *
@param tensorAccumulatedGradientMap A map of Tensor to its gradient. This map\n * is mutated by this
```

method.\n * @param filteredTape The filtered TapeNodes to backprop through.\n */\nexport function backpropagateGradients(\n tensorAccumulatedGradientMap: {[tensorId: number]: Tensor},\n filteredTape: TapeNode[], tidy: (f: Function) => Tensor,\n add: (a: Tensor, b: Tensor) => Tensor) {\n // Walk the tape backward and keep a map of Tensor to its gradient.\n for (let i = filteredTape.length - 1; i >= 0; i--) {\n const node = filteredTape[i];\n\n const dys: Tensor[] = [];\n node.outputs.forEach(o => {\n const gradTensor = tensorAccumulatedGradientMap[o.id];\n if (gradTensor != null) {\n dys.push(gradTensor);\n } else {\n // This particular output is not in the back-propagation subgraph, so it\n // does not affect the final output, thus we put null for its dy.\n dys.push(null);\n }\n });\n\n if (node.gradient == null) {\n throw new Error(\n `Cannot compute gradient: gradient function not found ` +\n `for ${node.kernelName}.`);\n }\n\n // Backprop dy through this node and accumulate gradients over the inputs.\n const inputGradients = node.gradient(dys);\n\n for (const inputName in node.inputs) {\n if (!(inputName in inputGradients)) {\n throw new Error(\n `Cannot backprop through input ${inputName}. ` +\n `Available gradients found: ${Object.keys(inputGradients)}.`);\n }\n\n // Call the gradient function.\n const dx = tidy(() => inputGradients[inputName]());\n if (dx.dtype !== 'float32') {\n throw new Error(\n `Error in gradient for op ${\n node.kernelName}. The gradient of input ` +\n `${inputName} must have 'float32' dtype, but has '${dx.dtype}'`);\n }\n const x = node.inputs[inputName];\n if (!util.arraysEqual(dx.shape, x.shape)) {\n throw new Error(\n `Error in gradient for op ${\n node.kernelName}. The gradient of input ` +\n `'${inputName}' has shape '${dx.shape}', which does not match ` +\n `the shape of the input '${x.shape}'`);\n }\n\n if (tensorAccumulatedGradientMap[x.id] == null) {\n tensorAccumulatedGradientMap[x.id] = dx;\n } else {\n const curGradient = tensorAccumulatedGradientMap[x.id];\n tensorAccumulatedGradientMap[x.id] = add(curGradient, dx);\n curGradient.dispose();\n }\n }\n}\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ===\n */\n\nimport {DataType, TypedArray} from './types';\nimport {computeStrides, isString, rightPad, sizeFromShape} from './util';\n\n// Maximum number of values before we decide to show ellipsis.\nconst FORMAT_LIMIT_NUM_VALS = 20;\n// Number of first and last values to show when displaying a, b,...,y, z.\nconst FORMAT_NUM_FIRST_LAST_VALS = 3;\n// Number of significant digits to show.\nconst FORMAT_NUM_SIG_DIGITS = 7;\n\nexport function tensorToString(\n vals: TypedArray|string[], shape: number[], dtype: DataType,\n verbose: boolean) {\n const strides = computeStrides(shape);\n const padPerCol = computeMaxSizePerColumn(vals, shape, dtype, strides);\n const rank = shape.length;\n const valsLines = subTensorToString(vals, shape, dtype, strides, padPerCol);\n const lines = ['Tensor'];\n if (verbose) {\n lines.push(` dtype: ${dtype}`);\n lines.push(` rank: ${rank}`);\n lines.push(` shape: [${shape}]`);\n lines.push(` values:`);\n }\n lines.push(valsLines.map(l => ' ' + l).join('\\n'));\n return lines.join('\\n');\n}\n\nfunction computeMaxSizePerColumn(\n vals: TypedArray|string[], shape: number[], dtype: DataType,\n strides: number[]): number[] {\n const n = sizeFromShape(shape);\n const numCols = strides[strides.length - 1];\n const padPerCol = new Array(numCols).fill(0);\n const rank = shape.length;\n const valuesOrTuples =\n dtype === 'complex64' ? createComplexTuples(vals) : vals;\n\n if (rank > 1) {\n for (let row = 0; row < n / numCols; row++) {\n const offset = row * numCols;\n for (let j = 0; j < numCols; j++) {\n padPerCol[j] = Math.max(\n padPerCol[j],\n valToString(valuesOrTuples[offset + j], 0, dtype).length);\n }\n }\n }\n return padPerCol;\n}\n\nfunction

```
valToString(\n    val: number|string|[number, number], pad: number, dtype: DataType) {\n  let valStr: string;\n  if (Array.isArray(val)) {\n    valStr = `${parseFloat(val[0].toFixed(FORMAT_NUM_SIG_DIGITS))} + ` +\n        `${parseFloat(val[1].toFixed(FORMAT_NUM_SIG_DIGITS))}j`;\n  } else if (isString(val)) {\n    valStr = `'${val}'`;\n  } else if (dtype === 'bool') {\n    valStr = boolNumToString(val);\n  } else {\n    valStr = parseFloat(val.toFixed(FORMAT_NUM_SIG_DIGITS)).toString();\n  }\n\n  return rightPad(valStr, pad);\n}\n\nfunction boolNumToString(v: number): string {\n  return v === 0 ? 'false' : 'true';\n}\n\nfunction subTensorToString(\n    vals: TypedArray|string[], shape: number[], dtype: DataType,\n    strides: number[], padPerCol: number[], isLast = true):
 string[] {\n  const storagePerElement = dtype === 'complex64' ? 2 : 1;\n\n  const size = shape[0];\n  const rank = shape.length;\n  if (rank === 0) {\n    if (dtype === 'complex64') {\n      const complexTuple = createComplexTuples(vals);\n      return [valToString(complexTuple[0], 0, dtype)];\n    }\n    if (dtype === 'bool') {\n      return [boolNumToString(vals[0] as number)];\n    }\n    return [vals[0].toString()];\n  }\n\n  if (rank === 1) {\n    if (size > FORMAT_LIMIT_NUM_VALS) {\n      const firstValsSize = FORMAT_NUM_FIRST_LAST_VALS * storagePerElement;\n\n      let firstVals = Array.from<number|string|[number, number]>(\n          vals.slice(0, firstValsSize));\n      let lastVals = Array.from<number|string|[number, number]>(vals.slice(\n          (size - FORMAT_NUM_FIRST_LAST_VALS) * storagePerElement,\n          size * storagePerElement));\n      if (dtype === 'complex64') {\n        firstVals = createComplexTuples(firstVals);\n        lastVals = createComplexTuples(lastVals);\n      }\n      return [\n        '[' +\n        firstVals.map((x, i) => valToString(x, padPerCol[i], dtype))\n            .join(', ') +\n        ', ..., ' +\n        lastVals\n            .map(\n                (x, i) => valToString(\n                    x, padPerCol[size - FORMAT_NUM_FIRST_LAST_VALS + i], dtype))\n            .join(', ') +\n        ']'\n      ];\n    }\n    const displayVals: Array<number|string|[number, number]> =\n        dtype === 'complex64' ? createComplexTuples(vals) :\n                                Array.from<number|string>(vals);\n\n    return [\n      '[' +\n      displayVals.map((x, i) => valToString(x, padPerCol[i], dtype))\n          .join(', ') +\n      ']'\n    ];\n  }\n\n  // The array is rank 2 or more.\n  const subshape = shape.slice(1);\n  const substrides = strides.slice(1);\n  const stride = strides[0] * storagePerElement;\n  const lines: string[] = [];\n  if (size > FORMAT_LIMIT_NUM_VALS) {\n    for (let i = 0; i < FORMAT_NUM_FIRST_LAST_VALS;
 i++) {\n      const start = i * stride;\n      const end = start + stride;\n      lines.push(...subTensorToString(\n          vals.slice(start, end), subshape, dtype, substrides, padPerCol,\n          false /* isLast */));\n    }\n    lines.push('...');\n    for (let i = size - FORMAT_NUM_FIRST_LAST_VALS; i < size; i++) {\n      const start = i * stride;\n      const end = start + stride;\n      lines.push(...subTensorToString(\n          vals.slice(start, end), subshape, dtype, substrides, padPerCol,\n          i === size - 1 /* isLast */));\n    }\n  } else {\n    for (let i = 0; i < size; i++) {\n      const start = i * stride;\n      const end = start + stride;\n      lines.push(...subTensorToString(\n          vals.slice(start, end), subshape, dtype, substrides, padPerCol,\n          i === size - 1 /* isLast */));\n    }\n  }\n  const sep = rank === 2 ? ',' : '';\n  lines[0] = '[' + lines[0] + sep;\n  for (let i = 1; i < lines.length - 1; i++) {\n    lines[i] = ' ' + lines[i] + sep;\n  }\n  let newLineSep = ',\\n';\n  for (let i = 2; i < rank; i++) {\n    newLineSep += '\\n';\n  }\n  lines[lines.length - 1] =\n      ' ' + lines[lines.length - 1] + ']' + (isLast ? '' : newLineSep);\n  return lines;\n}\n\nfunction createComplexTuples(vals: Array<{}>|\n                             TypedArray): Array<[number, number]> {\n  const complexTuples: Array<[number, number]> = [];\n  for (let i = 0; i < vals.length; i += 2) {\n    complexTuples.push([vals[i], vals[i + 1]] as [number, number]);\n  }\n  return complexTuples;\n}\n","/**\n * @license\n * Copyright 2017 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\"
 BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========================================================================\n */\n\nimport {getGlobal} from './global_util';\nimport {tensorToString} from './tensor_format';\nimport {ArrayMap,
```

```
BackendValues, DataType, DataTypeMap, DataValues, NumericDataType, Rank, ShapeMap, SingleValueMap,
TypedArray} from './types';\nimport * as util from './util';\nimport {computeStrides, toNestedArray} from
'./util';\n\nexport interface TensorData<D extends DataType> {\n  dataId?: DataId;\n  values?:
DataTypeMap[D];\n}\n\n// This interface mimics KernelBackend (in backend.ts), which would create a\n// circular
dependency if imported.\nexport interface Backend {}\n\n/**\n * A mutable object, similar to `tf.Tensor`, that
allows users to set values\n * at locations before converting to an immutable `tf.Tensor`.\n
 *\n * See `tf.buffer` for creating a tensor buffer.\n *\n * @doc {heading: 'Tensors', subheading: 'Classes'}\n
*/\nexport class TensorBuffer<R extends Rank, D extends DataType = 'float32'> {\n  size: number;\n  shape:
ShapeMap[R];\n  strides: number[];\n  values: DataTypeMap[D];\n\n  constructor(shape: ShapeMap[R], public
dtype: D, values?: DataTypeMap[D]) {\n    this.shape = shape.slice() as ShapeMap[R];\n    this.size =
util.sizeFromShape(shape);\n\n    if (values != null) {\n      const n = values.length;\n      util.assert(\n          n ===
this.size,\n          () => `Length of values '${n}' does not match the size ` +\n              `inferred by the shape
'${this.size}'.`);\n    }\n    if (dtype === 'complex64') {\n      throw new Error(\n          `complex64 dtype
TensorBuffers are not supported. Please create ` +\n          `a TensorBuffer for the real and imaginary parts
separately and ` +\n          `call tf.complex(real, imag).`);\n    }\n    this.values = values ||
 util.getArrayFromDType(dtype, this.size);\n    this.strides = computeStrides(shape);\n  }\n\n  /**\n   * Sets a value
in the buffer at a given location.\n   *\n   * @param value The value to set.\n   * @param locs  The location
indices.\n   *\n   * @doc {heading: 'Tensors', subheading: 'Creation'}\n   */\n  set(value: SingleValueMap[D], ...locs:
number[]): void {\n    if (locs.length === 0) {\n      locs = [0];\n    }\n    util.assert(\n        locs.length === this.rank,\n
    () => `The number of provided coordinates (${locs.length}) must ` +\n          `match the rank
(${this.rank})`);\n\n    const index = this.locToIndex(locs);\n    this.values[index] = value as number;\n  }\n\n  /**\n
* Returns the value in the buffer at the provided location.\n   *\n   * @param locs The location indices.\n   *\n   *
@doc {heading: 'Tensors', subheading: 'Creation'}\n   */\n  get(...locs: number[]): SingleValueMap[D] {\n    if
(locs.length === 0) {\n      locs = [0];\n    }\n    let i = 0;\n
    for (const loc of locs) {\n      if (loc < 0 || loc >= this.shape[i]) {\n        const msg = `Requested out of range
element at ${locs}. ` +\n            `  Buffer shape=${this.shape}`;\n        throw new Error(msg);\n      }\n      i++;\n
}\n    let index = locs[locs.length - 1];\n    for (let i = 0; i < locs.length - 1; ++i) {\n      index += this.strides[i] *
locs[i];\n    }\n    return this.values[index] as SingleValueMap[D];\n  }\n\n  locToIndex(locs: number[]): number {\n
 if (this.rank === 0) {\n      return 0;\n    } else if (this.rank === 1) {\n      return locs[0];\n    }\n    let index =
locs[locs.length - 1];\n    for (let i = 0; i < locs.length - 1; ++i) {\n      index += this.strides[i] * locs[i];\n    }\n
return index;\n  }\n\n  indexToLoc(index: number): number[] {\n    if (this.rank === 0) {\n      return [];\n    } else if
(this.rank === 1) {\n      return [index];\n    }\n    const locs: number[] = new Array(this.shape.length);\n    for (let i =
0; i < locs.length
 - 1; ++i) {\n      locs[i] = Math.floor(index / this.strides[i]);\n      index -= locs[i] * this.strides[i];\n    }\n
locs[locs.length - 1] = index;\n    return locs;\n  }\n\n  get rank() {\n    return this.shape.length;\n  }\n\n  /**\n   *
Creates an immutable `tf.Tensor` object from the buffer.\n   *\n   * @doc {heading: 'Tensors', subheading:
'Creation'}\n   */\n  toTensor(): Tensor<R> {\n    return trackerFn().makeTensor(this.values, this.shape, this.dtype)
as\n        Tensor<R>;\n  }\n}\n\nexport interface TensorTracker {\n  makeTensor(\n      values: DataValues, shape:
number[], dtype: DataType,\n      backend?: Backend): Tensor;\n  makeVariable(\n      initialValue: Tensor,
trainable?: boolean, name?: string,\n      dtype?: DataType): Variable;\n  incRef(a: Tensor, backend: Backend):
void;\n  disposeTensor(t: Tensor): void;\n  disposeVariable(v: Variable): void;\n  read(dataId: DataId):
Promise<BackendValues>;\n  readSync(dataId: DataId): BackendValues;\n}\n\n/**\n
 * The Tensor class calls into this handler to delegate chaining operations.\n */\nexport interface OpHandler {\n
cast<T extends Tensor>(x: T, dtype: DataType): T;\n  buffer<R extends Rank, D extends DataType>(\n      shape:
ShapeMap[R], dtype: D,\n      values?: DataTypeMap[D]): TensorBuffer<R, D>;\n  print<T extends Tensor>(x: T,
verbose: boolean): void;\n  clone<T extends Tensor>(x: T): T;\n  // TODO(yassogba) bring reshape back?\n}\n\n//
For tracking tensor creation and disposal.\nlet trackerFn: () => TensorTracker = null;\n// Used by chaining methods
to call into ops.\nlet opHandler: OpHandler = null;\n// Used to warn about deprecated methods.\nlet
```

deprecationWarningFn: (msg: string) => void = null;\n// This here so that we can use this method on dev branches and keep the\n// functionality at master.\n// tslint:disable-next-line:no-unused-expression\n[deprecationWarningFn];\n\n/**\n * An external consumer can register itself as the tensor tracker. This way\n * the Tensor class can
notify the tracker for every tensor created and\n * disposed.\n */\nexport function setTensorTracker(fn: () => TensorTracker) {\n trackerFn = fn;\n}\n\n/**\n * An external consumer can register itself as the op handler. This way the\n * Tensor class can have chaining methods that call into ops via the op\n * handler.\n */\nexport function setOpHandler(handler: OpHandler) {\n opHandler = handler;\n}\n\n/**\n * Sets the deprecation warning function to be used by this file. This way the\n * Tensor class can be a leaf but still use the environment.\n */\nexport function setDeprecationWarningFn(fn: (msg: string) => void) {\n deprecationWarningFn = fn;\n}\n\n/**\n * We wrap data id since we use weak map to avoid memory leaks.\n * Since we have our own memory management, we have a reference counter\n * mapping a tensor to its data, so there is always a pointer (even if that\n * data is otherwise garbage collectable).\n * See https://developer.mozilla.org/en-US/docs/Web/JavaScript/Reference/\n * Global_Objects/WeakMap\n */\nexport type DataId = object; // object instead of {} to force non-primitive.\n\n// Declare this namespace to make Tensor class augmentation work in google3.\nexport declare namespace Tensor {}\n/**\n * A `tf.Tensor` object represents an immutable, multidimensional array of\n * numbers that has a shape and a data type.\n *\n * See `tf.tensor` for details on how to create a `tf.Tensor`.\n *\n * @doc {heading: 'Tensors', subheading: 'Classes'}\n */\nexport class Tensor<R extends Rank = Rank> {\n /** Unique id of this tensor. */\n readonly id: number;\n /**\n * Id of the bucket holding the data for this tensor. Multiple arrays can\n * point to the same bucket (e.g. when calling array.reshape()).\n */\n dataId: DataId;\n /** The shape of the tensor. */\n readonly shape: ShapeMap[R];\n /** Number of elements in the tensor. */\n readonly size: number;\n /** The data type for the array. */\n readonly dtype: DataType;\n /** The rank type for
the array (see `Rank` enum). */\n readonly rankType: R;\n\n /** Whether this tensor has been globally kept. */\n kept = false;\n /** The id of the scope this tensor is being tracked in. */\n scopeId: number;\n\n /**\n * Number of elements to skip in each dimension when indexing. See\n * https://docs.scipy.org/doc/numpy/reference/generated/\\\n * numpy.ndarray.strides.html\n */\n readonly strides: number[];\n\n constructor(shape: ShapeMap[R], dtype: DataType, dataId: DataId, id: number) {\n this.shape = shape.slice() as ShapeMap[R];\n this.dtype = dtype || 'float32';\n this.size = util.sizeFromShape(shape);\n this.strides = computeStrides(shape);\n this.dataId = dataId;\n this.id = id;\n this.rankType = (this.rank < 5 ? this.rank.toString() : 'higher') as R;\n }\n\n get rank(): number {\n return this.shape.length;\n }\n\n /**\n * Returns a promise of `tf.TensorBuffer` that holds the underlying data.\n *\n * @doc {heading: 'Tensors', subheading:
'Classes'}\n */\n async buffer<D extends DataType = 'float32'>(): Promise<TensorBuffer<R, D>> {\n const vals = await this.data<D>();\n return opHandler.buffer(this.shape, this.dtype as D, vals);\n }\n\n /**\n * Returns a `tf.TensorBuffer` that holds the underlying data.\n * @doc {heading: 'Tensors', subheading: 'Classes'}\n */\n bufferSync<D extends DataType = 'float32'>(): TensorBuffer<R, D> {\n return opHandler.buffer(this.shape, this.dtype as D, this.dataSync());\n }\n\n /**\n * Returns the tensor data as a nested array. The transfer of data is done\n * asynchronously.\n *\n * @doc {heading: 'Tensors', subheading: 'Classes'}\n */\n async array(): Promise<ArrayMap[R]> {\n const vals = await this.data();\n return toNestedArray(this.shape, vals) as ArrayMap[R];\n }\n\n /**\n * Returns the tensor data as a nested array. The transfer of data is done\n * synchronously.\n *\n * @doc {heading: 'Tensors', subheading: 'Classes'}\n */\n
arraySync(): ArrayMap[R] {\n return toNestedArray(this.shape, this.dataSync()) as ArrayMap[R];\n }\n\n /**\n * Asynchronously downloads the values from the `tf.Tensor`. Returns a\n * promise of `TypedArray` that resolves when the computation has finished.\n *\n * @doc {heading: 'Tensors', subheading: 'Classes'}\n */\n async data<D extends DataType = NumericDataType>(): Promise<DataTypeMap[D]> {\n this.throwIfDisposed();\n const data = trackerFn().read(this.dataId);\n if (this.dtype === 'string') {\n const bytes = await data as Uint8Array[];\n try {\n return bytes.map(b => util.decodeString(b)) as DataTypeMap[D];\n } catch {\n throw new Error(\n 'Failed to decode the string bytes into utf-8. ' +\n 'To get the original bytes, call

tensor.bytes().');\n }\n }\n return data as Promise<DataTypeMap[D]>;\n }\n\n /**\n * Synchronously downloads the values from the `tf.Tensor`. This blocks the\n * UI
thread until the values are ready, which can cause performance issues.\n *\n * @doc {heading: 'Tensors', subheading: 'Classes'}\n */\n dataSync<D extends DataType = NumericDataType>(): DataTypeMap[D] {\n this.throwIfDisposed();\n const data = trackerFn().readSync(this.dataId);\n if (this.dtype === 'string') {\n try {\n return (data as Uint8Array[]).map(b => util.decodeString(b)) as\n DataTypeMap[D];\n } catch {\n throw new Error(\n 'Failed to decode the string bytes into utf-8. ' +\n 'To get the original bytes, call tensor.bytes().');\n }\n }\n return data as DataTypeMap[D];\n }\n\n /** Returns the underlying bytes of the tensor's data. */\n async bytes(): Promise<Uint8Array[]|Uint8Array> {\n this.throwIfDisposed();\n const data = await trackerFn().read(this.dataId);\n if (this.dtype === 'string') {\n return data as Uint8Array[];\n } else {\n return new Uint8Array((data as TypedArray).buffer);\n
}\n }\n\n /**\n * Disposes `tf.Tensor` from memory.\n *\n * @doc {heading: 'Tensors', subheading: 'Classes'}\n */\n dispose(): void {\n if (this.isDisposed) {\n return;\n }\n trackerFn().disposeTensor(this);\n this.isDisposedInternal = true;\n }\n\n protected isDisposedInternal = false;\n get isDisposed(): boolean {\n return this.isDisposedInternal;\n }\n\n throwIfDisposed() {\n if (this.isDisposed) {\n throw new Error(`Tensor is disposed.`);\n }\n }\n\n /**\n * Prints the `tf.Tensor`. See `tf.print` for details.\n *\n * @param verbose Whether to print verbose information about the tensor,\n * including dtype and size.\n *\n * @doc {heading: 'Tensors', subheading: 'Classes'}\n */\n print(verbose = false): void {\n return opHandler.print(this, verbose);\n }\n\n /**\n * Returns a copy of the tensor. See `tf.clone` for details.\n * @doc {heading: 'Tensors', subheading: 'Classes'}\n */\n clone<T
extends Tensor>(this: T): T {\n this.throwIfDisposed();\n return opHandler.clone(this);\n }\n\n /**\n * Returns a human-readable description of the tensor. Useful for logging.\n *\n * @doc {heading: 'Tensors', subheading: 'Classes'}\n */\n toString(verbose = false): string {\n const vals = this.dataSync();\n return tensorToString(vals, this.shape, this.dtype, verbose);\n }\n\n cast<T extends this>(dtype: DataType): T {\n this.throwIfDisposed();\n return opHandler.cast(this as T, dtype);\n }\n variable(trainable = true, name?: string, dtype?: DataType): Variable<R> {\n this.throwIfDisposed();\n return trackerFn().makeVariable(this, trainable, name, dtype) as\n Variable<R>;\n }\n}\nObject.defineProperty(Tensor, Symbol.hasInstance, {\n value: (instance: Tensor) => {\n // Implementation note: we should use properties of the object that will be\n // defined before the constructor body has finished executing (methods).\n // This
is because when this code is transpiled by babel, babel will call\n // classCallCheck before the constructor body is run.\n // See https://github.com/tensorflow/tfjs/issues/3384 for backstory.\n return !!instance && instance.data != null && instance.dataSync != null &&\n instance.throwIfDisposed != null;\n }\n});\n\nexport function getGlobalTensorClass() {\n // Use getGlobal so that we can augment the Tensor class across package\n // boundaries becase the node resolution alg may result in different modules\n // being returned for this file depending on the path they are loaded from.\n return getGlobal('Tensor', () => {\n return Tensor;\n });\n}\n\n// Global side effect. Cache global reference to Tensor class\ngetGlobalTensorClass();\n\nexport interface NumericTensor<R extends Rank = Rank> extends Tensor<R> {\n dtype: NumericDataType;\n dataSync<D extends DataType = NumericDataType>(): DataTypeMap[D];\n data<D extends DataType = NumericDataType>(): Promise<DataTypeMap[D]>;\n}\n\nexport
interface StringTensor<R extends Rank = Rank> extends Tensor<R> {\n dtype: 'string';\n dataSync<D extends DataType = 'string'>(): DataTypeMap[D];\n data<D extends DataType = 'string'>(): Promise<DataTypeMap[D]>;\n}\n\n/** @doclink Tensor */\nexport type Scalar = Tensor<Rank.R0>;\n/** @doclink Tensor */\nexport type Tensor1D = Tensor<Rank.R1>;\n/** @doclink Tensor */\nexport type Tensor2D = Tensor<Rank.R2>;\n/** @doclink Tensor */\nexport type Tensor3D = Tensor<Rank.R3>;\n/** @doclink Tensor */\nexport type Tensor4D = Tensor<Rank.R4>;\n/** @doclink Tensor */\nexport type Tensor5D = Tensor<Rank.R5>;\n/** @doclink Tensor */\nexport type Tensor6D = Tensor<Rank.R6>;\n\n/**\n * A mutable `tf.Tensor`, useful for persisting state, e.g. for training.\n *\n * @doc {heading: 'Tensors', subheading: 'Classes'}\n */\nexport class Variable<R extends Rank = Rank> extends Tensor<R> {\n name: string;\n\n constructor(\n

initialValue: Tensor<R>, public trainable: boolean,
name: string,\n tensorId: number) {\n super(\n initialValue.shape, initialValue.dtype, initialValue.dataId, tensorId);\n this.name = name;\n }\n\n /**\n * Assign a new `tf.Tensor` to this variable. The new `tf.Tensor` must have\n * the same shape and dtype as the old `tf.Tensor`.\n *\n * @param newValue New tensor to be assigned to this variable.\n *\n * @doc {heading: 'Tensors', subheading: 'Classes'}\n */\n assign(newValue: Tensor<R>): void {\n if (newValue.dtype !== this.dtype) {\n throw new Error(\n `dtype of the new value (${newValue.dtype}) and ` +\n `previous value (${this.dtype}) must match`);\n }\n if (!util.arraysEqual(newValue.shape, this.shape)) {\n throw new Error(\n `shape of the new value (${newValue.shape}) and ` +\n `previous value (${this.shape}) must match`);\n }\n trackerFn().disposeTensor(this);\n this.dataId = newValue.dataId;\n trackerFn().incRef(this, null /* backend */);\n }\n\n dispose(): void {\n trackerFn().disposeVariable(this);\n this.isDisposedInternal = true;\n }\n}\n\nObject.defineProperty(Variable, Symbol.hasInstance, {\n value: (instance: Variable) => {\n return instance instanceof Tensor && instance.assign != null &&\n instance.assign instanceof Function;\n }\n});\n","/**\n * @license\n * Copyright 2017 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\n/** @docalias number[] */\nexport interface ShapeMap {\n R0: number[];\n R1: [number];\n R2: [number, number];\n R3: [number, number, number];\n R4: [number, number, number, number];\n R5: [number, number, number, number, number];\n R6: [number, number, number, number, number, number];\n}\n\n/** @docalias number[] */\nexport interface ArrayMap {\n R0: number;\n R1: number[];\n R2: number[][];\n R3: number[][][];\n R4: number[][][][];\n R5: number[][][][][];\n R6: number[][][][][][];\n}\n\nexport interface DataTypeMap {\n float32: Float32Array;\n int32: Int32Array;\n bool: Uint8Array;\n complex64: Float32Array;\n string: string[];\n}\n\nexport interface SingleValueMap {\n bool: boolean;\n int32: number;\n float32: number;\n complex64: number;\n string: string;\n}\n\n/** @docalias 'float32'|'int32'|'bool'|'complex64'|'string' */\nexport type DataType = keyof DataTypeMap;\nexport type NumericDataType = 'float32'|'int32'|'bool'|'complex64';\nexport type TypedArray = Float32Array|Int32Array|Uint8Array;\n/** Tensor data used in tensor creation and user-facing API. */\nexport type DataValues = DataTypeMap[DataType];\n/** The underlying tensor data that gets stored in a backend. */\nexport type BackendValues = Float32Array|Int32Array|Uint8Array|Uint8Array[];\n\nexport enum Rank {\n R0 = 'R0',\n R1 = 'R1',\n R2 = 'R2',\n R3 = 'R3',\n R4 = 'R4',\n R5 = 'R5',\n R6 = 'R6'\n}\n\nexport type FlatVector = boolean[]|number[]|TypedArray;\nexport type RegularArray<T> = \n T[]|T[][]|T[][][]|T[][][][]|T[][][][][]|T[][][][][][];\n\n// tslint:disable-next-line:no-any\nexport interface RecursiveArray<T extends any> {\n [index: number]: T|RecursiveArray<T>;\n}\n\n// Looks for upcasting types. Used, for example, in operations with mixed dtype\n// inputs.\nenum UpcastInt32AndMap {\n 'float32' = 'float32',\n 'int32' = 'int32',\n 'bool' = 'int32',\n 'complex64' = 'complex64'\n}\n\nenum UpcastBoolAndMap {\n 'float32' = 'float32',\n 'int32' = 'int32',\n 'bool' = 'bool',\n 'complex64' = 'complex64'\n}\n\nenum UpcastFloat32AndMap {\n 'float32' = 'float32',\n 'int32' = 'float32',\n 'bool' = 'float32',\n 'complex64' = 'complex64'\n}\n\nenum UpcastComplex64AndMap {\n 'float32' = 'complex64',\n 'int32' = 'complex64',\n 'bool' = 'complex64',\n 'complex64' = 'complex64'\n}\n\nconst upcastTypeMap = {\n 'float32': UpcastFloat32AndMap,\n 'int32': UpcastInt32AndMap,\n 'bool': UpcastBoolAndMap,\n 'complex64': UpcastComplex64AndMap\n};\n\nexport function upcastType(typeA: DataType, typeB: DataType): DataType {\n if (typeA === 'string' || typeB === 'string') {\n if (typeA === 'string' && typeB === 'string') {\n return 'string';\n }\n throw new Error(`Can not upcast ${typeA} with ${typeB}`);\n }\n return upcastTypeMap[typeA][typeB];\n}\n\n/** Returns the output type after summation. */\nexport function

```
sumOutType(type: DataType): DataType {\n  return
 upcastType(type, 'int32');\n}\n\n/** @docalias TypedArray|Array */\nexport type TensorLike =\n
TypedArray|number|boolean|string|RecursiveArray<number|number[]|TypedArray>|\n
RecursiveArray<boolean>|RecursiveArray<string>|Uint8Array[];\nexport type ScalarLike =
number|boolean|string|Uint8Array;\n/** @docalias TypedArray|Array */\nexport type TensorLike1D =
TypedArray|number[]|boolean[]|string[]|Uint8Array[];\n/** @docalias TypedArray|Array */\nexport type
TensorLike2D = TypedArray|number[]|number[][]|boolean[]|boolean[][]|\n
string[]|string[][]|Uint8Array[]|Uint8Array[][];\n/** @docalias TypedArray|Array */\nexport type TensorLike3D =
TypedArray|number[]|number[][][]|boolean[]|\n
boolean[][][]|string[]|string[][][]|Uint8Array[]|Uint8Array[][][];\n/** @docalias TypedArray|Array */\nexport type
TensorLike4D = TypedArray|number[]|number[][][][]|boolean[]|\n
boolean[][][][]|string[]|string[][][][]|Uint8Array[]|Uint8Array[][][][];\n/** @docalias TypedArray|Array */\nexport
 type TensorLike5D =\n    TypedArray|number[]|number[][][][][]|boolean[]|boolean[][][][][]|string[]|\n
string[][][][][]|Uint8Array[]|Uint8Array[][][][][];\n/** @docalias TypedArray|Array */\nexport type TensorLike6D
=\n    TypedArray|number[]|number[][][][][][]|boolean[]|boolean[][][][][][]|\n
string[]|string[][][][][][]|Uint8Array[]|Uint8Array[][][][][];\n\n/** Type for representing image data in Uint8Array
type. */\nexport interface PixelData {\n  width: number;\n  height: number;\n  data: Uint8Array;\n}\n","/**\n *
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2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a
copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable
law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n *
WITHOUT WARRANTIES OR
 CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing
permissions and\n * limitations under the License.\n *
==========================================================================\n
*/\n\nimport {Tensor} from './tensor';\nimport {TensorContainer, TensorContainerArray} from
'./tensor_types';\nimport {upcastType} from './types';\nimport {assert} from './util';\n\nexport function
makeTypesMatch<T extends Tensor>(a: T, b: T): [T, T] {\n  if (a.dtype === b.dtype) {\n    return [a, b];\n  }\n
const dtype = upcastType(a.dtype, b.dtype);\n  return [a.cast(dtype), b.cast(dtype)];\n}\n\nexport function
assertTypesMatch(a: Tensor, b: Tensor): void {\n  assert(\n      a.dtype === b.dtype,\n      () => `The dtypes of the
first(${a.dtype}) and` +\n          ` second(${b.dtype}) input must match`);\n}\n\nexport function
isTensorInList(tensor: Tensor, tensorList: Tensor[]): boolean {\n  return tensorList.some(x => x.id ===
tensor.id);\n}\n\n/**\n
 * Extracts any `Tensor`s found within the provided object.\n *\n * @param container an object that may be a
`Tensor` or may directly contain\n *   `Tensor`s, such as a `Tensor[]` or `{key: Tensor, ...}`. In general it\n *   is safe
to pass any object here, except that `Promise`s are not\n *   supported.\n * @returns An array of `Tensors` found
within the passed object. If the\n *   argument is simply a `Tensor', a list containing that `Tensor` is\n *   returned. If
the object is not a `Tensor` or does not\n *   contain `Tensors`, an empty list is returned.\n */\nexport function
getTensorsInContainer(result: TensorContainer): Tensor[] {\n  const list: Tensor[] = [];\n  const seen = new
Set<{}|void>();\n  walkTensorContainer(result, list, seen);\n  return list;\n}\n\nfunction walkTensorContainer(\n
container: TensorContainer, list: Tensor[], seen: Set<{}|void>): void {\n  if (container == null) {\n    return;\n  }\n  if
(container instanceof Tensor) {\n    list.push(container);\n
    return;\n  }\n  if (!isIterable(container)) {\n    return;\n  }\n  // Iteration over keys works also for arrays.\n  const
iterable = container as TensorContainerArray;\n  for (const k in iterable) {\n    const val = iterable[k];\n    if
(!seen.has(val)) {\n      seen.add(val);\n      walkTensorContainer(val, list, seen);\n    }\n  }\n}\n\n// tslint:disable-
next-line:no-any\nfunction isIterable(obj: any): boolean {\n  return Array.isArray(obj) || typeof obj ===
'object';\n}\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the
Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the
```

License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ===\n */\n\nimport {BackendTimingInfo, DataMover, KernelBackend} from './backends/backend';\nimport {Environment, setEnvironmentGlobal} from './environment';\nimport {getGlobalNamespace} from './global_util';\nimport {Add, Cast, Identity} from './kernel_names';\nimport {getGradient, getKernel, getKernelsForBackend, GradFunc, NamedAttrMap, TensorInfo} from './kernel_registry';\nimport {KernelProfile, Profiler} from './profiler';\nimport {backpropagateGradients, getFilteredNodesXToY, TapeNode} from './tape';\nimport {DataId, setTensorTracker, Tensor, TensorTracker, Variable} from './tensor';\nimport {GradSaveFunc, NamedTensorMap, NamedVariableMap, TensorContainer} from './tensor_types';\nimport {getTensorsInContainer} from './tensor_util';\nimport {BackendValues, DataType, DataValues} from './types';\nimport * as util from './util';\nimport {bytesFromStringArray, makeOnesTypedArray, now, sizeFromShape} from './util';\n\n/**\n * A function that computes an output. The save function is for saving tensors\n * computed in the forward pass, that we need in the backward pass.\n */\nexport type ForwardFunc<T> = (backend: KernelBackend, save?: GradSaveFunc) => T;\n\n/**\n * @docalias (a: Tensor, b: Tensor,..., save?: Function) => {\n *   value: Tensor,\n *   gradFunc: (dy: Tensor, saved?: NamedTensorMap) => Tensor | Tensor[]\n * }\n */\nexport type CustomGradientFunc<T extends Tensor> =\n   (...inputs: Array<Tensor|GradSaveFunc>) => {\n   value: T;\n   gradFunc: (dy: T, saved: Tensor[]) => Tensor | Tensor[];\n   };\n\nexport type MemoryInfo = {\n numTensors: number; numDataBuffers: number; numBytes: number;\n unreliable?: boolean; reasons: string[];\n};\n\ntype KernelInfo = {\n name: string; bytesAdded: number; totalBytesSnapshot: number;\n tensorsAdded: number;\n totalTensorsSnapshot: number;\n inputShapes: number[][];\n outputShapes: number[][];\n kernelTimeMs: number | {error: string} | Promise<number|{error: string}>;\n extraInfo: string | Promise<string>;\n};\n\nexport type ProfileInfo = {\n newBytes: number; newTensors: number; peakBytes: number;\n kernels: KernelInfo[];\n result: TensorContainer;\n kernelNames: string[];\n};\n\nexport interface TimingInfo extends BackendTimingInfo {\n wallMs: number;\n}\n\n/** @docalias Function */\nexport type ScopeFn<T extends TensorContainer> = () => T;\n\ninterface ScopeState {\n track: Tensor[];\n name: string;\n id: number;\n}\n\ninterface RegisteredKernelInvocation<I extends NamedTensorMap> {\n kernelName: string;\n inputs: I;\n attrs?: NamedAttrMap;\n}\n\ninterface CustomGradKernelInvocation<T extends Tensor|Tensor[],\n   I extends NamedTensorMap> {\n forwardFunc: ForwardFunc<T>;\n backwardsFunc: (dy: T, saved: Tensor[]) => {\n   [P in keyof I]: () => I[P]\n };\n inputs: I;\n attrs?: NamedAttrMap;\n}\n\nfunction isRegisteredKernelInvocation<T extends Tensor|Tensor[],\n   I extends NamedTensorMap>(\n   kernelInvocation: RegisteredKernelInvocation<I>|\n   CustomGradKernelInvocation<T, I>):\n   kernelInvocation is RegisteredKernelInvocation<I> {\n return (kernelInvocation as RegisteredKernelInvocation<I>).kernelName !=\n   null;\n}\n\nclass EngineState {\n // Public since optimizers will use it.\n registeredVariables: NamedVariableMap = {};\n\n nextTapeNodeId = 0;\n numBytes = 0;\n numTensors = 0;\n numStringTensors = 0;\n numDataBuffers = 0;\n\n activeTape: TapeNode[];\n // Number of nested tf.grad() statements when computing higher-order\n // gradients. E.g. `1` for first-order gradients and `2` for second-order\n // gradients. Used to track if the tape should be removed after a backprop.\n gradientDepth = 0;\n // Number of nested kernel calls. When kernel depth is greater than 1, we turn\n // off the tape.\n kernelDepth = 0;\n\n // Keep Tensors that parallel the tapes.\n activeScope: ScopeState;\n scopeStack: ScopeState[] = [];\n /**\n   * Keeps track of the number of data moves during a kernel execution. We\n   * maintain a stack since kernels can call other kernels, recursively.\n   */\n numDataMovesStack: number[] = [];\n nextScopeId = 0;\n\n tensorInfo = new WeakMap<DataId, {\n   backend: KernelBackend,\n   bytes: number,\n   dtype: DataType,\n   shape: number[]\n }>();\n\n profiling = false;\n

```
activeProfile: ProfileInfo = {\n    newBytes: 0,\n    newTensors: 0,\n    peakBytes: 0,\n    kernels: [],\n    result: null,\n    get kernelNames():\n        string[] {\n        return Array.from(new Set(this.kernels.map(k => k.name)));\n    }\n  };\n\n  dispose() {\n    for (const variableName in this.registeredVariables) {\n this.registeredVariables[variableName].dispose();\n    }\n  }\n}\n\nexport class Engine implements  TensorTracker, DataMover {\n  state: EngineState;\n  backendName: string;\n  registry: {[id: string]: KernelBackend} = {};\n  registryFactory: {\n    [id: string]: {\n      factory: () => KernelBackend | Promise<KernelBackend>,\n      priority: number\n    }\n  } = {};\n\n  private profiler: Profiler;\n  private backendInstance: KernelBackend;\n  private pendingBackendInit: Promise<boolean>;\n  private pendingBackendInitId = 0;\n\n  constructor(public ENV: Environment) {\n    this.state = new EngineState();\n  }\n\n async ready(): Promise<void> {\n    if (this.pendingBackendInit != null) {\n      return this.pendingBackendInit.then(() => {});\n    }\n    if (this.backendInstance != null) {\n      return;\n    }\n    const sortedBackends = this.getSortedBackends();\n\n    for (let i = 0; i < sortedBackends.length; i++) {\n      const backendName = sortedBackends[i];\n      const success = await this.initializeBackend(backendName).success;\n      if (success) {\n        await this.setBackend(backendName);\n        return;\n      }\n    }\n\n    throw new Error(\n        `Could not initialize any backends, all backend initializations ` +\n        `failed.`);\n  }\n\n  get backend(): KernelBackend {\n    if (this.pendingBackendInit != null) {\n      throw new Error(\n          `Backend '${this.backendName}' has not yet been initialized. Make ` +\n          `sure to await tf.ready() or await tf.setBackend() before calling ` +\n          `other methods`);\n    }\n    if (this.backendInstance == null) {\n      const {name, asyncInit} = this.initializeBackendsAndReturnBest();\n      if (asyncInit) {\n        throw new Error(\n            `The highest priority backend '${name}' has not yet been ` +\n            `initialized. Make sure to await tf.ready() or ` +\n            `await tf.setBackend() before calling other methods`);\n      }\n      this.setBackend(name);\n    }\n    return this.backendInstance;\n  }\n\n  backendNames(): string[] {\n    return Object.keys(this.registryFactory);\n  }\n\n  findBackend(backendName: string): KernelBackend {\n    if (!(backendName in this.registry)) {\n      // If the backend hasn't been initialized but we have a registry entry for\n      // it, initialize it and return it.\n      if (backendName in this.registryFactory) {\n        const {asyncInit} = this.initializeBackend(backendName);\n        if (asyncInit) {\n          // Backend is not ready yet.\n          return null;\n        }\n      } else {\n        return null;\n      }\n    }\n    return this.registry[backendName];\n  }\n\n  findBackendFactory(backendName: string):\n      () => KernelBackend | Promise<KernelBackend> {\n    if (!(backendName in this.registryFactory)) {\n      return null;\n    }\n    return this.registryFactory[backendName].factory;\n  }\n\n  registerBackend(\n      backendName: string,\n      factory: () => KernelBackend | Promise<KernelBackend>,\n      priority = 1): boolean {\n    if (backendName in this.registryFactory) {\n      console.warn(\n          `${backendName} backend was already registered. ` +\n          `Reusing existing backend factory.`);\n      return false;\n    }\n    this.registryFactory[backendName] = {factory, priority};\n    return true;\n  }\n\n  async setBackend(backendName: string): Promise<boolean> {\n    if (this.registryFactory[backendName] == null) {\n      throw new Error(`Backend name '${backendName}' not found in registry`);\n    }\n    this.backendName = backendName;\n    if (this.registry[backendName] == null) {\n      this.backendInstance = null;\n      const {success, asyncInit} = this.initializeBackend(backendName);\n      const result = asyncInit ? await success : success;\n      if (!result) {\n        return false;\n      }\n    }\n    this.backendInstance = this.registry[backendName];\n    this.setupRegisteredKernels();\n    // Reset the profiler.\n    this.profiler = new Profiler(this.backendInstance);\n\n    return true;\n  }\n\n  private setupRegisteredKernels():  void {\n    const kernels = getKernelsForBackend(this.backendName);\n    kernels.forEach(kernel => {\n      if (kernel.setupFunc != null) {\n        kernel.setupFunc(this.backendInstance);\n      }\n    });\n  }\n\n  private disposeRegisteredKernels(backendName: string): void {\n    const kernels = getKernelsForBackend(backendName);\n    kernels.forEach(kernel => {\n      if (kernel.disposeFunc != null) {\n        kernel.disposeFunc(this.registry[backendName]);\n      }\n    });\n  }\n\n  /**\n   * Initializes a backend by looking up the backend name in the factory\n   * registry and calling the factory method. Returns a boolean representing\n   * whether the initialization of the backend suceeded. Throws an error if\n   * there is no backend in the factory
```

```
registry.\n   */\n  private initializeBackend(backendName: string):\n      {success: boolean|Promise<boolean>,
asyncInit: boolean} {\n    const registryFactoryEntry = this.registryFactory[backendName];\n    if
(registryFactoryEntry
 == null) {\n      throw new Error(\n          `Cannot initialize backend ${backendName}, no registration found.`);\n
}\n\n    try {\n      const backend = registryFactoryEntry.factory();\n      /* Test if the factory returns a promise.\n
Done in a more liberal way than\n      previous 'Promise.resolve(backend)===backend'\n      as we needed to account
for custom Promise\n      implementations (e.g. Angular) */\n      if (backend && !(backend instanceof
KernelBackend) &&\n          typeof backend.then === 'function') {\n        const promiseId =
++this.pendingBackendInitId;\n        const success =\n            backend\n                .then(backendInstance => {\n
        // Outdated promise. Another backend was set in the meantime.\n                if (promiseId <
this.pendingBackendInitId) {\n                  return false;\n                }\n                this.registry[backendName] =
backendInstance;\n                this.pendingBackendInit = null;\n
            return true;\n                })\n                .catch(err => {\n                  // Outdated promise. Another backend
was set in the meantime.\n                  if (promiseId < this.pendingBackendInitId) {\n                    return false;\n
      }\n                  this.pendingBackendInit = null;\n                  console.warn(\n                      `Initialization of
backend ${backendName} failed`);\n                  console.warn(err.stack || err.message);\n                  return false;\n
        });\n        this.pendingBackendInit = success;\n        return {success, asyncInit: true};\n      } else {\n
this.registry[backendName] = backend as KernelBackend;\n        return {success: true, asyncInit: false};\n      }\n    }
catch (err) {\n      console.warn(`Initialization of backend ${backendName} failed`);\n      console.warn(err.stack ||
err.message);\n      return {success: false, asyncInit: false};\n    }\n  }\n\n  removeBackend(backendName:
 string): void {\n    if (!(backendName in this.registryFactory)) {\n      throw new Error(`${backendName} backend
not found in registry`);\n    }\n    if (this.backendName === backendName && this.pendingBackendInit != null) {\n
  // There is a pending promise of the backend we want to remove. Make it\n      // obsolete.\n
this.pendingBackendInitId++;\n    }\n\n    if (backendName in this.registry) {\n
this.disposeRegisteredKernels(backendName);\n      this.registry[backendName].dispose();\n      delete
this.registry[backendName];\n    }\n\n    delete this.registryFactory[backendName];\n\n    // Unset the backend if it is
active.\n    if (this.backendName === backendName) {\n      this.pendingBackendInit = null;\n      this.backendName
= null;\n      this.backendInstance = null;\n    }\n  }\n\n  private getSortedBackends(): string[] {\n    if
(Object.keys(this.registryFactory).length === 0) {\n      throw new Error('No backend found in registry.');\n    }\n
  return Object.keys(this.registryFactory).sort((a: string, b: string) => {\n      // Highest priority comes first.\n
return this.registryFactory[b].priority -\n          this.registryFactory[a].priority;\n    });\n  }\n\n  private
initializeBackendsAndReturnBest():\n      {name: string, asyncInit: boolean} {\n    const sortedBackends =
this.getSortedBackends();\n\n    for (let i = 0; i < sortedBackends.length; i++) {\n      const backendName =
sortedBackends[i];\n      const {success, asyncInit} = this.initializeBackend(backendName);\n      if (asyncInit ||
success) {\n        return {name: backendName, asyncInit};\n      }\n    }\n    throw new Error(\n        `Could not
initialize any backends, all backend initializations ` +\n        `failed.`);\n  }\n\n  moveData(backend: KernelBackend,
dataId: DataId) {\n    const info = this.state.tensorInfo.get(dataId);\n    const srcBackend = info.backend;\n    const
values = this.readSync(dataId);\n    const refCount = srcBackend.refCount(dataId);\n
  // Delete the tensor from the old backend and move it to the new\n    // backend.\n
srcBackend.disposeData(dataId, true);\n    info.backend = backend;\n    backend.move(dataId, values, info.shape,
info.dtype, refCount);\n    if (this.shouldCheckForMemLeaks()) {\n      // Track the number of moves during a kernel
execution to correctly\n      // detect memory leaks.\n
this.state.numDataMovesStack[this.state.numDataMovesStack.length - 1]++;\n    }\n  }\n\n  tidy<T extends
TensorContainer>(nameOrFn: string|ScopeFn<T>, fn?: ScopeFn<T>):\n      T {\n    let name: string = null;\n    if (fn
== null) {\n      // Called with only 1 argument.\n      if (typeof nameOrFn !== 'function') {\n        throw new
Error('Please provide a function to tidy()');\n      }\n      fn = nameOrFn;\n    } else {\n      // Called with 2
arguments.\n      if (typeof nameOrFn !== 'string' && !(nameOrFn instanceof String)) {\n        throw new Error(\n
    'When calling with two arguments,
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```
 the first argument ' +\n            'to tidy() must be a string');\n      }\n      if (typeof fn !== 'function') {\n        throw new Error(\n            'When calling with two arguments, the 2nd argument ' +\n            'to tidy() must be a function');\n      }\n      name = nameOrFn as string;\n      // TODO(nsthorat,smilkov): Do operation logging and performance\n      // profiling.\n    }\n    let result: T;\n    return this.scopedRun(\n        () => this.startScope(name), () => this.endScope(result), () => {\n          result = fn();\n          if (result instanceof Promise) {\n            console.error('Cannot return a Promise inside of tidy.');\n          }\n          return result;\n        });\n  }\n\n  private scopedRun<T>(start: () => void, end: () => void, f: () => T): T {\n    start();\n    try {\n      const res = f();\n      end();\n      return res;\n    } catch (ex) {\n      end();\n      throw ex;\n    }\n  }\n\n  private static nextTensorId = 0;\n  private nextTensorId():
 number {\n    return Engine.nextTensorId++;\n  }\n\n  private static nextVariableId = 0;\n  private nextVariableId(): number {\n    return Engine.nextVariableId++;\n  }\n\n  /**\n   * This method is called instead of the public-facing tensor.clone() when\n   * saving a tensor for backwards pass. It makes sure to add the clone\n   * operation to the tape regardless of being called inside a kernel\n   * execution.\n   */\n  private clone(x: Tensor): Tensor {\n    const y: Tensor = ENGINE.runKernel(Identity, {x} as {} as NamedTensorMap);\n    const inputs = {x};\n    const grad = (dy: Tensor) => ({\n      x: () => {\n        const dtype = 'float32';\n        const gradInputs = {x: dy};\n        const attrs = {dtype};\n\n        return ENGINE.runKernel(\n                   Cast, gradInputs as {} as NamedTensorMap,\n                   // tslint:disable-next-line: no-unnecessary-type-assertion\n                   attrs as {} as NamedAttrMap) as Tensor;\n      }\n    });\n    const
 saved: Tensor[] = [];\n    this.addTapeNode(this.state.activeScope.name, inputs, [y], grad, saved, {});\n    return y;\n  }\n\n  /**\n   * Execute a kernel with the given name and return the output tensor.\n   *\n   * @param kernelName The name of the kernel to execute.\n   * @param inputs A map of input names to tensors.\n   * @param attrs A map of attribute names to their values. An attribute is a\n   *     primitive (non-tensor) input to the kernel.\n   * @param inputsToSave A list of tensors, inputs to save for the backprop\n   *     computation.\n   * @param outputsToSave A list of booleans, specifying which output to save\n   *     for the backprop computation. These are booleans since the output\n   * tensors are not visible to the user.\n   */\n  runKernel<T extends Tensor|Tensor[]>(\n      kernelName: string, inputs: NamedTensorMap, attrs?: NamedAttrMap): T {\n    const hasKernel = getKernel(kernelName, this.backendName) != null;\n    if (!hasKernel) {\n      throw new Error(`Kernel
 '${kernelName}' not registered for backend '${\n          this.backendName}'`);\n    }\n    return this.runKernelFunc({kernelName, inputs, attrs});\n  }\n\n  private shouldCheckForMemLeaks(): boolean {\n    return this.ENV.getBool('IS_TEST');\n  }\n\n  private checkKernelForMemLeak(\n      kernelName: string, numDataIdsBefore: number,\n      outInfos: TensorInfo[]): void {\n    const numDataIdsAfter = this.backend.numDataIds();\n\n    // Count the number of data ids associated with the result of the kernel.\n    let numOutputDataIds = 0;\n    outInfos.forEach(info => {\n      // Complex numbers allocate 3 data ids, one for 'real', one for\n      // 'imaginary', and one for the container that holds the former two.\n      numOutputDataIds += (info.dtype === 'complex64' ? 3 : 1);\n    });\n\n    // Account for the number of moves during kernel execution. A \"data move\"\n    // can happen in the middle of a kernel execution, placing a new (key,value)\n    // pair in the data storage.
 Since data moves have net zero effect (we\n    // always remove the data from the old backend), we have to cancel them out\n    // when detecting memory leaks.\n    const numMoves =\n        this.state.numDataMovesStack[this.state.numDataMovesStack.length - 1];\n    const dataIdsLeaked =\n        numDataIdsAfter - numDataIdsBefore - numOutputDataIds - numMoves;\n    if (dataIdsLeaked > 0) {\n      throw new Error(\n          `Backend '${this.backendName}' has an internal memory leak ` +\n          `(${dataIdsLeaked} data ids) after running '${kernelName}'`);\n    }\n  }\n\n  /**\n   * Internal helper method to execute a kernel Func\n   *\n   * Use `runKernel` to execute kernels from outside of engine.\n   */\n  private runKernelFunc<T extends Tensor|Tensor[], I extends NamedTensorMap>(\n      kernelParams: RegisteredKernelInvocation<I>|\n      CustomGradKernelInvocation<T, I>): T {\n    let outputs: Tensor[];\n    let saved: Tensor[] = [];\n    const isTapeOn = this.isTapeOn();\n\n
```

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    const startingBytecount = this.state.numBytes;\n    const startingNumTensors = this.state.numTensors;\n\n    if (this.shouldCheckForMemLeaks()) {\n      this.state.numDataMovesStack.push(0);\n    }\n\n    let kernelFunc: () => Tensor[];\n    if (this.backendName == null) {\n      // backend has not been initialized yet (backend initialization is lazy\n      // can be deferred until an op/ kernel is run).\n      // The below getter has side effects that will try to initialize the\n      // backend and set properties like this.backendName\n      // tslint:disable-next-line: no-unused-expression\n      this.backend;\n    }\n\n    let out: TensorInfo|TensorInfo[];\n\n    const kernelOrScopeName = isRegisteredKernelInvocation(kernelParams) ?\n        kernelParams.kernelName :\n        this.state.activeScope != null ? this.state.activeScope.name : '';\n\n    // Create the kernelFunc from either a registered kernel OR passed in\n    // forward/backward functions (used by custom grad). In
 this context a\n    // kernelFunc wraps a kernel implementation with some bookkeeping.\n\n    if (isRegisteredKernelInvocation(kernelParams)) {\n      const {kernelName, inputs, attrs} = kernelParams;\n      if (this.backendName == null) {\n        // backend has not been initialized yet (backend initialization is lazy\n        // can be deferred until an op/ kernel is run).\n        // The below getter has side effects that will try to initialize the\n
 // backend and set properties like this.backendName\n        // tslint:disable-next-line: no-unused-expression\n
this.backend;\n      }\n      const kernel = getKernel(kernelName, this.backendName);\n      util.assert(\n          kernel != null,\n          () => `Cannot find registered kernel '${kernelName}' for backend '${\n
this.backendName}'`);\n\n      kernelFunc = () => {\n        const numDataIdsBefore = this.backend.numDataIds();\n
    out = kernel.kernelFunc({inputs, attrs, backend: this.backend});\n
        const outInfos = Array.isArray(out) ? out : [out];\n        if (this.shouldCheckForMemLeaks()) {\n
this.checkKernelForMemLeak(kernelName, numDataIdsBefore, outInfos);\n        }\n\n        const outTensors =
outInfos.map((outInfo: TensorInfo|Tensor) => {\n          // todo (yassogba) remove this option (Tensor) when node
backend\n          // methods have been modularized and they all return tensorInfo.\n          // TensorInfos do not have
a rank attribute.\n          if ((outInfo as Tensor).rank != null) {\n            return outInfo as Tensor;\n          }\n
const {dataId, shape, dtype} = outInfo as TensorInfo;\n          return this.makeTensorFromDataId(dataId, shape,
dtype);\n        });\n\n        // Save any required inputs and outputs.\n\n        // Do not save unless we are recording to
the tape. Otherwise it would\n        // cause a mem leak since there would be no backprop for these tensors\n        //
(which would otherwise dispose them).\n
    if (isTapeOn) {\n          const tensorsToSave =\n              this.getTensorsForGradient(kernelName, inputs,
outTensors);\n          saved = this.saveTensorsForBackwardMode(tensorsToSave);\n        }\n        return
outTensors;\n      };\n    } else {\n      const {forwardFunc} = kernelParams;\n      // Running a customGrad op.\n
const saveFunc: GradSaveFunc = (tensors) => {\n        // Do not save unless we are recording to the tape. Otherwise
it would\n        // cause a mem leak since we would never run backprop, which disposes\n        // the kept tensors.\n
  if (!isTapeOn) {\n          return;\n        }\n        saved = tensors.map(tensor => this.keep(this.clone(tensor)));\n
};\n\n      kernelFunc = () => {\n        const numDataIdsBefore = this.backend.numDataIds();\n        out = this.tidy(()
=> forwardFunc(this.backend, saveFunc));\n        const outs = (Array.isArray(out) ? out : [out]) as Tensor[];\n        if
(this.shouldCheckForMemLeaks()) {\n
  // Scope name is used to print a more helpful error message if needed.\n
this.checkKernelForMemLeak(kernelOrScopeName, numDataIdsBefore, outs);\n        }\n        return outs;\n      };\n
}\n\n    //\n    // Run the kernelFunc. Optionally profiling it.\n    //\n    const {inputs, attrs} = kernelParams;\n    const
backwardsFunc = isRegisteredKernelInvocation(kernelParams) ?\n        null :\n
kernelParams.backwardsFunc;\n\n    let kernelProfile: KernelProfile;\n    this.scopedRun(\n        // Stop recording to
a tape when running a kernel.\n        () => this.state.kernelDepth++, () => this.state.kernelDepth--, () => {\n          if
(!this.ENV.getBool('DEBUG') && !this.state.profiling) {\n            outputs = kernelFunc();\n          } else {\n
kernelProfile = this.profiler.profileKernel(\n                kernelOrScopeName, inputs, () => kernelFunc());\n            if
(this.ENV.getBool('DEBUG')) {\n              this.profiler.logKernelProfile(kernelProfile);\n
        }\n            outputs = kernelProfile.outputs;\n          }\n        });\n\n    if (isTapeOn) {\n
this.addTapeNode(\n          kernelOrScopeName, inputs, outputs, backwardsFunc, saved, attrs);\n    }\n\n    if
(this.state.profiling) {\n      this.state.activeProfile.kernels.push({\n        name: kernelOrScopeName,\n
```

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bytesAdded: this.state.numBytes - startingBytecount,\n        totalBytesSnapshot: this.state.numBytes,\n
tensorsAdded: this.state.numTensors - startingNumTensors,\n        totalTensorsSnapshot: this.state.numTensors,\n
  inputShapes: Object.keys(inputs).map(\n            key => inputs[key] != null ? inputs[key].shape : null),\n
outputShapes: outputs.map(item => item.shape),\n        kernelTimeMs: kernelProfile.timeMs,\n        extraInfo:
kernelProfile.extraInfo\n      });\n    }\n    return (Array.isArray(out) ? outputs : outputs[0]) as T;\n  }\n\n  /**\n   *
Saves tensors used in forward mode for use in backward mode.\n   *\n
   * @param tensors the list of tensors to save.\n   */\n  private saveTensorsForBackwardMode(tensors: Tensor[]):
Tensor[] {\n    const saved = tensors.map(tensor => this.keep(this.clone(tensor)));\n    return saved;\n  }\n\n  /**\n   *
Returns a list of tensors to save for a given gradient calculation.\n   *\n   * @param kernelName name of kernel to
look up gradient for.\n   * @param inputs a map of input tensors.\n   * @param outputs an array of output tensors
from forward mode of kernel.\n   */\n  private getTensorsForGradient(\n      kernelName: string, inputs:
NamedTensorMap,\n      outputs: Tensor[]): Tensor[]|null {\n    const gradConfig = getGradient(kernelName);\n    if
(gradConfig != null) {\n      const inputsToSave: string[] = gradConfig.inputsToSave || [];\n      const outputsToSave:
boolean[] = gradConfig.outputsToSave || [];\n\n      // If saveAllInputs is true, all inputs will be saved. Otherwise,
inputs\n      // specified in inputsToSave will be saved.\n      let inputTensorsToSave:
 Tensor[];\n      if (gradConfig.saveAllInputs) {\n        util.assert(\n            Array.isArray(inputs),\n            () =>
'saveAllInputs is true, expected inputs to be an array.');\n\n        inputTensorsToSave =
Object.keys(inputs).map((key) => inputs[key]);\n      } else {\n        inputTensorsToSave =
inputsToSave.map((inputName) => inputs[inputName]);\n      }\n\n      const outputTensorsToSave: Tensor[] =\n
  outputs.filter((_, i) => outputsToSave[i]);\n\n      return inputTensorsToSave.concat(outputTensorsToSave);\n    }\n
  // We return an empty list rather than throw an error because the kernel we\n    // are looking up may not actually be
relevant to backproping through the\n    // overall function\n    //\n    // See 'does not error if irrelevant (pruned) ops
are missing grads' test\n    // in gradients_test.ts for an example.\n    return [];\n  }\n\n  /**\n   * Internal method used
by public APIs for tensor creation. Makes a new\n   * tensor with
 the provided shape, dtype and values. It always\n   * creates a new data id and writes the values to the underlying
backend.\n   */\n  makeTensor(\n      values: DataValues, shape: number[], dtype: DataType,\n      backend?:
KernelBackend): Tensor {\n    if (values == null) {\n      throw new Error('Values passed to engine.makeTensor() are
null');\n    }\n    dtype = dtype || 'float32';\n    backend = backend || this.backend;\n    let backendVals = values as
BackendValues;\n    if (dtype === 'string' && util.isString(values[0])) {\n      backendVals = (values as
string[]).map(d => util.encodeString(d));\n    }\n    const dataId = backend.write(backendVals, shape, dtype);\n
const t = new Tensor(shape, dtype, dataId, this.nextTensorId());\n    this.trackTensor(t, backend);\n\n    // Count
bytes for string tensors.\n    if (dtype === 'string') {\n      const info = this.state.tensorInfo.get(dataId);\n      const
newBytes = bytesFromStringArray(backendVals as Uint8Array[]);\n      this.state.numBytes
 += newBytes - info.bytes;\n      info.bytes = newBytes;\n    }\n    return t;\n  }\n\n  /**\n   * Internal method used by
backends. Makes a new tensor\n   * that is a wrapper around an existing data id. It doesn't create\n   * a new data id,
only increments the ref count used in memory tracking.\n   */\n  makeTensorFromDataId(\n      dataId: DataId,
shape: number[], dtype: DataType,\n      backend?: KernelBackend): Tensor {\n    dtype = dtype || 'float32';\n    const
t = new Tensor(shape, dtype, dataId, this.nextTensorId());\n    this.trackTensor(t, backend);\n    return t;\n  }\n\n
makeVariable(\n      initialValue: Tensor, trainable = true, name?: string,\n      dtype?: DataType): Variable {\n
name = name || this.nextVariableId().toString();\n    if (dtype != null && dtype !== initialValue.dtype) {\n
initialValue = initialValue.cast(dtype);\n    }\n    const v = new Variable(initialValue, trainable, name,
this.nextTensorId());\n    if (this.state.registeredVariables[v.name]
 != null) {\n      throw new Error(`Variable with name ${v.name} was already registered`);\n    }\n
this.state.registeredVariables[v.name] = v;\n    this.incRef(v, this.backend);\n    return v;\n  }\n\n  trackTensor(a:
Tensor, backend: KernelBackend): void {\n    this.state.numTensors++;\n    if (a.dtype === 'string') {\n
this.state.numStringTensors++;\n    }\n    // Bytes for complex numbers are counted by their components. Bytes for\n
  // string tensors are counted when writing values.\n    let bytes = 0;\n    if (a.dtype !== 'complex64' && a.dtype !==
'string') {\n      bytes = a.size * util.bytesPerElement(a.dtype);\n    }\n    this.state.numBytes += bytes;\n\n    if
```

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(!this.state.tensorInfo.has(a.dataId)) {\n      this.state.numDataBuffers++;\n      this.state.tensorInfo.set(a.dataId, {\n
  backend: backend || this.backend,\n        dtype: a.dtype,\n        shape: a.shape,\n        bytes\n      });\n    }\n\n    if
(!(a instanceof Variable)) {\n      this.track(a);\n
    }\n  }\n\n  // Track the tensor by dataId and increase the refCount for the dataId in the\n  // backend.\n  //
TODO(pyu10055): This is currently used by makeVariable method, to increase\n  // refCount on the backend for the
dataId. It can potentially be replaced with\n  // Identity op indead of calling backend directly.\n  incRef(a: Tensor,
backend: KernelBackend): void {\n    this.trackTensor(a, backend);\n    this.backend.incRef(a.dataId);\n  }\n\n
removeDataId(dataId: DataId, backend: KernelBackend) {\n    if (this.state.tensorInfo.has(dataId) &&\n
this.state.tensorInfo.get(dataId).backend === backend) {\n      this.state.tensorInfo.delete(dataId);\n
this.state.numDataBuffers--;\n    }\n  }\n  disposeTensor(a: Tensor): void {\n    if
(!this.state.tensorInfo.has(a.dataId)) {\n      return;\n    }\n    const info = this.state.tensorInfo.get(a.dataId);\n\n
this.state.numTensors--;\n    if (a.dtype === 'string') {\n      this.state.numStringTensors--;\n
      this.state.numBytes -= info.bytes;\n    }\n    // Don't count bytes for complex numbers as they are counted by
their\n    // components.\n    if (a.dtype !== 'complex64' && a.dtype !== 'string') {\n      const bytes = a.size *
util.bytesPerElement(a.dtype);\n      this.state.numBytes -= bytes;\n    }\n\n    // Remove the reference to dataId if
backend dispose the data successfully\n    if (info.backend.disposeData(a.dataId)) {\n
this.removeDataId(a.dataId, info.backend);\n    }\n\n    // TODO(nsthorat): Construct an error and save the stack
trace for\n    // debugging when in debug mode. Creating a stack trace is too expensive\n    // to do unconditionally.\n
}\n\n  disposeVariables(): void {\n    for (const varName in this.state.registeredVariables) {\n      const v =
this.state.registeredVariables[varName];\n      this.disposeVariable(v);\n    }\n  }\n\n  disposeVariable(v: Variable):
void {\n    this.disposeTensor(v);\n    if (this.state.registeredVariables[v.name] != null)
  {\n      delete this.state.registeredVariables[v.name];\n    }\n  }\n\n  memory(): MemoryInfo {\n    const info =
this.backend.memory() as MemoryInfo;\n    info.numTensors = this.state.numTensors;\n    info.numDataBuffers =
this.state.numDataBuffers;\n    info.numBytes = this.state.numBytes;\n    if (this.state.numStringTensors > 0) {\n
info.unreliable = true;\n      if (info.reasons == null) {\n        info.reasons = [];\n      }\n      info.reasons.push(\n
'Memory usage by string tensors is approximate ' +\n          '(2 bytes per character)');\n    }\n    return info;\n  }\n\n
async profile(query: () => (TensorContainer | Promise<TensorContainer>)):\n      Promise<ProfileInfo> {\n
this.state.profiling = true;\n\n    const startBytes = this.state.numBytes;\n    const startNumTensors =
this.state.numTensors;\n\n    this.state.activeProfile.kernels = [];\n    this.state.activeProfile.result = await
query();\n\n    this.state.profiling = false;\n\n    this.state.activeProfile.peakBytes
  = Math.max(\n        ...this.state.activeProfile.kernels.map(d => d.totalBytesSnapshot));\n
this.state.activeProfile.newBytes = this.state.numBytes - startBytes;\n    this.state.activeProfile.newTensors =\n
this.state.numTensors - startNumTensors;\n    for (const kernel of this.state.activeProfile.kernels) {\n
kernel.kernelTimeMs = await kernel.kernelTimeMs;\n      kernel.extraInfo = await kernel.extraInfo;\n    }\n    return
this.state.activeProfile;\n  }\n\n  isTapeOn(): boolean {\n    return this.state.gradientDepth > 0 &&
this.state.kernelDepth === 0;\n  }\n\n  private addTapeNode(\n      kernelName: string, inputs: NamedTensorMap,
outputs: Tensor[],\n      gradientsFunc: GradFunc, saved: Tensor[], attrs: NamedAttrMap): void {\n    const
tapeNode: TapeNode =\n        {id: this.state.nextTapeNodeId++, kernelName, inputs, outputs, saved};\n\n    const
gradConfig = getGradient(kernelName);\n    if (gradConfig != null) {\n      gradientsFunc = gradConfig.gradFunc;\n
    }\n    if (gradientsFunc != null) {\n      tapeNode.gradient = (dys: Tensor[]) => {\n        // TODO(smilkov): To
optimize back-prop, pass dys that are not used in\n        // the backprop graph to the user as null instead of zeros\n
dys = dys.map((dy, i) => {\n          if (dy == null) {\n            const output = outputs[i];\n            const vals =
util.makeZerosTypedArray(output.size, output.dtype);\n            return this.makeTensor(vals, output.shape,
output.dtype);\n          }\n          return dy;\n        });\n        // Grad functions of ops with single outputs expect a dy,
while ops\n        // with multiple outputs expect dys (array of dy).\n        return gradientsFunc(dys.length > 1 ? dys :
dys[0], saved, attrs);\n      };\n    }\n    this.state.activeTape.push(tapeNode);\n  }\n\n  keep<T extends
Tensor>(result: T): T {\n    result.kept = true;\n    return result;\n  }\n\n  private startTape() {\n    if
(this.state.gradientDepth === 0) {\n
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this.state.activeTape = [];\n  }\n  this.state.gradientDepth++;\n  }\n\n  private endTape() {\n
this.state.gradientDepth--;\n  }\n\n  /**\n  * Start a scope. Use this with endScope() to achieve the same
functionality\n  * as scope() without the need for a function closure.\n  */\n  startScope(name?: string) {\n  const
scopeInfo: ScopeState = {\n  track: [],\n  name: 'unnamed scope',\n  id: this.state.nextScopeId++\n  };\n  if
(name) {\n  scopeInfo.name = name;\n  }\n  this.state.scopeStack.push(scopeInfo);\n  this.state.activeScope =
scopeInfo;\n  }\n\n  /**\n  * End a scope. Use this with startScope() to achieve the same functionality\n  * as
scope() without the need for a function closure.\n  */\n  endScope(result?: TensorContainer) {\n  const
tensorsToTrackInParent = getTensorsInContainer(result);\n  const tensorsToTrackInParentSet =\n  new
Set(tensorsToTrackInParent.map(t => t.id));\n\n  // Dispose the arrays tracked in this
 scope.\n  for (let i = 0; i < this.state.activeScope.track.length; i++) {\n  const tensor =
this.state.activeScope.track[i];\n  if (!tensor.kept && !tensorsToTrackInParentSet.has(tensor.id)) {\n
tensor.dispose();\n  }\n  }\n\n  const oldScope = this.state.scopeStack.pop();\n  this.state.activeScope =
this.state.scopeStack.length === 0 ?\n  null :\n  this.state.scopeStack[this.state.scopeStack.length - 1];\n\n  //
Track the current result in the parent scope.\n  tensorsToTrackInParent.forEach(tensor => {\n  // Only track the
tensor if was allocated in the inner scope and is not\n  // globally kept.\n  if (!tensor.kept && tensor.scopeId
=== oldScope.id) {\n  this.track(tensor);\n  }\n  });\n  }\n\n  /**\n  * Returns gradients of `f` with respect to
each of the `xs`. The gradients\n  * returned are of the same length as `xs`, but some might be null if `f`\n  * was
not a function of that `x`. It also takes optional dy
 to multiply the\n  * gradient, which defaults to `1`.\n  */\n  gradients<T extends Tensor>(\n  f: () => T, xs:
Tensor[], dy?: T,\n  allowNoGradients = false): {value: T, grads: Tensor[]} {\n  util.assert(\n  xs.length > 0,
() => 'gradients() received an empty list of xs.');\n  if (dy != null && dy.dtype !== 'float32') {\n  throw new
Error(`dy must have 'float32' dtype, but has '${dy.dtype}'`);\n  }\n\n  const y = this.scopedRun(\n  () =>
this.startTape(), () => this.endTape(),\n  () => this.tidy('forward', f));\n\n  util.assert(\n  y instanceof
Tensor,\n  () => 'The result y returned by f() must be a tensor.');\n  // Filter out the nodes that don't connect x =>
y.\n  const filteredTape = getFilteredNodesXToY(this.state.activeTape, xs, y);\n  if (!allowNoGradients &&
filteredTape.length === 0 && xs.length > 0) {\n  throw new Error(\n  'Cannot compute gradient of y=f(x)
with respect to x. Make sure ' +\n  'that
 the f you passed encloses all operations that lead from x ' +\n  'to y.');\n  }\n\n  return this.tidy('backward', ()
=> {\n  const accumulatedGradientMap: {[tensorId: number]: Tensor} = {};\n  accumulatedGradientMap[y.id]
= (dy == null) ? ones(y.shape) : dy;\n\n  // Backprop gradients through the filtered nodes.\n
backpropagateGradients(\n  accumulatedGradientMap, filteredTape,\n  // Pass the tidy function to avoid
circular dep with `tape.ts`.\n  f => this.tidy(f as ScopeFn<Tensor>),\n  // Pass an add function to avoide a
circular dep with `tape.ts`.\n  add);\n  const grads = xs.map(x => accumulatedGradientMap[x.id]);\n\n  if
(this.state.gradientDepth === 0) {\n  // This means that we are not computing higher-order gradients\n  // and
can clean up the tape.\n  this.state.activeTape.forEach(node => {\n  for (const tensor of node.saved) {\n
  tensor.dispose();\n  }\n
  });\n  this.state.activeTape = null;\n  }\n  return {value: y, grads};\n  });\n  }\n\n  customGrad<T
extends Tensor>(f: CustomGradientFunc<T>):\n  (...args: Array<Tensor|GradSaveFunc>) => T {\n  util.assert(\n
  util.isFunction(f),\n  () => 'The f passed in customGrad(f) must be a function.');\n  return (...inputs:
Tensor[]): T => {\n  util.assert(\n  inputs.every(t => t instanceof Tensor),\n  () => 'The args passed in
customGrad(f)(x1, x2,...) must all be ' +\n  'tensors');\n\n  let res: {\n  value: T,\n  gradFunc: (dy: T,
saved: Tensor[]) => Tensor | Tensor[],\n  };\n  const inputMap: NamedTensorMap = {};\n
inputs.forEach((input, i) => {\n  inputMap[i] = input;\n  });\n\n  const forwardFunc: ForwardFunc<T> = (_,
save) => {\n  res = f(...[...inputs, save]);\n  util.assert(\n  res.value instanceof Tensor,\n  () =>
'The function f passed in
 customGrad(f) must return an ' +\n  'object where `obj.value` is a tensor');\n  util.assert(\n
util.isFunction(res.gradFunc),\n  () => 'The function f passed in customGrad(f) must return an ' +\n
'object where `obj.gradFunc` is a function.');\n  return res.value;\n  };\n\n  const backwardsFunc = (dy: T,
```

saved: Tensor[]) => {\n const gradRes = res.gradFunc(dy, saved);\n const grads: Tensor[] = Array.isArray(gradRes) ? gradRes : [gradRes];\n util.assert(\n grads.length === inputs.length,\n () => 'The function f passed in customGrad(f) must return an ' +\n 'object where `obj.gradFunc` is a function that returns ' +\n 'the same number of tensors as inputs passed to f(...).');\n util.assert(\n grads.every(t => t instanceof Tensor),\n () => 'The function f passed in customGrad(f) must return an ' +\n 'object where `obj.gradFunc` is a function that returns ' +\n 'a list of only tensors.');\n const gradMap: {[key: string]: () => Tensor} = {};\n grads.forEach((grad, i) => {\n gradMap[i] = () => grad;\n });\n return gradMap;\n };\n\n return this.runKernelFunc({\n forwardFunc,\n backwardsFunc,\n inputs: inputMap,\n });\n };\n }\n\n readSync(dataId: DataId): BackendValues {\n // Route the read to the correct backend.\n const info = this.state.tensorInfo.get(dataId);\n return info.backend.readSync(dataId);\n }\n read(dataId: DataId): Promise<BackendValues> {\n // Route the read to the correct backend.\n const info = this.state.tensorInfo.get(dataId);\n return info.backend.read(dataId);\n }\n\n async time(query: () => void): Promise<TimingInfo> {\n const start = now();\n const timingInfo = await this.backend.time(query) as TimingInfo;\n timingInfo.wallMs = now() - start;\n return timingInfo;\n }\n\n /**\n * Tracks a Tensor in the current scope to be automatically cleaned up\n * when the current scope ends, and returns the value.\n *\n * @param result The Tensor to track in the current scope.\n */\n private track<T extends Tensor>(result: T): T {\n if (this.state.activeScope != null) {\n result.scopeId = this.state.activeScope.id;\n this.state.activeScope.track.push(result);\n }\n\n return result;\n }\n\n get registeredVariables(): NamedVariableMap {\n return this.state.registeredVariables;\n }\n\n /**\n * Resets the engine state. Removes all backends but does not remove\n * registered backend factories.\n */\n reset(): void {\n // Make any pending promise obsolete.\n this.pendingBackendInitId++;\n\n this.state.dispose();\n this.ENV.reset();\n this.state = new EngineState();\n\n for (const backendName in this.registry) {\n this.disposeRegisteredKernels(backendName);\n this.registry[backendName].dispose();\n delete this.registry[backendName];\n }\n this.backendName = null;\n this.backendInstance = null;\n this.pendingBackendInit = null;\n }\n}\n\nfunction ones(shape: number[]): Tensor {\n const values = makeOnesTypedArray(sizeFromShape(shape), 'float32');\n return ENGINE.makeTensor(values, shape, 'float32');\n}\n\nexport function getOrMakeEngine(): Engine {\n const ns = getGlobalNamespace() as {} as {_tfengine: Engine};\n if (ns._tfengine == null) {\n const environment = new Environment(ns);\n ns._tfengine = new Engine(environment);\n }\n setEnvironmentGlobal(ns._tfengine.ENV);\n\n // Tell the current tensor interface that the global engine is responsible\n // for tracking.\n setTensorTracker(() => ns._tfengine);\n return ns._tfengine;\n}\n\nexport const ENGINE = getOrMakeEngine();\n\n/**\n * A implementation of the add op for use within engine and tape.\n *\n * This allows us to avoid a circular dependency between add.ts and engine.\n * It is exported to be available in tape tests.\n */\nexport function add(a: Tensor, b: Tensor): Tensor {\n // We duplicate Add here to avoid a circular dependency with add.ts.\n const inputs = {a, b};\n return ENGINE.runKernel(Add, inputs as {} as NamedTensorMap);\n}\n","/**\n * @license\n * Copyright 2017 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n * ===\n */\n\n// tslint:disable-next-line:no-any\nfunction _isNavigatorDefined(): boolean {\n return typeof navigator !== 'undefined' && navigator != null;\n}\n\nexport function isMobile(): boolean {\n if (_isNavigatorDefined()) {\n // tslint:disable-next-line:no-any\n const a = navigator.userAgent || navigator.vendor || (window as any).opera;\n // tslint:disable-next-line:max-line-length\n return /(android|bb\\d+|meego).+mobile|avantgo|bada\\/|blackberry|blazer|compal|elaine|fennec|hiptop|iemobile|ip(hone|od)|

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|0|1)|47|mc|nd|ri)|sgh\\-|shar|sie(\\-|m)|sk\\-0|sl(45|id)|sm(al|ar|b3|it|t5)|so(ft|ny)|sp(01|h\\-|v\\-|v
)|sy(01|mb)|t2(18|50)|t6(00|10|18)|ta(gt|lk)|tcl\\-|tdg\\-|tel(i|m)|tim\\-|t\\-mo|to(pl|sh)|ts(70|m\\-|m3|m5)|tx\\-
9|up(\\.b|g1|si)|utst|v400|v750|veri|vi(rg|te)|vk(40|5[0-3]|\\-
v)|vm40|voda|vulc|vx(52|53|60|61|70|80|81|83|85|98)|w3c(\\-|)|webc|whit|wi(g |nc|nw)|wmlb|wonu|x700|yas\\-
|your|zeto|zte\\-/i\n .test(a.substr(0, 4));\n }\n return false;\n}\n\nexport function isBrowser(): boolean {\n
return (typeof window !== 'undefined' && window.document != null) ||\n //@ts-ignore\n (typeof
WorkerGlobalScope !== 'undefined');\n}\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights
Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file
except in compliance with the License.\n * You may obtain a copy of the License at\n *\n *
http://www.apache.org/licenses/LICENSE-2.0\n
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distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either
express or implied.\n * See the License for the specific language governing permissions and\n * limitations under
the License.\n *
==\n
*/\nimport './engine';\n\nimport * as device_util from './device_util';\nimport {env} from './environment';\n\nconst
ENV = env();\n\n/**\n * This file contains environment-related flag registrations.\n */\n\n/** Whether to enable
debug mode. */\nENV.registerFlag('DEBUG', () => false, debugValue => {\n if (debugValue) {\n
console.warn(\n 'Debugging mode is ON. The output of every math call will ' +\n 'be downloaded to CPU
and checked for NaNs. ' +\n 'This significantly impacts performance.');\n }\n});\n\n/** Whether
we are in a browser (as versus, say, node.js) environment. */\nENV.registerFlag('IS_BROWSER', () =>
device_util.isBrowser());\n\n/** Whether we are in a browser (as versus, say, node.js) environment.
*/\nENV.registerFlag(\n 'IS_NODE',\n () => (typeof process !== 'undefined') &&\n (typeof process.versions
!== 'undefined') &&\n (typeof process.versions.node !== 'undefined'));\n\n/** Whether this browser is Chrome.
*/\nENV.registerFlag(\n 'IS_CHROME',\n () => typeof navigator !== 'undefined' && navigator != null &&\n
navigator.userAgent != null && /Chrome/.test(navigator.userAgent) &&\n /Google
Inc/.test(navigator.vendor));\n\n/**\n * True when the environment is \"production\" where we disable safety
checks\n * to gain performance.\n */\nENV.registerFlag('PROD', () => false);\n\n/**\n * Whether to do sanity
checks when inferring a shape from user-provided\n * values, used when creating a new tensor.\n
*/\nENV.registerFlag(\n 'TENSORLIKE_CHECK_SHAPE_CONSISTENCY',

```
() => ENV.getBool('DEBUG'));\n\n/** Whether deprecation warnings are enabled.
*/\nENV.registerFlag('DEPRECATION_WARNINGS_ENABLED', () => true);\n\n/** True if running unit tests.
*/\nENV.registerFlag('IS_TEST', () => false);\n\n/** Whether to check computation result for errors.
*/\nENV.registerFlag('CHECK_COMPUTATION_FOR_ERRORS', () => true);\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n
 * =============================================================================\n
*/\n\nimport {ENGINE} from './engine';\nimport {env} from './environment';\nimport {Tensor} from './tensor';\nimport {DataType, TensorLike} from './types';\nimport {assert, flatten, inferDtype, isTypedArray, toTypedArray} from './util';\n\nexport function inferShape(val: TensorLike, dtype?: DataType): number[] {\n  let firstElem: typeof val = val;\n\n  if (isTypedArray(val)) {\n    return dtype === 'string' ? [] : [val.length];\n  }\n  if (!Array.isArray(val)) {\n    return [];  // Scalar.\n  }\n  const shape: number[] = [];\n\n  while (Array.isArray(firstElem) ||\n         isTypedArray(firstElem) && dtype !== 'string') {\n    shape.push(firstElem.length);\n    firstElem = firstElem[0];\n  }\n  if (Array.isArray(val) &&\n      env().getBool('TENSORLIKE_CHECK_SHAPE_CONSISTENCY')) {\n    deepAssertShapeConsistency(val, shape, []);\n  }\n\n  return shape;\n}\n\nfunction deepAssertShapeConsistency(\n    val: TensorLike, shape: number[], indices: number[]) {\n  indices = indices || [];\n  if (!(Array.isArray(val)) && !isTypedArray(val)) {\n    assert(\n        shape.length === 0,\n        () => `Element arr[${indices.join('][')}] is a primitive, ` +\n            `but should be an array/TypedArray of ${shape[0]} elements`);\n    return;\n  }\n  assert(\n      shape.length > 0,\n      () => `Element arr[${indices.join('][')}] should be a primitive, ` +\n          `but is an array of ${val.length} elements`);\n  assert(\n      val.length === shape[0],\n      () => `Element arr[${indices.join('][')}] should have ${shape[0]} ` +\n          `elements, but has ${val.length} elements`);\n  const subShape = shape.slice(1);\n  for (let i = 0; i < val.length; ++i) {\n    deepAssertShapeConsistency(val[i], subShape, indices.concat(i));\n  }\n}\n\nfunction assertDtype(\n    expectedDtype: DataType|'numeric'|'string_or_numeric',\n actualDType: DataType, argName: string, functionName: string)
 {\n  if (expectedDtype === 'string_or_numeric') {\n    return;\n  }\n  if (expectedDtype == null) {\n    throw new Error(`Expected dtype cannot be null.`);\n  }\n  if (expectedDtype !== 'numeric' && expectedDtype !== actualDType ||\n      expectedDtype === 'numeric' && actualDType === 'string') {\n    throw new Error(\n `Argument '${argName}' passed to '${functionName}' must ` +\n        `be ${expectedDtype} tensor, but got ${actualDType} tensor`);\n  }\n}\n\nexport function convertToTensor<T extends Tensor>(\n    x: T|TensorLike, argName: string, functionName: string,\n    parseAsDtype: DataType|'numeric'|'string_or_numeric' = 'numeric'): T {\n  if (x instanceof Tensor) {\n    assertDtype(parseAsDtype, x.dtype, argName, functionName);\n    return x;\n  }\n  let inferredDtype = inferDtype(x);\n  // If the user expects a bool/int/float, use that info to update the\n  // inferredDtype when it is not a string.\n  if (inferredDtype !== 'string' &&\n      ['bool', 'int32', 'float32'].indexOf(parseAsDtype)
 >= 0) {\n    inferredDtype = parseAsDtype as DataType;\n  }\n  assertDtype(parseAsDtype, inferredDtype, argName, functionName);\n\n  if ((x == null) ||\n      (!isTypedArray(x) && !Array.isArray(x) && typeof x !== 'number' &&\n       typeof x !== 'boolean' && typeof x !== 'string')) {\n    const type = x == null ? 'null' : (x as {}).constructor.name;\n    throw new Error(\n        `Argument '${argName}' passed to '${functionName}' must be a ` +\n        `Tensor or TensorLike, but got '${type}'`);\n  }\n  const inferredShape = inferShape(x, inferredDtype);\n  if (!isTypedArray(x) && !Array.isArray(x)) {\n    x = [x] as number[];\n  }\n  const skipTypedArray = true;\n  const values = inferredDtype !== 'string' ?\n      toTypedArray(x, inferredDtype as DataType) :\n      flatten(x as string[], [], skipTypedArray) as string[];\n  return ENGINE.makeTensor(values, inferredShape, inferredDtype) as T;\n}\n\nexport function convertToTensorArray<T extends Tensor>(\n    arg:
```

Array<T|TensorLike>, argName: string, functionName: string,\n parseAsDtype: DataType|'numeric'|'string_or_numeric' = 'numeric'): T[] {\n if (!Array.isArray(arg)) {\n throw new Error(\n `Argument ${argName} passed to ${functionName} must be a ` +\n '`Tensor[]` or `TensorLike[]`');\n }\n const tensors = arg as T[];\n return tensors.map(\n (t, i) =>\n convertToTensor(t, `${argName}[${i}]`, functionName, parseAsDtype));\n}\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n *\n See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\nimport {ENGINE} from '../engine';\nimport {isPromise} from '../util';\n\nexport const OP_SCOPE_SUFFIX = '__op';\n\n/**\n * Used for wrapping functions that perform math operations on\n * Tensors. The function will be wrapped in a named scope that cleans all\n * memory usage after the function is done.\n */\nexport function op<T extends Function>(f: {[name: string]: T}): T {\n const keys = Object.keys(f);\n if (keys.length !== 1) {\n throw new Error(\n `Please provide an object with a single key ` +\n `(operation name) mapping to a function. Got an object with ` +\n `${keys.length} keys.`);\n }\n\n let opName = keys[0];\n const fn = f[opName];\n\n // Strip the underscore from the end of the function name.\n if (opName.endsWith('_')) {\n opName = opName.substring(0,\n opName.length - 1);\n }\n\n // add an __op suffix to distinguish ops from kernels in tf.profile\n opName = opName + OP_SCOPE_SUFFIX;\n\n // tslint:disable-next-line:no-any\n const f2 = (...args: any[]) => {\n ENGINE.startScope(opName);\n try {\n const result = fn(...args);\n if (isPromise(result)) {\n console.error('Cannot return a Promise inside of tidy.');\n }\n ENGINE.endScope(result);\n return result;\n } catch (ex) {\n ENGINE.endScope(null);\n throw ex;\n }\n };\n Object.defineProperty(f2, 'name', {value: opName, configurable: true});\n\n // tslint:disable-next-line:no-any\n return f2 as any as T;\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\nimport {ENGINE} from '../engine';\nimport {Complex, ComplexInputs} from '../kernel_names';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\nimport * as util from '../util';\n\nimport {op} from './operation';\n\n/**\n * Converts two real numbers to a complex number.\n *\n * Given a tensor `real` representing the real part of a complex number, and a\n * tensor `imag` representing the imaginary part of a complex number, this\n * operation returns complex numbers elementwise
of the form [r0, i0, r1, i1],\n * where r represents the real part and i represents the imag part.\n *\n * The input tensors real and imag must have the same shape.\n *\n * ```js\n * const real = tf.tensor1d([2.25, 3.25]);\n * const imag = tf.tensor1d([4.75, 5.75]);\n * const complex = tf.complex(real, imag);\n *\n * complex.print();\n * ```\n *\n * @doc {heading: 'Tensors', subheading: 'Creation'}\n */\nfunction complex_<T extends Tensor>(real: T|TensorLike, imag: T|TensorLike): T {\n const $real = convertToTensor(real, 'real', 'complex');\n const $imag = convertToTensor(imag, 'imag', 'complex');\n util.assertShapesMatch(\n $real.shape, $imag.shape,\n `real and imag shapes, ${$real.shape} and ${$imag.shape}, ` +\n `must match in call to tf.complex().`);\n\n const inputs: ComplexInputs = {real: $real, imag: $imag};\n return ENGINE.runKernel(Complex, inputs as {} as NamedTensorMap);\n}\n\nexport const complex = op({complex_});\n","/**\n * @license\n * Copyright

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==========\n */\n\nimport {ENGINE} from '../engine';\nimport {Tensor} from '../tensor';\nimport {TensorLike, TypedArray} from '../types';\nimport {DataType} from '../types';\nimport {assert, assertNonNegativeIntegerDimensions, flatten, inferDtype, isTypedArray, sizeFromShape, toTypedArray} from '../util';\n\n/** This is shared code across all tensor creation methods. */\nexport function makeTensor(\n values: TensorLike, shape: number[], inferredShape: number[],\n dtype?: DataType): Tensor {\n if (dtype == null) {\n dtype = inferDtype(values);\n }\n if (dtype === 'complex64') {\n throw new Error(\n `Cannot construct a complex64 tensor directly. ` +\n `Please use tf.complex(real, imag).`);\n }\n if (!isTypedArray(values) && !Array.isArray(values) &&\n typeof values !== 'number' && typeof values !== 'boolean' &&\n typeof values !== 'string') {\n throw new Error(\n 'values passed to tensor(values) must be a number/boolean/string or ' +\n 'an array of numbers/booleans/strings, or a TypedArray');\n }\n if (shape != null) {\n assertNonNegativeIntegerDimensions(shape);\n\n const providedSize = sizeFromShape(shape);\n const inferredSize = sizeFromShape(inferredShape);\n assert(\n providedSize === inferredSize,\n () =>\n `Based on the provided shape, [${shape}], the tensor should have ` +\n `${providedSize} values but has ${inferredSize}`);\n\n for (let i = 0; i < inferredShape.length; ++i) {\n const inferred = inferredShape[i];\n const flatDimsDontMatch = i === inferredShape.length - 1 ?\n inferred !== sizeFromShape(shape.slice(i)) :\n true;\n assert(\n inferredShape[i] === shape[i] || !flatDimsDontMatch,\n () => `Error creating a new Tensor. Inferred shape ` +\n `(${inferredShape}) does not match the provided ` +\n `shape (${shape}). `);\n }\n }\n\n if (!isTypedArray(values) && !Array.isArray(values)) {\n values = [values] as number[];\n }\n\n shape = shape || inferredShape;\n values = dtype !== 'string' ?\n toTypedArray(values, dtype) :\n flatten(values as string[], [], true) as string[];\n return ENGINE.makeTensor(values as TypedArray, shape, dtype);\n}\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {Tensor} from '../tensor';\nimport {inferShape} from '../tensor_util_env';\nimport {TensorLike} from '../types';\nimport {DataType, Rank, ShapeMap} from '../types';\n\nimport {makeTensor} from './tensor_ops_util';\n\n/**\n * Creates a `tf.Tensor` with the provided values, shape and dtype.\n *\n * ```js\n * // Pass an array of values to create a vector.\n * tf.tensor([1, 2, 3, 4]).print();\n * ```\n *\n * ```js\n * // Pass a nested array of values to make a matrix or a higher\n * // dimensional tensor.\n * tf.tensor([[1, 2], [3, 4]]).print();\n * ```\n *\n * ```js\n * // Pass a flat array and specify a shape yourself.\n * tf.tensor([1, 2, 3, 4], [2, 2]).print();\n * ```\n *\n * @param values The values of the tensor. Can be nested array of numbers,\n * or a flat array, or a `TypedArray`. If the values are strings,\n * they will be encoded as utf-8 and kept as `Uint8Array[]`.\n * @param shape The shape of the tensor. Optional. If not provided,\n * it is inferred from `values`.\n * @param dtype The data type.\n *\n * @doc {heading: 'Tensors', subheading: 'Creation'}\n */\nexport function tensor<R extends Rank>(\n values: TensorLike, shape?: ShapeMap[R], dtype?: DataType): Tensor<R> {\n const inferredShape = inferShape(values, dtype);\n return makeTensor(values,

shape, inferredShape, dtype) as Tensor<R>;\n}\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\n/* Type definitions for exporting and importing of models. */\n\n/**\n * A map from Tensor dtype to number of bytes per element of the Tensor.\n */\nexport const DTYPE_VALUE_SIZE_MAP: {[dtype: string]: number} = {\n 'float32':
4,\n 'float16': 2,\n 'int32': 4,\n 'uint16': 2,\n 'uint8': 1,\n 'bool': 1,\n 'complex64': 8\n};\n\n/**\n * A weight manifest.\n *\n * The weight manifest consists of an ordered list of weight-manifest groups.\n * Each weight-manifest group (\"group\" for short hereafter) consists of a\n * number of weight values stored in a number of paths.\n * See the documentation of `WeightManifestGroupConfig` below for more details.\n */\nexport declare type WeightsManifestConfig = WeightsManifestGroupConfig[];\n\n/**\n * A weight-manifest group.\n *\n * Consists of an ordered list of weight values encoded in binary format,\n * stored in an ordered list of paths.\n */\nexport declare interface WeightsManifestGroupConfig {\n /**\n * An ordered list of paths.\n *\n * Paths are intentionally abstract in order to be general. For example, they\n * can be relative URL paths or relative paths on the file system.\n */\n paths: string[];\n\n /**\n * Specifications of the weights
stored in the paths.\n */\n weights: WeightsManifestEntry[];\n}\n\n/**\n * Group to which the weight belongs.\n *\n * - 'optimizer': Weight from a stateful optimizer.\n */\nexport type WeightGroup = 'model'|'optimizer';\n\n/**\n * An entry in the weight manifest.\n *\n * The entry contains specification of a weight.\n */\nexport declare interface WeightsManifestEntry {\n /**\n * Name of the weight, e.g., 'Dense_1/bias'\n */\n name: string;\n\n /**\n * Shape of the weight.\n */\n shape: number[];\n\n /**\n * Data type of the weight.\n */\n dtype: 'float32'|'int32'|'bool'|'string'|'complex64';\n\n /**\n * Type of the weight.\n *\n * Optional.\n *\n * The value 'optimizer' indicates the weight belongs to an optimizer\n * (i.e., used only during model training and not during inference).\n */\n group?: WeightGroup;\n\n /**\n * Information for dequantization of the weight.\n */\n quantization?: {\n scale?: number, // The scaling constant to multiply
by.\n min?: number, // The (possibly nudged) minimum weight to add.\n dtype: 'uint16'|'uint8'|'float16' // The dtype of the quantized weights.\n };\n}\n\n/**\n * Options for saving a model.\n * @innamespace io\n */\nexport interface SaveConfig {\n /**\n * Whether to save only the trainable weights of the model, ignoring the\n * non-trainable ones.\n */\n trainableOnly?: boolean;\n\n /**\n * Whether the optimizer will be saved (if exists).\n *\n * Default: `false`.\n */\n includeOptimizer?: boolean;\n}\n\n/**\n * Result of a saving operation.\n */\nexport interface SaveResult {\n /**\n * Information about the model artifacts saved.\n */\n modelArtifactsInfo: ModelArtifactsInfo;\n\n /**\n * HTTP responses from the server that handled the model-saving request (if\n * any). This is applicable only to server-based saving routes.\n */\n responses?: Response[];\n\n /**\n * Error messages and related data (if any).\n */\n errors?: Array<{}|string>;\n}\n\nexport declare interface ModelArtifactsInfo {\n /**\n * Timestamp for when the model is saved.\n */\n dateSaved: Date;\n\n /**\n * TODO (cais,yassogba) consider removing GraphDef as GraphDefs now\n * come in a JSON format and none of our IOHandlers support a non json\n * format. We could conder replacing this with 'Binary' if we want to\n * allow future handlers to save to non json formats (though they will\n * probably want more information than 'Binary').\n * Type of the model topology\n *\n * Type of the model topology\n *\n * Possible values:\n * - JSON: JSON config (human-readable, e.g., Keras JSON).\n * - GraphDef: TensorFlow\n * [GraphDef](https://www.tensorflow.org/extend/tool_developers/#graphdef)\n * protocol buffer (binary).\n */\n modelTopologyType: 'JSON'|'GraphDef';\n\n /**\n * Size of model topology (Keras JSON or GraphDef), in bytes.\n */\n modelTopologyBytes?: number;\n\n /**\n * Size of weight

specification or manifest, in bytes.\n */\n weightSpecsBytes?: number;\n\n /**\n * Size of weight value data, in bytes.\n */\n weightDataBytes?: number;\n}\n\n/** Model training configuration. */\nexport declare interface TrainingConfig {\n // TODO(cais): Tighten the typing once keras spec is available to tfjs-core.\n // See\n // tslint:disable-next-line:max-line-length\n // https://github.com/tensorflow/tfjs-layers/blob/master/src/keras_format/training_config.ts\n /** Optimizer used for the model training. */\n optimizer_config: {};\n\n // TODO(cais): Tighten the typing once keras spec is available to tfjs-core.\n /** Loss function(s) for the model's output(s). */\n loss: string|string[]|{[key: string]: string};\n\n // TODO(cais): Tighten the typing once keras spec is available to tfjs-core.\n /** Metric function(s) for the model's output(s). */\n metrics?: string[]|{[key: string]: string};\n\n // TODO(cais): Tighten the typing once keras spec is available to tfjs-core.\n weighted_metrics?: string[];\n\n // TODO(cais): Tighten the typing once keras spec is available to tfjs-core.\n sample_weight_mode?: string;\n\n loss_weights?: number[]|{[key: string]: number};\n}\n\n/**\n * The serialized artifacts of a model, including topology and weights.\n *\n * The `modelTopology`, `trainingConfig`, `weightSpecs` and `weightData` fields\n * of this interface are optional, in order to support topology- or weights-only\n * saving and loading.\n *\n * Note this interface is used internally in IOHandlers. For the file format\n * written to disk as `model.json`, see `ModelJSON`.\n */\nexport declare interface ModelArtifacts {\n /**\n * Model topology.\n *\n * For Keras-style `tf.Model`s, this is a JSON object.\n * For TensorFlow-style models (e.g., `SavedModel`), this is the JSON\n * encoding of the `GraphDef` protocol buffer.\n */\n modelTopology?: {}|ArrayBuffer;\n\n /**\n * Serialized configuration for the model's training.\n */\n trainingConfig?: TrainingConfig;\n\n /**\n * Weight specifications.\n *\n * This corresponds to the weightsData below.\n */\n weightSpecs?: WeightsManifestEntry[];\n\n /**\n * Binary buffer for all weight values concatenated in the order specified\n * by `weightSpecs`.\n */\n weightData?: ArrayBuffer;\n\n /**\n * Hard-coded format name for models saved from TensorFlow.js or converted\n * by TensorFlow.js Converter.\n */\n format?: string;\n\n /**\n * What library is responsible for originally generating this artifact.\n *\n * Used for debugging purposes. E.g., 'TensorFlow.js v1.0.0'.\n */\n generatedBy?: string;\n\n /**\n * What library or tool is responsible for converting the original model\n * to this format, applicable only if the model is output by a converter.\n *\n * Used for debugging purposes. E.g., 'TensorFlow.js Converter v1.0.0'.\n *\n * A value of `null` means the model artifacts are generated without any\n * conversion process (e.g., saved directly from a TensorFlow.js\n * `tf.LayersModel` instance.)\n */\n convertedBy?: string|null;\n\n /**\n * Inputs and outputs signature for saved model.\n */\n signature?: {};\n\n /**\n * User-defined metadata about the model.\n */\n userDefinedMetadata?: {[key: string]: {}};\n\n /**\n * Initializer for the model.\n */\n modelInitializer?: {};\n}\n\n/**\n * The on-disk format of the `model.json` file.\n *\n * TF.js 1.0 always populates the optional fields when writing model.json.\n * Prior versions did not provide those fields.\n */\nexport declare interface ModelJSON {\n /**\n * Model topology.\n *\n * For Keras-style `tf.Model`s, this is a JSON object.\n * For TensorFlow-style models (e.g., `SavedModel`), this is the JSON\n * encoding of the `GraphDef` protocol buffer.\n */\n modelTopology: {};\n\n /** Model training configuration. */\n trainingConfig?: TrainingConfig;\n\n /**\n * Weights manifest.\n *\n * The weights manifest consists of an ordered list of weight-manifest\n * groups. Each weight-manifest group consists of a number of weight values\n * stored in a number of paths. See the documentation of\n * `WeightsManifestConfig` for more details.\n */\n weightsManifest: WeightsManifestConfig;\n\n /**\n * Hard-coded format name for models saved from TensorFlow.js or converted\n * by TensorFlow.js Converter.\n */\n format?: string;\n\n /**\n * What library is responsible for originally generating this artifact.\n *\n * Used for debugging purposes. E.g., 'TensorFlow.js v1.0.0'.\n */\n generatedBy?: string;\n\n /**\n * What library or tool is responsible for converting the original model\n * to this format, applicable only if the model is output by a converter.\n *\n * Used for debugging purposes. E.g., 'TensorFlow.js Converter v1.0.0'.\n *\n * A value of `null` means the model artifacts are generated without any\n * conversion process (e.g., saved directly from a TensorFlow.js\n * `tf.LayersModel` instance.)\n */\n convertedBy?: string|null;\n\n /**\n * Inputs and outputs signature for saved model.\n */\n signature?: {};\n\n /**\n * User-defined metadata about the model.\n */\n userDefinedMetadata?: {[key: string]: {}};\n\n /**\n * Initializer for the model.\n */\n modelInitializer?:

{};\n}\n\n/**\n * Type definition for handlers of loading operations.\n */\nexport type LoadHandler = () => Promise<ModelArtifacts>;\n\n/**\n * Type definition for handlers of saving operations.\n */\nexport type SaveHandler = (modelArtifact: ModelArtifacts) =>\n Promise<SaveResult>;\n\n/**\n * Interface for a model import/export handler.\n *\n * The `save` and `load` handlers are both optional, in order to allow handlers\n * that support only saving or loading.\n */\n// tslint:disable-next-line:interface-name\nexport interface IOHandler {\n save?: SaveHandler;\n load?: LoadHandler;\n}\n\n/**\n * An interface for the manager of a model store.\n *\n * A model store is defined as a storage medium on which multiple models can\n * be stored. Each stored model has a unique `path` as its identifier.\n * A `ModelStoreManager` for the store allows actions including\n *\n * - Listing the models stored in the store.\n * - Deleting a model from the store.\n */\nexport interface ModelStoreManager {\n /**\n * List all models in the model store.\n *\n * @returns A dictionary mapping paths of existing models to their\n * model artifacts info. Model artifacts info include type of the model's\n * topology, byte sizes of the topology, weights, etc.\n */\n listModels(): Promise<{[path: string]: ModelArtifactsInfo}>;\n\n /**\n * Remove a model specified by `path`.\n *\n * @param path\n * @returns ModelArtifactsInfo of the deleted model (if and only if deletion\n * is successful).\n * @throws Error if deletion fails, e.g., if no model exists at `path`.\n */\n removeModel(path: string): Promise<ModelArtifactsInfo>;\n}\n\n/**\n * Callback for the progress of a long-running action such as an HTTP\n * request for a large binary object.\n *\n * `fraction` should be a number in the [0, 1] interval, indicating how\n * much of the action has completed.\n */\nexport type OnProgressCallback = (fraction: number) => void;\n\n/** @innamespace io */\nexport interface LoadOptions {\n /**\n * RequestInit (options) for HTTP requests.\n *\n * For detailed information on the supported fields, see\n * [https://developer.mozilla.org/en-US/docs/Web/API/Request/Request](\n * https://developer.mozilla.org/en-US/docs/Web/API/Request/Request)\n */\n requestInit?: RequestInit;\n\n /**\n * Progress callback.\n */\n onProgress?: OnProgressCallback;\n\n /**\n * A function used to override the `window.fetch` function.\n */\n fetchFunc?: Function;\n\n /**\n * Strict loading model: whether extraneous weights or missing\n * weights should trigger an `Error`.\n *\n *
If `true`, require that the provided weights exactly match those\n * required by the layers. `false` means that both extra weights\n * and missing weights will be silently ignored.\n *\n * Default: `true`.\n */\n strict?: boolean;\n\n /**\n * Path prefix for weight files, by default this is calculated from the\n * path of the model JSON file.\n *\n * For instance, if the path to the model JSON file is\n * `http://localhost/foo/model.json`, then the default path prefix will be\n * `http://localhost/foo/`. If a weight file has the path value\n * `group1-shard1of2` in the weight manifest, then the weight file will be\n * loaded from `http://localhost/foo/group1-shard1of2` by default. However,\n * if you provide a `weightPathPrefix` value of\n * `http://localhost/foo/alt-weights`, then the weight file will be loaded\n * from the path `http://localhost/foo/alt-weights/group1-shard1of2` instead.\n */\n weightPathPrefix?: string;\n\n /**\n * Whether the module or model is to be loaded from TF Hub.\n *\n * Setting this to `true` allows passing a TF-Hub module URL, omitting the\n * standard model file name and the query parameters.\n *\n * Default: `false`.\n */\n fromTFHub?: boolean;\n\n /**\n * An async function to convert weight file name to URL. The weight file\n * names are stored in model.json's weightsManifest.paths field. By default we\n * consider weight files are colocated with the model.json file. For example:\n * model.json URL: https://www.google.com/models/1/model.json\n * group1-shard1of1.bin url:\n * https://www.google.com/models/1/group1-shard1of1.bin\n *\n * With this func you can convert the weight file name to any URL.\n */\n weightUrlConverter?: (weightFileName: string) => Promise<string>;\n}\n\n/**\n * Additional options for Platform.fetch\n */\nexport interface RequestDetails {\n /**\n * Is this request for a binary file (as opposed to a json file)\n */\n isBinary?: boolean;\n}\n","'use strict'\n\nexports.byteLength = byteLength\nexports.toByteArray = toByteArray\nexports.fromByteArray = fromByteArray\n\nvar lookup = []\nvar revLookup = []\nvar Arr = typeof Uint8Array !== 'undefined' ? Uint8Array : Array\n\nvar code = 'ABCDEFGHIJKLMNOPQRSTUVWXYZabcdefghijklmnopqrstuvwxyz0123456789+/'\nfor (var i = 0, len = code.length; i < len; ++i) {\n lookup[i] = code[i]\n revLookup[code.charCodeAt(i)] = i\n}\n\n// Support decoding

URL-safe base64 strings, as Node.js does.\n// See:
https://en.wikipedia.org/wiki/Base64#URL_applications\nrevLookup['-'.charCodeAt(0)] =
62\nrevLookup['_'.charCodeAt(0)] = 63\n\nfunction getLens (b64) {\n var len = b64.length\n\n if (len % 4 > 0) {\n
throw new Error('Invalid string. Length must be a multiple of 4')\n }\n\n // Trim off extra bytes after placeholder
bytes are found\n // See: https://github.com/beatgammit/base64-js/issues/42\n var validLen = b64.indexOf('=')\n if
(validLen === -1) validLen = len\n\n var
placeHoldersLen = validLen === len\n   ? 0\n   : 4 - (validLen % 4)\n\n return [validLen,
placeHoldersLen]\n}\n\n// base64 is 4/3 + up to two characters of the original data\nfunction byteLength (b64) {\n
var lens = getLens(b64)\n var validLen = lens[0]\n var placeHoldersLen = lens[1]\n return ((validLen +
placeHoldersLen) * 3 / 4) - placeHoldersLen\n}\n\nfunction _byteLength (b64, validLen, placeHoldersLen) {\n
return ((validLen + placeHoldersLen) * 3 / 4) - placeHoldersLen\n}\n\nfunction toByteArray (b64) {\n var tmp\n
var lens = getLens(b64)\n var validLen = lens[0]\n var placeHoldersLen = lens[1]\n\n var arr = new
Arr(_byteLength(b64, validLen, placeHoldersLen))\n\n var curByte = 0\n\n // if there are placeholders, only get up
to the last complete 4 chars\n var len = placeHoldersLen > 0\n   ? validLen - 4\n   : validLen\n\n var i\n for (i = 0;
i < len; i += 4) {\n   tmp =\n   (revLookup[b64.charCodeAt(i)] << 18) |\n   (revLookup[b64.charCodeAt(i + 1)]
<< 12) |\n   (revLookup[b64.charCodeAt(i + 2)] << 6) |\n   revLookup[b64.charCodeAt(i + 3)]\n
arr[curByte++] = (tmp >> 16) & 0xFF\n   arr[curByte++] = (tmp >> 8) & 0xFF\n   arr[curByte++] = tmp & 0xFF\n
}\n\n if (placeHoldersLen === 2) {\n   tmp =\n   (revLookup[b64.charCodeAt(i)] << 2) |\n
(revLookup[b64.charCodeAt(i + 1)] >> 4)\n   arr[curByte++] = tmp & 0xFF\n }\n\n if (placeHoldersLen === 1)
{\n   tmp =\n   (revLookup[b64.charCodeAt(i)] << 10) |\n   (revLookup[b64.charCodeAt(i + 1)] << 4) |\n
(revLookup[b64.charCodeAt(i + 2)] >> 2)\n   arr[curByte++] = (tmp >> 8) & 0xFF\n   arr[curByte++] = tmp &
0xFF\n }\n\n return arr\n}\n\nfunction tripletToBase64 (num) {\n return lookup[num >> 18 & 0x3F] +\n
lookup[num >> 12 & 0x3F] +\n   lookup[num >> 6 & 0x3F] +\n   lookup[num & 0x3F]\n}\n\nfunction
encodeChunk (uint8, start, end) {\n var tmp\n var output = []\n for (var i = start; i < end; i += 3) {\n   tmp =\n
((uint8[i] << 16) & 0xFF0000)
+\n   ((uint8[i + 1] << 8) & 0xFF00) +\n   (uint8[i + 2] & 0xFF)\n   output.push(tripletToBase64(tmp))\n }\n
return output.join('')\n}\n\nfunction fromByteArray (uint8) {\n var tmp\n var len = uint8.length\n var extraBytes =
len % 3 // if we have 1 byte left, pad 2 bytes\n var parts = []\n var maxChunkLength = 16383 // must be multiple of
3\n\n // go through the array every three bytes, we'll deal with trailing stuff later\n for (var i = 0, len2 = len -
extraBytes; i < len2; i += maxChunkLength) {\n   parts.push(encodeChunk(\n   uint8, i, (i + maxChunkLength) >
len2 ? len2 : (i + maxChunkLength)\n   ))\n }\n\n // pad the end with zeros, but make sure to not forget the extra
bytes\n if (extraBytes === 1) {\n   tmp = uint8[len - 1]\n   parts.push(\n   lookup[tmp >> 2] +\n   lookup[(tmp
<< 4) & 0x3F] +\n   '==\n   )\n } else if (extraBytes === 2) {\n   tmp = (uint8[len - 2] << 8) + uint8[len - 1]\n
parts.push(\n   lookup[tmp >> 10] +\n
  lookup[(tmp >> 4) & 0x3F] +\n   lookup[(tmp << 2) & 0x3F] +\n   '=\n   )\n }\n\n return
parts.join('')\n}\n","exports.read = function (buffer, offset, isLE, mLen, nBytes) {\n var e, m\n var eLen = (nBytes
* 8) - mLen - 1\n var eMax = (1 << eLen) - 1\n var eBias = eMax >> 1\n var nBits = -7\n var i = isLE ? (nBytes -
1) : 0\n var d = isLE ? -1 : 1\n var s = buffer[offset + i]\n\n i += d\n\n e = s & ((1 << (-nBits)) - 1)\n s >>= (-
nBits)\n nBits += eLen\n for (; nBits > 0; e = (e * 256) + buffer[offset + i], i += d, nBits -= 8) {}\n\n m = e & ((1
<< (-nBits)) - 1)\n e >>= (-nBits)\n nBits += mLen\n for (; nBits > 0; m = (m * 256) + buffer[offset + i], i += d,
nBits -= 8) {}\n\n if (e === 0) {\n   e = 1 - eBias\n } else if (e === eMax) {\n   return m ? NaN : ((s ? -1 : 1) *
Infinity)\n } else {\n   m = m + Math.pow(2, mLen)\n   e = e - eBias\n }\n return (s ? -1 : 1) * m * Math.pow(2, e
- mLen)\n}\n\nexports.write = function (buffer, value, offset, isLE,
  mLen, nBytes) {\n var e, m, c\n var eLen = (nBytes * 8) - mLen - 1\n var eMax = (1 << eLen) - 1\n var eBias =
eMax >> 1\n var rt = (mLen === 23 ? Math.pow(2, -24) - Math.pow(2, -77) : 0)\n var i = isLE ? 0 : (nBytes - 1)\n
var d = isLE ? 1 : -1\n var s = value < 0 || (value === 0 && 1 / value < 0) ? 1 : 0\n\n value = Math.abs(value)\n\n if
(isNaN(value) || value === Infinity) {\n   m = isNaN(value) ? 1 : 0\n   e = eMax\n } else {\n   e =
Math.floor(Math.log(value) / Math.LN2)\n   if (value * (c = Math.pow(2, -e)) < 1) {\n   e--\n   c *= 2\n   }\n   if

(e + eBias >= 1) {\n value += rt / c\n } else {\n value += rt * Math.pow(2, 1 - eBias)\n }\n if (value * c >= 2) {\n e++\n c /= 2\n }\n\n if (e + eBias >= eMax) {\n m = 0\n e = eMax\n } else if (e + eBias >= 1) {\n m = ((value * c) - 1) * Math.pow(2, mLen)\n e = e + eBias\n } else {\n m = value * Math.pow(2, eBias - 1) * Math.pow(2, mLen)\n e = 0\n }\n }\n\n for (; mLen >= 8; buffer[offset + i] = m & 0xff, i += d, m /= 256, mLen -= 8) {}\n\n e = (e << mLen) | m\n eLen += mLen\n for (; eLen > 0; buffer[offset + i] = e & 0xff, i += d, e /= 256, eLen -= 8) {}\n\n buffer[offset + i - d] |= s * 128\n}\n","var toString = {}.toString;\n\nmodule.exports = Array.isArray || function (arr) {\n return toString.call(arr) == '[object Array]';\n};\n","/*!\n * The buffer module from node.js, for the browser.\n *\n * @author Feross Aboukhadijeh <feross@feross.org> <http://feross.org>\n * @license MIT\n */\n/* eslint-disable no-proto */\n\n'use strict'\n\nvar base64 = require('base64-js')\nvar ieee754 = require('ieee754')\nvar isArray = require('isarray')\n\nexports.Buffer = Buffer\nexports.SlowBuffer = SlowBuffer\nexports.INSPECT_MAX_BYTES = 50\n\n/**\n * If `Buffer.TYPED_ARRAY_SUPPORT`:\n * === true Use Uint8Array implementation (fastest)\n * === false Use Object implementation (most compatible, even IE6)\n *\n * Browsers that support typed arrays are IE 10+, Firefox 4+, Chrome 7+, Safari 5.1+,\n * Opera 11.6+, iOS 4.2+.\n *\n * Due to various browser bugs, sometimes the Object implementation will be used even\n * when the browser supports typed arrays.\n *\n * Note:\n *\n * - Firefox 4-29 lacks support for adding new properties to `Uint8Array` instances,\n * See: https://bugzilla.mozilla.org/show_bug.cgi?id=695438.\n *\n * - Chrome 9-10 is missing the `TypedArray.prototype.subarray` function.\n *\n * - IE10 has a broken `TypedArray.prototype.subarray` function which returns arrays of\n * incorrect length in some situations.\n\n * We detect these buggy browsers and set `Buffer.TYPED_ARRAY_SUPPORT` to `false` so they\n * get the Object implementation, which is slower but behaves correctly.\n */\nBuffer.TYPED_ARRAY_SUPPORT = global.TYPED_ARRAY_SUPPORT !== undefined\n ? global.TYPED_ARRAY_SUPPORT\n : typedArraySupport()\n\n/*\n * Export kMaxLength after typed array support is determined.\n */\nexports.kMaxLength = kMaxLength()\n\nfunction typedArraySupport () {\n try {\n var arr = new Uint8Array(1)\n arr.__proto__ = {__proto__: Uint8Array.prototype, foo: function () { return 42 }}\n return arr.foo() === 42 && // typed array instances can be augmented\n typeof arr.subarray === 'function' && // chrome 9-10 lack `subarray`\n arr.subarray(1, 1).byteLength === 0 // ie10 has broken `subarray`\n } catch (e) {\n return false\n }\n}\n\nfunction kMaxLength () {\n return Buffer.TYPED_ARRAY_SUPPORT\n ? 0x7fffffff\n : 0x3fffffff\n}\n\nfunction createBuffer (that, length) {\n if (kMaxLength() < length) {\n throw new RangeError('Invalid typed array length')\n }\n if (Buffer.TYPED_ARRAY_SUPPORT) {\n // Return an augmented `Uint8Array` instance, for best performance\n that = new Uint8Array(length)\n that.__proto__ = Buffer.prototype\n } else {\n // Fallback: Return an object instance of the Buffer class\n if (that === null) {\n that = new Buffer(length)\n }\n that.length = length\n }\n\n return that\n}\n\n/**\n * The Buffer constructor returns instances of `Uint8Array` that have their\n * prototype changed to `Buffer.prototype`. Furthermore, `Buffer` is a subclass of\n * `Uint8Array`, so the returned instances will have all the node `Buffer` methods\n * and the `Uint8Array` methods. Square bracket notation works as expected -- it\n * returns a single octet.\n *\n * The `Uint8Array` prototype remains unmodified.\n */\n\nfunction Buffer (arg, encodingOrOffset, length) {\n if (!Buffer.TYPED_ARRAY_SUPPORT && !(this instanceof Buffer)) {\n return new Buffer(arg, encodingOrOffset, length)\n }\n\n // Common case.\n if (typeof arg === 'number') {\n if (typeof encodingOrOffset === 'string') {\n throw new Error(\n 'If encoding is specified then the first argument must be a string'\n)\n }\n return allocUnsafe(this, arg)\n }\n return from(this, arg, encodingOrOffset, length)\n}\n\nBuffer.poolSize = 8192 // not used by this implementation\n\n// TODO: Legacy, not needed anymore. Remove in next major version.\nBuffer._augment = function (arr) {\n arr.__proto__ = Buffer.prototype\n return arr\n}\n\nfunction from (that, value, encodingOrOffset, length) {\n if (typeof value === 'number') {\n throw new TypeError('\"value\" argument must not be a number')\n }\n\n if (typeof ArrayBuffer !== 'undefined' && value instanceof ArrayBuffer) {\n return fromArrayBuffer(that, value, encodingOrOffset, length)\n }\n\n if (typeof value === 'string') {\n

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return fromString(that, value, encodingOrOffset)\n  }\n\n  return fromObject(that, value)\n}\n\n/**\n * Functionally equivalent to Buffer(arg, encoding) but throws a TypeError\n * if value is a number.\n * Buffer.from(str[, encoding])\n * Buffer.from(array)\n * Buffer.from(buffer)\n * Buffer.from(arrayBuffer[, byteOffset[, length]])\n **/\nBuffer.from = function (value, encodingOrOffset, length) {\n  return
 from(null, value, encodingOrOffset, length)\n}\n\nif (Buffer.TYPED_ARRAY_SUPPORT) {\n Buffer.prototype.__proto__ = Uint8Array.prototype\n  Buffer.__proto__ = Uint8Array\n  if (typeof Symbol !== 'undefined' && Symbol.species &&\n      Buffer[Symbol.species] === Buffer) {\n    // Fix subarray() in ES2016. See: https://github.com/feross/buffer/pull/97\n    Object.defineProperty(Buffer, Symbol.species, {\n      value: null,\n      configurable: true\n    })\n  }\n}\n\nfunction assertSize (size) {\n  if (typeof size !== 'number') {\n    throw new TypeError('\"size\" argument must be a number')\n  } else if (size < 0) {\n    throw new RangeError('\"size\" argument must not be negative')\n  }\n}\n\nfunction alloc (that, size, fill, encoding) {\n  assertSize(size)\n  if (size <= 0) {\n    return createBuffer(that, size)\n  }\n  if (fill !== undefined) {\n    // Only pay attention to encoding if it's a string. This\n    // prevents accidentally sending in a number that would\n    // be interpretted
 as a start offset.\n    return typeof encoding === 'string'\n      ? createBuffer(that, size).fill(fill, encoding)\n      : createBuffer(that, size).fill(fill)\n  }\n  return createBuffer(that, size)\n}\n\n/**\n * Creates a new filled Buffer instance.\n * alloc(size[, fill[, encoding]])\n **/\nBuffer.alloc = function (size, fill, encoding) {\n  return alloc(null, size, fill, encoding)\n}\n\nfunction allocUnsafe (that, size) {\n  assertSize(size)\n  that = createBuffer(that, size < 0 ? 0 : checked(size) | 0)\n  if (!Buffer.TYPED_ARRAY_SUPPORT) {\n    for (var i = 0; i < size; ++i) {\n      that[i] = 0\n    }\n  }\n  return that\n}\n\n/**\n * Equivalent to Buffer(num), by default creates a non-zero-filled Buffer instance.\n * */\nBuffer.allocUnsafe = function (size) {\n  return allocUnsafe(null, size)\n}\n/**\n * Equivalent to SlowBuffer(num), by default creates a non-zero-filled Buffer instance.\n */\nBuffer.allocUnsafeSlow = function (size) {\n  return allocUnsafe(null, size)\n}\n\nfunction
 fromString (that, string, encoding) {\n  if (typeof encoding !== 'string' || encoding === '') {\n    encoding = 'utf8'\n  }\n\n  if (!Buffer.isEncoding(encoding)) {\n    throw new TypeError('\"encoding\" must be a valid string encoding')\n  }\n\n  var length = byteLength(string, encoding) | 0\n  that = createBuffer(that, length)\n\n  var actual = that.write(string, encoding)\n\n  if (actual !== length) {\n    // Writing a hex string, for example, that contains invalid characters will\n    // cause everything after the first invalid character to be ignored. (e.g.\n    // 'abxxcd' will be treated as 'ab')\n    that = that.slice(0, actual)\n  }\n\n  return that\n}\n\nfunction fromArrayLike (that, array) {\n  var length = array.length < 0 ? 0 : checked(array.length) | 0\n  that = createBuffer(that, length)\n  for (var i = 0; i < length; i += 1) {\n    that[i] = array[i] & 255\n  }\n  return that\n}\n\nfunction fromArrayBuffer (that, array, byteOffset, length) {\n  array.byteLength
 // this throws if `array` is not a valid ArrayBuffer\n\n  if (byteOffset < 0 || array.byteLength < byteOffset) {\n    throw new RangeError('\\'offset\\' is out of bounds')\n  }\n\n  if (array.byteLength < byteOffset + (length || 0)) {\n    throw new RangeError('\\'length\\' is out of bounds')\n  }\n\n  if (byteOffset === undefined && length === undefined) {\n    array = new Uint8Array(array)\n  } else if (length === undefined) {\n    array = new Uint8Array(array, byteOffset)\n  } else {\n    array = new Uint8Array(array, byteOffset, length)\n  }\n\n  if (Buffer.TYPED_ARRAY_SUPPORT) {\n    // Return an augmented `Uint8Array` instance, for best performance\n    that = array\n    that.__proto__ = Buffer.prototype\n  } else {\n    // Fallback: Return an object instance of the Buffer class\n    that = fromArrayLike(that, array)\n  }\n  return that\n}\n\nfunction fromObject (that, obj) {\n  if (Buffer.isBuffer(obj)) {\n    var len = checked(obj.length) | 0\n    that = createBuffer(that,
 len)\n\n    if (that.length === 0) {\n      return that\n    }\n\n    obj.copy(that, 0, 0, len)\n    return that\n  }\n\n  if (obj) {\n    if ((typeof ArrayBuffer !== 'undefined' &&\n        obj.buffer instanceof ArrayBuffer) || 'length' in obj) {\n      if (typeof obj.length !== 'number' || isnan(obj.length)) {\n        return createBuffer(that, 0)\n      }\n      return fromArrayLike(that, obj)\n    }\n\n    if (obj.type === 'Buffer' && isArray(obj.data)) {\n      return fromArrayLike(that, obj.data)\n    }\n  }\n\n  throw new TypeError('First argument must be a string, Buffer, ArrayBuffer, Array, or array-like object.')\n}\n\nfunction checked (length) {\n  // Note: cannot use `length < kMaxLength()` here because that fails when\n  // length is NaN (which is otherwise coerced to zero.)\n  if (length >= kMaxLength()) {\n    throw new RangeError('Attempt to allocate Buffer larger than maximum ' +\n
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'size: 0x' + kMaxLength().toString(16) + ' bytes')\n }\n return length | 0\n}\n\nfunction SlowBuffer (length) {\n if (+length != length) { // eslint-disable-line eqeqeq\n length = 0\n }\n return Buffer.alloc(+length)\n}\n\nBuffer.isBuffer = function isBuffer (b) {\n return !!(b != null && b._isBuffer)\n}\n\nBuffer.compare = function compare (a, b) {\n if (!Buffer.isBuffer(a) || !Buffer.isBuffer(b)) {\n throw new TypeError('Arguments must be Buffers')\n }\n\n if (a === b) return 0\n\n var x = a.length\n var y = b.length\n\n for (var i = 0, len = Math.min(x, y); i < len; ++i) {\n if (a[i] !== b[i]) {\n x = a[i]\n y = b[i]\n break\n }\n }\n\n if (x < y) return -1\n if (y < x) return 1\n return 0\n}\n\nBuffer.isEncoding = function isEncoding (encoding) {\n switch (String(encoding).toLowerCase()) {\n case 'hex':\n case 'utf8':\n case 'utf-8':\n case 'ascii':\n case 'latin1':\n case 'binary':\n case 'base64':\n case 'ucs2':\n case 'ucs-2':\n case 'utf16le':\n case 'utf-16le':\n return true\n default:\n return false\n }\n}\n\nBuffer.concat = function concat (list, length) {\n if (!isArray(list)) {\n throw new TypeError('\"list\" argument must be an Array of Buffers')\n }\n\n if (list.length === 0) {\n return Buffer.alloc(0)\n }\n\n var i\n if (length === undefined) {\n length = 0\n for (i = 0; i < list.length; ++i) {\n length += list[i].length\n }\n }\n\n var buffer = Buffer.allocUnsafe(length)\n var pos = 0\n for (i = 0; i < list.length; ++i) {\n var buf = list[i]\n if (!Buffer.isBuffer(buf)) {\n throw new TypeError('\"list\" argument must be an Array of Buffers')\n }\n buf.copy(buffer, pos)\n pos += buf.length\n }\n return buffer\n}\n\nfunction byteLength (string, encoding) {\n if (Buffer.isBuffer(string)) {\n return string.length\n }\n if (typeof ArrayBuffer !== 'undefined' && typeof ArrayBuffer.isView === 'function' &&\n (ArrayBuffer.isView(string) || string instanceof ArrayBuffer))
{\n return string.byteLength\n }\n if (typeof string !== 'string') {\n string = '' + string\n }\n\n var len = string.length\n if (len === 0) return 0\n\n // Use a for loop to avoid recursion\n var loweredCase = false\n for (;;) {\n switch (encoding) {\n case 'ascii':\n case 'latin1':\n case 'binary':\n return len\n case 'utf8':\n case 'utf-8':\n case undefined:\n return utf8ToBytes(string).length\n case 'ucs2':\n case 'ucs-2':\n case 'utf16le':\n case 'utf-16le':\n return len * 2\n case 'hex':\n return len >>> 1\n case 'base64':\n return base64ToBytes(string).length\n default:\n if (loweredCase) return utf8ToBytes(string).length // assume utf8\n encoding = ('' + encoding).toLowerCase()\n loweredCase = true\n }\n}\n\nBuffer.byteLength = byteLength\n\nfunction slowToString (encoding, start, end) {\n var loweredCase = false\n\n // No need
to verify that \"this.length <= MAX_UINT32\" since it's a read-only\n // property of a typed array.\n\n // This behaves neither like String nor Uint8Array in that we set start/end\n // to their upper/lower bounds if the value passed is out of range.\n // undefined is handled specially as per ECMA-262 6th Edition,\n // Section 13.3.3.7 Runtime Semantics: KeyedBindingInitialization.\n if (start === undefined || start < 0) {\n start = 0\n }\n // Return early if start > this.length. Done here to prevent potential uint32\n // coercion fail below.\n if (start > this.length) {\n return ''\n }\n\n if (end === undefined || end > this.length) {\n end = this.length\n }\n\n if (end <= 0) {\n return ''\n }\n\n // Force coersion to uint32. This will also coerce falsey/NaN values to 0.\n end >>>= 0\n start >>>= 0\n\n if (end <= start) {\n return ''\n }\n\n if (!encoding) encoding = 'utf8'\n\n while (true) {\n switch (encoding) {\n case 'hex':\n return
hexSlice(this, start, end)\n\n case 'utf8':\n case 'utf-8':\n return utf8Slice(this, start, end)\n\n case 'ascii':\n return asciiSlice(this, start, end)\n\n case 'latin1':\n case 'binary':\n return latin1Slice(this, start, end)\n\n case 'base64':\n return base64Slice(this, start, end)\n\n case 'ucs2':\n case 'ucs-2':\n case 'utf16le':\n case 'utf-16le':\n return utf16leSlice(this, start, end)\n\n default:\n if (loweredCase) throw new TypeError('Unknown encoding: ' + encoding)\n encoding = (encoding + '').toLowerCase()\n loweredCase = true\n }\n }\n}\n\n// The property is used by `Buffer.isBuffer` and `is-buffer` (in Safari 5-7) to detect\n// Buffer instances.\nBuffer.prototype._isBuffer = true\n\nfunction swap (b, n, m) {\n var i = b[n]\n b[n] = b[m]\n b[m] = i\n}\n\nBuffer.prototype.swap16 = function swap16 () {\n var len = this.length\n if (len % 2 !== 0) {\n
throw new RangeError('Buffer size must be a multiple of 16-bits')\n }\n for (var i = 0; i < len; i += 2) {\n swap(this, i, i + 1)\n }\n return this\n}\n\nBuffer.prototype.swap32 = function swap32 () {\n var len = this.length\n

if (len % 4 !== 0) {\n throw new RangeError('Buffer size must be a multiple of 32-bits')\n }\n for (var i = 0; i < len; i += 4) {\n swap(this, i, i + 3)\n swap(this, i + 1, i + 2)\n }\n return this\n}\n\nBuffer.prototype.swap64 = function swap64 () {\n var len = this.length\n if (len % 8 !== 0) {\n throw new RangeError('Buffer size must be a multiple of 64-bits')\n }\n for (var i = 0; i < len; i += 8) {\n swap(this, i, i + 7)\n swap(this, i + 1, i + 6)\n swap(this, i + 2, i + 5)\n swap(this, i + 3, i + 4)\n }\n return this\n}\n\nBuffer.prototype.toString = function toString () {\n var length = this.length | 0\n if (length === 0) return ''\n if (arguments.length === 0) return utf8Slice(this, 0, length)\n return slowToString.apply(this,
 arguments)\n}\n\nBuffer.prototype.equals = function equals (b) {\n if (!Buffer.isBuffer(b)) throw new TypeError('Argument must be a Buffer')\n if (this === b) return true\n return Buffer.compare(this, b) === 0\n}\n\nBuffer.prototype.inspect = function inspect () {\n var str = ''\n var max = exports.INSPECT_MAX_BYTES\n if (this.length > 0) {\n str = this.toString('hex', 0, max).match(/.{2}/g).join(' ')\n if (this.length > max) str += ' ... '\n }\n return '<Buffer ' + str + '>'\n}\n\nBuffer.prototype.compare = function compare (target, start, end, thisStart, thisEnd) {\n if (!Buffer.isBuffer(target)) {\n throw new TypeError('Argument must be a Buffer')\n }\n\n if (start === undefined) {\n start = 0\n }\n if (end === undefined) {\n end = target ? target.length : 0\n }\n if (thisStart === undefined) {\n thisStart = 0\n }\n if (thisEnd === undefined) {\n thisEnd = this.length\n }\n\n if (start < 0 || end > target.length || thisStart < 0 || thisEnd > this.length) {\n throw new RangeError('out of range index')\n }\n\n if (thisStart >= thisEnd && start >= end) {\n return 0\n }\n if (thisStart >= thisEnd) {\n return -1\n }\n if (start >= end) {\n return 1\n }\n\n start >>>= 0\n end >>>= 0\n thisStart >>>= 0\n thisEnd >>>= 0\n\n if (this === target) return 0\n\n var x = thisEnd - thisStart\n var y = end - start\n var len = Math.min(x, y)\n\n var thisCopy = this.slice(thisStart, thisEnd)\n var targetCopy = target.slice(start, end)\n\n for (var i = 0; i < len; ++i) {\n if (thisCopy[i] !== targetCopy[i]) {\n   x = thisCopy[i]\n   y = targetCopy[i]\n   break\n }\n }\n\n if (x < y) return -1\n if (y < x) return 1\n return 0\n}\n\n// Finds either the first index of `val` in `buffer` at offset >= `byteOffset`,\n// OR the last index of `val` in `buffer` at offset <= `byteOffset`.\n//\n// Arguments:\n// - buffer - a Buffer to search\n// - val - a string, Buffer, or number\n// -
 byteOffset - an index into `buffer`; will be clamped to an int32\n// - encoding - an optional encoding, relevant is val is a string\n// - dir - true for indexOf, false for lastIndexOf\nfunction bidirectionalIndexOf (buffer, val, byteOffset, encoding, dir) {\n // Empty buffer means no match\n if (buffer.length === 0) return -1\n\n // Normalize byteOffset\n if (typeof byteOffset === 'string') {\n encoding = byteOffset\n byteOffset = 0\n } else if (byteOffset > 0x7fffffff) {\n byteOffset = 0x7fffffff\n } else if (byteOffset < -0x80000000) {\n byteOffset = -0x80000000\n }\n byteOffset = +byteOffset // Coerce to Number.\n if (isNaN(byteOffset)) {\n // byteOffset: it it's undefined, null, NaN, \"foo\", etc, search whole buffer\n byteOffset = dir ? 0 : (buffer.length - 1)\n }\n\n // Normalize byteOffset: negative offsets start from the end of the buffer\n if (byteOffset < 0) byteOffset = buffer.length + byteOffset\n if (byteOffset >= buffer.length) {\n if (dir)
 return -1\n else byteOffset = buffer.length - 1\n } else if (byteOffset < 0) {\n if (dir) byteOffset = 0\n else return -1\n }\n\n // Normalize val\n if (typeof val === 'string') {\n val = Buffer.from(val, encoding)\n }\n\n // Finally, search either indexOf (if dir is true) or lastIndexOf\n if (Buffer.isBuffer(val)) {\n // Special case: looking for empty string/buffer always fails\n if (val.length === 0) {\n   return -1\n }\n return arrayIndexOf(buffer, val, byteOffset, encoding, dir)\n } else if (typeof val === 'number') {\n val = val & 0xFF // Search for a byte value [0-255]\n if (Buffer.TYPED_ARRAY_SUPPORT &&\n   typeof Uint8Array.prototype.indexOf === 'function') {\n   if (dir) {\n   return Uint8Array.prototype.indexOf.call(buffer, val, byteOffset)\n   } else {\n   return Uint8Array.prototype.lastIndexOf.call(buffer, val, byteOffset)\n   }\n }\n return arrayIndexOf(buffer, [val], byteOffset, encoding, dir)\n
 }\n\n throw new TypeError('val must be string, number or Buffer')\n}\n\nfunction arrayIndexOf (arr, val, byteOffset, encoding, dir) {\n var indexSize = 1\n var arrLength = arr.length\n var valLength = val.length\n\n if (encoding !== undefined) {\n encoding = String(encoding).toLowerCase()\n if (encoding === 'ucs2' || encoding === 'ucs-2' ||\n   encoding === 'utf16le' || encoding === 'utf-16le') {\n   if (arr.length < 2 || val.length < 2) {\n   return -1\n   }\n   indexSize = 2\n   arrLength /= 2\n   valLength /= 2\n   byteOffset /= 2\n }\n }\n\n

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function read (buf, i) {\n  if (indexSize === 1) {\n    return buf[i]\n  } else {\n    return buf.readUInt16BE(i * indexSize)\n  }\n}\n\nvar i\nif (dir) {\n  var foundIndex = -1\n  for (i = byteOffset; i < arrLength; i++) {\n    if (read(arr, i) === read(val, foundIndex === -1 ? 0 : i - foundIndex)) {\n      if (foundIndex === -1) foundIndex = i\n      if (i - foundIndex + 1 === valLength) return foundIndex * indexSize\n    } else {\n      if (foundIndex !== -1) i -= i - foundIndex\n      foundIndex = -1\n    }\n  }\n} else {\n  if (byteOffset + valLength > arrLength) byteOffset = arrLength - valLength\n  for (i = byteOffset; i >= 0; i--) {\n    var found = true\n    for (var j = 0; j < valLength; j++) {\n      if (read(arr, i + j) !== read(val, j)) {\n        found = false\n        break\n      }\n    }\n    if (found) return i\n  }\n}\n\nreturn -1\n}\n\nBuffer.prototype.includes = function includes (val, byteOffset, encoding) {\n  return this.indexOf(val, byteOffset, encoding) !== -1\n}\n\nBuffer.prototype.indexOf = function indexOf (val, byteOffset, encoding) {\n  return bidirectionalIndexOf(this, val, byteOffset, encoding, true)\n}\n\nBuffer.prototype.lastIndexOf = function lastIndexOf (val, byteOffset, encoding) {\n  return bidirectionalIndexOf(this, val, byteOffset, encoding, false)\n}\n\nfunction hexWrite (buf, string, offset, length) {\n  offset = Number(offset) || 0\n  var remaining = buf.length - offset\n  if (!length) {\n    length = remaining\n  } else {\n    length = Number(length)\n    if (length > remaining) {\n      length = remaining\n    }\n  }\n\n  // must be an even number of digits\n  var strLen = string.length\n  if (strLen % 2 !== 0) throw new TypeError('Invalid hex string')\n\n  if (length > strLen / 2) {\n    length = strLen / 2\n  }\n  for (var i = 0; i < length; ++i) {\n    var parsed = parseInt(string.substr(i * 2, 2), 16)\n    if (isNaN(parsed)) return i\n    buf[offset + i] = parsed\n  }\n  return i\n}\n\nfunction utf8Write (buf, string, offset, length) {\n  return blitBuffer(utf8ToBytes(string, buf.length - offset), buf, offset, length)\n}\n\nfunction asciiWrite (buf, string, offset, length) {\n  return blitBuffer(asciiToBytes(string), buf, offset, length)\n}\n\nfunction latin1Write (buf, string, offset, length) {\n  return asciiWrite(buf, string, offset, length)\n}\n\nfunction base64Write (buf, string, offset, length) {\n  return blitBuffer(base64ToBytes(string), buf, offset, length)\n}\n\nfunction ucs2Write (buf, string, offset, length) {\n  return blitBuffer(utf16leToBytes(string, buf.length - offset), buf, offset, length)\n}\n\nBuffer.prototype.write = function write (string, offset, length, encoding) {\n  // Buffer#write(string)\n  if (offset === undefined) {\n    encoding = 'utf8'\n    length = this.length\n    offset = 0\n  // Buffer#write(string, encoding)\n  } else if (length === undefined && typeof offset === 'string') {\n    encoding = offset\n    length = this.length\n    offset = 0\n  // Buffer#write(string, offset[, length][, encoding])\n  } else if (isFinite(offset)) {\n    offset = offset | 0\n    if (isFinite(length)) {\n      length = length | 0\n      if (encoding === undefined) encoding = 'utf8'\n    } else {\n      encoding = length\n      length = undefined\n    }\n  // legacy write(string, encoding, offset, length) - remove\n  } else {\n    throw new Error(\n      'Buffer.write(string, encoding, offset[, length]) is no longer supported'\n    )\n  }\n\n  var remaining = this.length - offset\n  if (length === undefined || length > remaining) length = remaining\n\n  if ((string.length > 0 && (length < 0 || offset < 0)) || offset > this.length) {\n    throw new RangeError('Attempt to write outside buffer bounds')\n  }\n\n  if (!encoding) encoding = 'utf8'\n\n  var loweredCase = false\n  for (;;) {\n    switch (encoding) {\n      case 'hex':\n        return hexWrite(this, string, offset, length)\n\n      case 'utf8':\n      case 'utf-8':\n        return utf8Write(this, string, offset, length)\n\n      case 'ascii':\n        return asciiWrite(this, string, offset, length)\n\n      case 'latin1':\n      case 'binary':\n        return latin1Write(this, string, offset, length)\n\n      case 'base64':\n        // Warning: maxLength not taken into account in base64Write\n        return base64Write(this, string, offset, length)\n\n      case 'ucs2':\n      case 'ucs-2':\n      case 'utf16le':\n      case 'utf-16le':\n        return ucs2Write(this, string, offset, length)\n\n      default:\n        if (loweredCase) throw new TypeError('Unknown encoding: ' + encoding)\n        encoding = ('' + encoding).toLowerCase()\n        loweredCase = true\n    }\n  }\n}\n\nBuffer.prototype.toJSON = function toJSON () {\n  return {\n    type: 'Buffer',\n    data: Array.prototype.slice.call(this._arr || this, 0)\n  }\n}\n\nfunction base64Slice (buf, start, end) {\n  if (start === 0 && end === buf.length) {\n    return base64.fromByteArray(buf)\n  } else {\n    return base64.fromByteArray(buf.slice(start, end))\n  }\n}\n\nfunction utf8Slice (buf, start, end) {\n  end = Math.min(buf.length, end)\n  var res = []\n\n  var i = start\n  while (i < end) {\n    var firstByte = buf[i]\n    var
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codePoint = null\n var bytesPerSequence = (firstByte > 0xEF) ? 4\n   : (firstByte > 0xDF) ? 3\n   : (firstByte > 0xBF) ? 2\n   : 1\n\n if (i + bytesPerSequence <= end) {\n   var secondByte, thirdByte, fourthByte, tempCodePoint\n\n   switch (bytesPerSequence) {\n   case 1:\n   if (firstByte < 0x80) {\n   codePoint = firstByte\n   }\n   break\n   case 2:\n   secondByte = buf[i + 1]\n   if ((secondByte & 0xC0) === 0x80) {\n   tempCodePoint = (firstByte & 0x1F) << 0x6 | (secondByte & 0x3F)\n   if (tempCodePoint > 0x7F) {\n   codePoint = tempCodePoint\n   }\n   }\n   break\n   case 3:\n   secondByte = buf[i + 1]\n   thirdByte = buf[i + 2]\n   if ((secondByte & 0xC0) === 0x80 && (thirdByte & 0xC0) === 0x80) {\n   tempCodePoint = (firstByte & 0xF) << 0xC | (secondByte & 0x3F) << 0x6 | (thirdByte & 0x3F)\n   if (tempCodePoint > 0x7FF && (tempCodePoint < 0xD800 || tempCodePoint > 0xDFFF)) {\n   codePoint = tempCodePoint\n   }\n   }\n   break\n   case 4:\n   secondByte = buf[i + 1]\n   thirdByte = buf[i + 2]\n   fourthByte = buf[i + 3]\n   if ((secondByte & 0xC0) === 0x80 && (thirdByte & 0xC0) === 0x80 && (fourthByte & 0xC0) === 0x80) {\n   tempCodePoint = (firstByte & 0xF) << 0x12 | (secondByte & 0x3F) << 0xC | (thirdByte & 0x3F) << 0x6 | (fourthByte & 0x3F)\n   if (tempCodePoint > 0xFFFF && tempCodePoint < 0x110000) {\n   codePoint = tempCodePoint\n   }\n   }\n   }\n\n if (codePoint === null) {\n   // we did not generate a valid codePoint so insert a\n   // replacement char (U+FFFD) and advance only 1 byte\n   codePoint = 0xFFFD\n   bytesPerSequence = 1\n } else if (codePoint > 0xFFFF) {\n   // encode to utf16 (surrogate pair dance)\n   codePoint -= 0x10000\n   res.push(codePoint >>> 10 & 0x3FF | 0xD800)\n   codePoint = 0xDC00 | codePoint & 0x3FF\n }\n\n res.push(codePoint)\n i += bytesPerSequence\n}\n\nreturn decodeCodePointsArray(res)\n}\n\n// Based on http://stackoverflow.com/a/22747272/680742, the browser with\n// the lowest limit is Chrome, with 0x10000 args.\n// We go 1 magnitude less, for safety\nvar MAX_ARGUMENTS_LENGTH = 0x1000\n\nfunction decodeCodePointsArray (codePoints) {\n var len = codePoints.length\n if (len <= MAX_ARGUMENTS_LENGTH) {\n   return String.fromCharCode.apply(String, codePoints) // avoid extra slice()\n }\n\n // Decode in chunks to avoid \"call stack size exceeded\".\n var res = ''\n var i = 0\n while (i < len) {\n   res += String.fromCharCode.apply(\n   String,\n   codePoints.slice(i, i += MAX_ARGUMENTS_LENGTH)\n   )\n }\n return res\n}\n\nfunction asciiSlice (buf, start, end) {\n var ret = ''\n end = Math.min(buf.length, end)\n\n for (var i = start; i < end; ++i) {\n   ret += String.fromCharCode(buf[i] & 0x7F)\n }\n return ret\n}\n\nfunction latin1Slice (buf, start, end) {\n var ret = ''\n end = Math.min(buf.length, end)\n\n for (var i = start; i < end; ++i) {\n   ret += String.fromCharCode(buf[i])\n }\n return ret\n}\n\nfunction hexSlice (buf, start, end) {\n var len = buf.length\n\n if (!start || start < 0) start = 0\n if (!end || end < 0 || end > len) end = len\n\n var out = ''\n for (var i = start; i < end; ++i) {\n   out += toHex(buf[i])\n }\n return out\n}\n\nfunction utf16leSlice (buf, start, end) {\n var bytes = buf.slice(start, end)\n var res = ''\n for (var i = 0; i < bytes.length; i += 2) {\n   res += String.fromCharCode(bytes[i] + bytes[i + 1] * 256)\n }\n return res\n}\n\nBuffer.prototype.slice = function slice (start, end) {\n var len = this.length\n start = ~~start\n end = end === undefined ? len : ~~end\n\n if (start < 0) {\n   start += len\n   if (start < 0) start = 0\n } else if (start > len) {\n   start = len\n }\n\n if (end < 0) {\n   end += len\n   if (end < 0) end = 0\n } else if (end > len) {\n   end = len\n }\n\n if (end < start) end = start\n\n var newBuf\n if (Buffer.TYPED_ARRAY_SUPPORT) {\n   newBuf = this.subarray(start, end)\n   newBuf.__proto__ = Buffer.prototype\n } else {\n   var sliceLen = end - start\n   newBuf = new Buffer(sliceLen, undefined)\n   for (var i = 0; i < sliceLen; ++i) {\n   newBuf[i] = this[i + start]\n   }\n }\n\n return newBuf\n}\n\n/*\n * Need to make sure that buffer isn't trying to write out of bounds.\n */\nfunction checkOffset (offset, ext, length) {\n if ((offset % 1) !== 0 || offset < 0) throw new RangeError('offset is not uint')\n if (offset + ext > length) throw new RangeError('Trying to access beyond buffer length')\n}\n\nBuffer.prototype.readUIntLE = function readUIntLE (offset, byteLength, noAssert) {\n offset = offset | 0\n byteLength = byteLength | 0\n if (!noAssert) checkOffset(offset, byteLength, this.length)\n\n var val = this[offset]\n var mul = 1\n var i = 0\n while (++i < byteLength && (mul *= 0x100)) {\n   val += this[offset

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 + i] * mul\n  }\n\n  return val\n}\n\nBuffer.prototype.readUIntBE = function readUIntBE (offset, byteLength,
noAssert) {\n  offset = offset | 0\n  byteLength = byteLength | 0\n  if (!noAssert) {\n    checkOffset(offset,
byteLength, this.length)\n  }\n\n  var val = this[offset + --byteLength]\n  var mul = 1\n  while (byteLength > 0 &&
(mul *= 0x100)) {\n    val += this[offset + --byteLength] * mul\n  }\n\n  return val\n}\n\nBuffer.prototype.readUInt8
= function readUInt8 (offset, noAssert) {\n  if (!noAssert) checkOffset(offset, 1, this.length)\n  return
this[offset]\n}\n\nBuffer.prototype.readUInt16LE = function readUInt16LE (offset, noAssert) {\n  if (!noAssert)
checkOffset(offset, 2, this.length)\n  return this[offset] | (this[offset + 1] <<
8)\n}\n\nBuffer.prototype.readUInt16BE = function readUInt16BE (offset, noAssert) {\n  if (!noAssert)
checkOffset(offset, 2, this.length)\n  return (this[offset] << 8) | this[offset + 1]\n}\n\nBuffer.prototype.readUInt32LE
= function readUInt32LE
 (offset, noAssert) {\n  if (!noAssert) checkOffset(offset, 4, this.length)\n\n  return ((this[offset]) |\n      (this[offset +
1] << 8) |\n      (this[offset + 2] << 16)) +\n      (this[offset + 3] * 0x1000000)\n}\n\nBuffer.prototype.readUInt32BE
= function readUInt32BE (offset, noAssert) {\n  if (!noAssert) checkOffset(offset, 4, this.length)\n\n  return
(this[offset] * 0x1000000) +\n    ((this[offset + 1] << 16) |\n    (this[offset + 2] << 8) |\n    this[offset +
3])\n}\n\nBuffer.prototype.readIntLE = function readIntLE (offset, byteLength, noAssert) {\n  offset = offset | 0\n
byteLength = byteLength | 0\n  if (!noAssert) checkOffset(offset, byteLength, this.length)\n\n  var val =
this[offset]\n  var mul = 1\n  var i = 0\n  while (++i < byteLength && (mul *= 0x100)) {\n    val += this[offset + i] *
mul\n  }\n  mul *= 0x80\n\n  if (val >= mul) val -= Math.pow(2, 8 * byteLength)\n\n  return
val\n}\n\nBuffer.prototype.readIntBE = function readIntBE (offset, byteLength, noAssert)
 {\n  offset = offset | 0\n  byteLength = byteLength | 0\n  if (!noAssert) checkOffset(offset, byteLength,
this.length)\n\n  var i = byteLength\n  var mul = 1\n  var val = this[offset + --i]\n  while (i > 0 && (mul *= 0x100))
{\n    val += this[offset + --i] * mul\n  }\n  mul *= 0x80\n\n  if (val >= mul) val -= Math.pow(2, 8 * byteLength)\n\n
return val\n}\n\nBuffer.prototype.readInt8 = function readInt8 (offset, noAssert) {\n  if (!noAssert)
checkOffset(offset, 1, this.length)\n  if (!(this[offset] & 0x80)) return (this[offset])\n  return ((0xff - this[offset] + 1)
* -1)\n}\n\nBuffer.prototype.readInt16LE = function readInt16LE (offset, noAssert) {\n  if (!noAssert)
checkOffset(offset, 2, this.length)\n  var val = this[offset] | (this[offset + 1] << 8)\n  return (val & 0x8000) ? val |
0xFFFF0000 : val\n}\n\nBuffer.prototype.readInt16BE = function readInt16BE (offset, noAssert) {\n  if (!noAssert)
checkOffset(offset, 2, this.length)\n  var val = this[offset + 1] | (this[offset] << 8)\n
  return (val & 0x8000) ? val | 0xFFFF0000 : val\n}\n\nBuffer.prototype.readInt32LE = function readInt32LE
(offset, noAssert) {\n  if (!noAssert) checkOffset(offset, 4, this.length)\n\n  return (this[offset]) |\n    (this[offset + 1]
<< 8) |\n    (this[offset + 2] << 16) |\n    (this[offset + 3] << 24)\n}\n\nBuffer.prototype.readInt32BE = function
readInt32BE (offset, noAssert) {\n  if (!noAssert) checkOffset(offset, 4, this.length)\n\n  return (this[offset] << 24)
|\n    (this[offset + 1] << 16) |\n    (this[offset + 2] << 8) |\n    (this[offset + 3])\n}\n\nBuffer.prototype.readFloatLE =
function readFloatLE (offset, noAssert) {\n  if (!noAssert) checkOffset(offset, 4, this.length)\n  return
ieee754.read(this, offset, true, 23, 4)\n}\n\nBuffer.prototype.readFloatBE = function readFloatBE (offset, noAssert)
{\n  if (!noAssert) checkOffset(offset, 4, this.length)\n  return ieee754.read(this, offset, false, 23,
4)\n}\n\nBuffer.prototype.readDoubleLE = function readDoubleLE (offset, noAssert)
 {\n  if (!noAssert) checkOffset(offset, 8, this.length)\n  return ieee754.read(this, offset, true, 52,
8)\n}\n\nBuffer.prototype.readDoubleBE = function readDoubleBE (offset, noAssert) {\n  if (!noAssert)
checkOffset(offset, 8, this.length)\n  return ieee754.read(this, offset, false, 52, 8)\n}\n\nfunction checkInt (buf,
value, offset, ext, max, min) {\n  if (!Buffer.isBuffer(buf)) throw new TypeError('\"buffer\" argument must be a
Buffer instance')\n  if (value > max || value < min) throw new RangeError('\"value\" argument is out of bounds')\n  if
(offset + ext > buf.length) throw new RangeError('Index out of range')\n}\n\nBuffer.prototype.writeUIntLE =
function writeUIntLE (value, offset, byteLength, noAssert) {\n  value = +value\n  offset = offset | 0\n  byteLength =
byteLength | 0\n  if (!noAssert) {\n    var maxBytes = Math.pow(2, 8 * byteLength) - 1\n    checkInt(this, value,
offset, byteLength, maxBytes, 0)\n  }\n\n  var mul = 1\n  var i = 0\n  this[offset] = value & 0xFF\n
  while (++i < byteLength && (mul *= 0x100)) {\n    this[offset + i] = (value / mul) & 0xFF\n  }\n\n  return offset +
byteLength\n}\n\nBuffer.prototype.writeUIntBE = function writeUIntBE (value, offset, byteLength, noAssert) {\n
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value = +value\n offset = offset | 0\n byteLength = byteLength | 0\n if (!noAssert) {\n   var maxBytes = Math.pow(2, 8 * byteLength) - 1\n   checkInt(this, value, offset, byteLength, maxBytes, 0)\n }\n\n var i = byteLength - 1\n var mul = 1\n this[offset + i] = value & 0xFF\n while (--i >= 0 && (mul *= 0x100)) {\n this[offset + i] = (value / mul) & 0xFF\n }\n\n return offset + byteLength\n}\n\nBuffer.prototype.writeUInt8 = function writeUInt8 (value, offset, noAssert) {\n value = +value\n offset = offset | 0\n if (!noAssert) checkInt(this, value, offset, 1, 0xff, 0)\n if (!Buffer.TYPED_ARRAY_SUPPORT) value = Math.floor(value)\n this[offset] = (value & 0xff)\n return offset + 1\n}\n\nfunction objectWriteUInt16 (buf, value, offset, littleEndian) {\n if (value < 0) value = 0xffff + value + 1\n for (var i = 0, j = Math.min(buf.length - offset, 2); i < j; ++i) {\n buf[offset + i] = (value & (0xff << (8 * (littleEndian ? i : 1 - i)))) >>>\n   (littleEndian ? i : 1 - i) * 8\n }\n}\n\nBuffer.prototype.writeUInt16LE = function writeUInt16LE (value, offset, noAssert) {\n value = +value\n offset = offset | 0\n if (!noAssert) checkInt(this, value, offset, 2, 0xffff, 0)\n if (Buffer.TYPED_ARRAY_SUPPORT) {\n   this[offset] = (value & 0xff)\n   this[offset + 1] = (value >>> 8)\n } else {\n   objectWriteUInt16(this, value, offset, true)\n }\n return offset + 2\n}\n\nBuffer.prototype.writeUInt16BE = function writeUInt16BE (value, offset, noAssert) {\n value = +value\n offset = offset | 0\n if (!noAssert) checkInt(this, value, offset, 2, 0xffff, 0)\n if (Buffer.TYPED_ARRAY_SUPPORT) {\n   this[offset] = (value >>> 8)\n   this[offset + 1] = (value & 0xff)\n } else {\n   objectWriteUInt16(this, value, offset, false)\n }\n return offset + 2\n}\n\nfunction objectWriteUInt32 (buf, value, offset, littleEndian) {\n if (value < 0) value = 0xffffffff + value + 1\n for (var i = 0, j = Math.min(buf.length - offset, 4); i < j; ++i) {\n   buf[offset + i] = (value >>> (littleEndian ? i : 3 - i) * 8) & 0xff\n }\n}\n\nBuffer.prototype.writeUInt32LE = function writeUInt32LE (value, offset, noAssert) {\n value = +value\n offset = offset | 0\n if (!noAssert) checkInt(this, value, offset, 4, 0xffffffff, 0)\n if (Buffer.TYPED_ARRAY_SUPPORT) {\n   this[offset + 3] = (value >>> 24)\n   this[offset + 2] = (value >>> 16)\n   this[offset + 1] = (value >>> 8)\n   this[offset] = (value & 0xff)\n } else {\n   objectWriteUInt32(this, value, offset, true)\n }\n return offset + 4\n}\n\nBuffer.prototype.writeUInt32BE = function writeUInt32BE (value, offset, noAssert) {\n value = +value\n offset = offset | 0\n if (!noAssert) checkInt(this, value, offset, 4, 0xffffffff, 0)\n if (Buffer.TYPED_ARRAY_SUPPORT)
  {\n   this[offset] = (value >>> 24)\n   this[offset + 1] = (value >>> 16)\n   this[offset + 2] = (value >>> 8)\n   this[offset + 3] = (value & 0xff)\n } else {\n   objectWriteUInt32(this, value, offset, false)\n }\n return offset + 4\n}\n\nBuffer.prototype.writeIntLE = function writeIntLE (value, offset, byteLength, noAssert) {\n value = +value\n offset = offset | 0\n if (!noAssert) {\n   var limit = Math.pow(2, 8 * byteLength - 1)\n\n   checkInt(this, value, offset, byteLength, limit - 1, -limit)\n }\n\n var i = 0\n var mul = 1\n var sub = 0\n this[offset] = value & 0xFF\n while (++i < byteLength && (mul *= 0x100)) {\n   if (value < 0 && sub === 0 && this[offset + i - 1] !== 0) {\n   sub = 1\n   }\n   this[offset + i] = ((value / mul) >> 0) - sub & 0xFF\n }\n\n return offset + byteLength\n}\n\nBuffer.prototype.writeIntBE = function writeIntBE (value, offset, byteLength, noAssert) {\n value = +value\n offset = offset | 0\n if (!noAssert) {\n   var limit
  = Math.pow(2, 8 * byteLength - 1)\n\n   checkInt(this, value, offset, byteLength, limit - 1, -limit)\n }\n\n var i = byteLength - 1\n var mul = 1\n var sub = 0\n this[offset + i] = value & 0xFF\n while (--i >= 0 && (mul *= 0x100)) {\n   if (value < 0 && sub === 0 && this[offset + i + 1] !== 0) {\n   sub = 1\n   }\n   this[offset + i] = ((value / mul) >> 0) - sub & 0xFF\n }\n\n return offset + byteLength\n}\n\nBuffer.prototype.writeInt8 = function writeInt8 (value, offset, noAssert) {\n value = +value\n offset = offset | 0\n if (!noAssert) checkInt(this, value, offset, 1, 0x7f, -0x80)\n if (!Buffer.TYPED_ARRAY_SUPPORT) value = Math.floor(value)\n if (value < 0) value = 0xff + value + 1\n this[offset] = (value & 0xff)\n return offset + 1\n}\n\nBuffer.prototype.writeInt16LE = function writeInt16LE (value, offset, noAssert) {\n value = +value\n offset = offset | 0\n if (!noAssert) checkInt(this, value, offset, 2, 0x7fff, -0x8000)\n if (Buffer.TYPED_ARRAY_SUPPORT)
  {\n   this[offset] = (value & 0xff)\n   this[offset + 1] = (value >>> 8)\n } else {\n   objectWriteUInt16(this, value, offset, true)\n }\n return offset + 2\n}\n\nBuffer.prototype.writeInt16BE = function writeInt16BE (value, offset, noAssert) {\n value = +value\n offset = offset | 0\n if (!noAssert) checkInt(this, value, offset, 2, 0x7fff, -0x8000)\n if (Buffer.TYPED_ARRAY_SUPPORT) {\n   this[offset] = (value >>> 8)\n   this[offset + 1] = (value & 0xff)\n } else {\n   objectWriteUInt16(this, value, offset, false)\n }\n return offset + 2\n}\n\nBuffer.prototype.writeInt32LE

= function writeInt32LE (value, offset, noAssert) {\n value = +value\n offset = offset | 0\n if (!noAssert) checkInt(this, value, offset, 4, 0x7fffffff, -0x80000000)\n if (Buffer.TYPED_ARRAY_SUPPORT) {\n this[offset] = (value & 0xff)\n   this[offset + 1] = (value >>> 8)\n   this[offset + 2] = (value >>> 16)\n   this[offset + 3] = (value >>> 24)\n } else {\n   objectWriteUInt32(this, value,
 offset, true)\n }\n return offset + 4\n}\n\nBuffer.prototype.writeInt32BE = function writeInt32BE (value, offset, noAssert) {\n value = +value\n offset = offset | 0\n if (!noAssert) checkInt(this, value, offset, 4, 0x7fffffff, -0x80000000)\n if (value < 0) value = 0xffffffff + value + 1\n if (Buffer.TYPED_ARRAY_SUPPORT) {\n this[offset] = (value >>> 24)\n   this[offset + 1] = (value >>> 16)\n   this[offset + 2] = (value >>> 8)\n   this[offset + 3] = (value & 0xff)\n } else {\n   objectWriteUInt32(this, value, offset, false)\n }\n return offset + 4\n}\n\nfunction checkIEEE754 (buf, value, offset, ext, max, min) {\n if (offset + ext > buf.length) throw new RangeError('Index out of range')\n if (offset < 0) throw new RangeError('Index out of range')\n}\n\nfunction writeFloat (buf, value, offset, littleEndian, noAssert) {\n if (!noAssert) {\n   checkIEEE754(buf, value, offset, 4, 3.4028234663852886e+38, -3.4028234663852886e+38)\n }\n ieee754.write(buf, value, offset,
 littleEndian, 23, 4)\n return offset + 4\n}\n\nBuffer.prototype.writeFloatLE = function writeFloatLE (value, offset, noAssert) {\n return writeFloat(this, value, offset, true, noAssert)\n}\n\nBuffer.prototype.writeFloatBE = function writeFloatBE (value, offset, noAssert) {\n return writeFloat(this, value, offset, false, noAssert)\n}\n\nfunction writeDouble (buf, value, offset, littleEndian, noAssert) {\n if (!noAssert) {\n   checkIEEE754(buf, value, offset, 8, 1.7976931348623157E+308, -1.7976931348623157E+308)\n }\n ieee754.write(buf, value, offset, littleEndian, 52, 8)\n return offset + 8\n}\n\nBuffer.prototype.writeDoubleLE = function writeDoubleLE (value, offset, noAssert) {\n return writeDouble(this, value, offset, true, noAssert)\n}\n\nBuffer.prototype.writeDoubleBE = function writeDoubleBE (value, offset, noAssert) {\n return writeDouble(this, value, offset, false, noAssert)\n}\n\n// copy(targetBuffer, targetStart=0, sourceStart=0, sourceEnd=buffer.length)\nBuffer.prototype.copy
 = function copy (target, targetStart, start, end) {\n if (!start) start = 0\n if (!end && end !== 0) end = this.length\n if (targetStart >= target.length) targetStart = target.length\n if (!targetStart) targetStart = 0\n if (end > 0 && end < start) end = start\n\n // Copy 0 bytes; we're done\n if (end === start) return 0\n if (target.length === 0 || this.length === 0) return 0\n\n // Fatal error conditions\n if (targetStart < 0) {\n   throw new RangeError('targetStart out of bounds')\n }\n if (start < 0 || start >= this.length) throw new RangeError('sourceStart out of bounds')\n if (end < 0) throw new RangeError('sourceEnd out of bounds')\n\n // Are we oob?\n if (end > this.length) end = this.length\n if (target.length - targetStart < end - start) {\n   end = target.length - targetStart + start\n }\n\n var len = end - start\n var i\n\n if (this === target && start < targetStart && targetStart < end) {\n   // descending copy from end\n   for (i = len
 - 1; i >= 0; --i) {\n   target[i + targetStart] = this[i + start]\n   }\n } else if (len < 1000 || !Buffer.TYPED_ARRAY_SUPPORT) {\n   // ascending copy from start\n   for (i = 0; i < len; ++i) {\n   target[i + targetStart] = this[i + start]\n   }\n } else {\n   Uint8Array.prototype.set.call(\n   target,\n   this.subarray(start, start + len),\n   targetStart\n   )\n }\n\n return len\n}\n\n// Usage:\n//   buffer.fill(number[, offset[, end]])\n//   buffer.fill(buffer[, offset[, end]])\n//   buffer.fill(string[, offset[, end]][, encoding])\nBuffer.prototype.fill = function fill (val, start, end, encoding) {\n // Handle string cases:\n if (typeof val === 'string') {\n   if (typeof start === 'string') {\n   encoding = start\n   start = 0\n   end = this.length\n   } else if (typeof end === 'string') {\n   encoding = end\n   end = this.length\n   }\n   if (val.length === 1) {\n   var code = val.charCodeAt(0)\n   if (code < 256) {\n
 val = code\n   }\n   }\n   if (encoding !== undefined && typeof encoding !== 'string') {\n   throw new TypeError('encoding must be a string')\n   }\n   if (typeof encoding === 'string' && !Buffer.isEncoding(encoding)) {\n   throw new TypeError('Unknown encoding: ' + encoding)\n   }\n } else if (typeof val === 'number') {\n   val = val & 255\n }\n\n // Invalid ranges are not set to a default, so can range check early.\n if (start < 0 || this.length < start || this.length < end) {\n   throw new RangeError('Out of range index')\n }\n\n if (end <= start) {\n   return this\n }\n\n start = start >>> 0\n end = end === undefined ? this.length : end >>> 0\n\n if (!val) val = 0\n\n var i\n if (typeof val === 'number') {\n   for (i = start; i < end; ++i) {\n   this[i] = val\n   }\n } else {\n   var bytes = Buffer.isBuffer(val)\n   ? val\n   : utf8ToBytes(new Buffer(val, encoding).toString())\n   var len = bytes.length\n

```
 for (i = 0; i < end - start; ++i)
 {\n      this[i + start] = bytes[i % len]\n    }\n  }\n\n  return this\n}\n\n// HELPER FUNCTIONS\n//
================\n\nvar INVALID_BASE64_RE = /[^+\\/0-9A-Za-z-_]/g\n\nfunction base64clean (str) {\n  //
Node strips out invalid characters like \\n and \\t from the string, base64-js does not\n  str =
stringtrim(str).replace(INVALID_BASE64_RE, '')\n  // Node converts strings with length < 2 to ''\n  if (str.length <
2) return ''\n  // Node allows for non-padded base64 strings (missing trailing ===), base64-js does not\n  while
(str.length % 4 !== 0) {\n    str = str + '='\n  }\n  return str\n}\n\nfunction stringtrim (str) {\n  if (str.trim) return
str.trim()\n  return str.replace(/^\\s+|\\s+$/g, '')\n}\n\nfunction toHex (n) {\n  if (n < 16) return '0' + n.toString(16)\n
return n.toString(16)\n}\n\nfunction utf8ToBytes (string, units) {\n  units = units || Infinity\n  var codePoint\n  var
length = string.length\n  var leadSurrogate = null\n  var bytes = []\n\n  for (var i = 0; i < length;
 ++i) {\n    codePoint = string.charCodeAt(i)\n\n    // is surrogate component\n    if (codePoint > 0xD7FF &&
codePoint < 0xE000) {\n      // last char was a lead\n      if (!leadSurrogate) {\n        // no lead yet\n        if (codePoint
> 0xDBFF) {\n          // unexpected trail\n          if ((units -= 3) > -1) bytes.push(0xEF, 0xBF, 0xBD)\n
continue\n        } else if (i + 1 === length) {\n          // unpaired lead\n          if ((units -= 3) > -1) bytes.push(0xEF,
0xBF, 0xBD)\n          continue\n        }\n\n        // valid lead\n        leadSurrogate = codePoint\n\n        continue\n
}\n\n      // 2 leads in a row\n      if (codePoint < 0xDC00) {\n        if ((units -= 3) > -1) bytes.push(0xEF, 0xBF,
0xBD)\n        leadSurrogate = codePoint\n        continue\n      }\n\n      // valid surrogate pair\n      codePoint =
(leadSurrogate - 0xD800 << 10 | codePoint - 0xDC00) + 0x10000\n    } else if (leadSurrogate) {\n      // valid bmp
char, but last char was a lead\n
    if ((units -= 3) > -1) bytes.push(0xEF, 0xBF, 0xBD)\n    }\n\n    leadSurrogate = null\n\n    // encode utf8\n    if
(codePoint < 0x80) {\n      if ((units -= 1) < 0) break\n      bytes.push(codePoint)\n    } else if (codePoint < 0x800)
{\n      if ((units -= 2) < 0) break\n      bytes.push(\n        codePoint >> 0x6 | 0xC0,\n        codePoint & 0x3F | 0x80\n
  )\n    } else if (codePoint < 0x10000) {\n      if ((units -= 3) < 0) break\n      bytes.push(\n        codePoint >> 0xC |
0xE0,\n        codePoint >> 0x6 & 0x3F | 0x80,\n        codePoint & 0x3F | 0x80\n      )\n    } else if (codePoint <
0x110000) {\n      if ((units -= 4) < 0) break\n      bytes.push(\n        codePoint >> 0x12 | 0xF0,\n        codePoint >>
0xC & 0x3F | 0x80,\n        codePoint >> 0x6 & 0x3F | 0x80,\n        codePoint & 0x3F | 0x80\n      )\n    } else {\n
throw new Error('Invalid code point')\n    }\n  }\n\n  return bytes\n}\n\nfunction asciiToBytes (str) {\n  var
byteArray = []\n  for (var
 i = 0; i < str.length; ++i) {\n    // Node's code seems to be doing this and not & 0x7F..\n
byteArray.push(str.charCodeAt(i) & 0xFF)\n  }\n  return byteArray\n}\n\nfunction utf16leToBytes (str, units) {\n
var c, hi, lo\n  var byteArray = []\n  for (var i = 0; i < str.length; ++i) {\n    if ((units -= 2) < 0) break\n\n    c =
str.charCodeAt(i)\n    hi = c >> 8\n    lo = c % 256\n    byteArray.push(lo)\n    byteArray.push(hi)\n  }\n\n  return
byteArray\n}\n\nfunction base64ToBytes (str) {\n  return base64.toByteArray(base64clean(str))\n}\n\nfunction
blitBuffer (src, dst, offset, length) {\n  for (var i = 0; i < length; ++i) {\n    if ((i + offset >= dst.length) || (i >=
src.length)) break\n    dst[i + offset] = src[i]\n  }\n  return i\n}\n\nfunction isnan (val) {\n  return val !== val // eslint-
disable-line no-self-compare\n}\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n *
Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not
 use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n *
http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing,
software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES
OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language
governing permissions and\n * limitations under the License.\n *
==========================================================================\n
*/\n\nimport {complex} from '../ops/complex';\n\nimport {tensor} from '../ops/tensor';\nimport {NamedTensor,
NamedTensorMap} from '../tensor_types';\nimport {TypedArray} from '../types';\nimport {sizeFromShape} from
'../util';\n\nimport {DTYPE_VALUE_SIZE_MAP, ModelArtifacts, ModelArtifactsInfo, WeightGroup,
WeightsManifestEntry} from './types';\n\n/** Number of bytes reserved for the length of the string. (32bit integer).
*/\nconst
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NUM_BYTES_STRING_LENGTH = 4;\n\n/**\n * Encode a map from names to weight values as an ArrayBuffer, along with an\n * `Array` of `WeightsManifestEntry` as specification of the encoded weights.\n *\n * This function does not perform sharding.\n *\n * This function is the reverse of `decodeWeights`.\n *\n * @param tensors A map (\"dict\") from names to tensors.\n * @param group Group to which the weights belong (optional).\n * @returns A `Promise` of\n *   - A flat `ArrayBuffer` with all the binary values of the `Tensor`s\n *     concatenated.\n *   - An `Array` of `WeightManifestEntry`s, carrying information including\n *     tensor names, `dtype`s and shapes.\n * @throws Error: on unsupported tensor `dtype`.\n */\nexport async function encodeWeights(\n    tensors: NamedTensorMap|NamedTensor[], group?: WeightGroup):\n    Promise<{data: ArrayBuffer, specs: WeightsManifestEntry[]}> {\n  // TODO(adarob, cais): Support quantization.\n  const specs: WeightsManifestEntry[] = [];\n  const dataPromises:
 Array<Promise<TypedArray>> = [];\n\n  const names: string[] = Array.isArray(tensors) ?\n      tensors.map(tensor => tensor.name) :\n      Object.keys(tensors);\n\n  for (let i = 0; i < names.length; ++i) {\n    const name = names[i];\n    const t = Array.isArray(tensors) ? tensors[i].tensor : tensors[name];\n    if (t.dtype !== 'float32' && t.dtype !== 'int32' && t.dtype !== 'bool' &&\n        t.dtype !== 'string' && t.dtype !== 'complex64') {\n      throw new Error(`Unsupported dtype in weight '${name}': ${t.dtype}`);\n    }\n    const spec: WeightsManifestEntry = {name, shape: t.shape, dtype: t.dtype};\n    if (t.dtype === 'string') {\n      const utf8bytes = new Promise<TypedArray>(async resolve => {\n        const vals = await t.bytes() as Uint8Array[];\n        const totalNumBytes = vals.reduce((p, c) => p + c.length, 0) +\n            NUM_BYTES_STRING_LENGTH * vals.length;\n        const bytes = new Uint8Array(totalNumBytes);\n        let offset = 0;\n        for (let i = 0; i < vals.length; i++) {\n          const val = vals[i];\n          const bytesOfLength =\n              new Uint8Array(new Uint32Array([val.length]).buffer);\n          bytes.set(bytesOfLength, offset);\n          offset += NUM_BYTES_STRING_LENGTH;\n          bytes.set(val, offset);\n          offset += val.length;\n        }\n        resolve(bytes);\n      });\n      dataPromises.push(utf8bytes);\n    } else {\n      dataPromises.push(t.data());\n    }\n    if (group != null) {\n      spec.group = group;\n    }\n    specs.push(spec);\n  }\n\n  const tensorValues = await Promise.all(dataPromises);\n  return {data: concatenateTypedArrays(tensorValues), specs};\n}\n\n/**\n * Decode flat ArrayBuffer as weights.\n *\n * This function does not handle sharding.\n *\n * This function is the reverse of `encodeWeights`.\n *\n * @param buffer A flat ArrayBuffer carrying the binary values of the tensors\n *     concatenated in the order specified in `specs`.\n * @param specs Specifications of
 the names, dtypes and shapes of the tensors\n *     whose value are encoded by `buffer`.\n * @return A map from tensor name to tensor value, with the names corresponding\n *     to names in `specs`.\n * @throws Error, if any of the tensors has unsupported dtype.\n */\nexport function decodeWeights(\n    buffer: ArrayBuffer, specs: WeightsManifestEntry[]): NamedTensorMap {\n  // TODO(adarob, cais): Support quantization.\n  const out: NamedTensorMap = {};\n  let float16Decode: (buffer: Uint16Array) => Float32Array | undefined;\n  let offset = 0;\n  for (const spec of specs) {\n    const name = spec.name;\n    const dtype = spec.dtype;\n    const shape = spec.shape;\n    const size = sizeFromShape(shape);\n    let values: TypedArray|string[]|Uint8Array[];\n\n    if ('quantization' in spec) {\n      const quantization = spec.quantization;\n      if (quantization.dtype === 'uint8' || quantization.dtype === 'uint16') {\n        if (!('min' in quantization && 'scale' in quantization)) {\n          throw new Error(\n              `Weight ${spec.name} with quantization ${quantization.dtype} ` +\n              `doesn't have corresponding metadata min and scale.`);\n        }\n      } else if (quantization.dtype === 'float16') {\n        if (dtype !== 'float32') {\n          throw new Error(\n              `Weight ${spec.name} is quantized with ${quantization.dtype} ` +\n              `which only supports weights of type float32 not ${dtype}.`);\n        }\n      } else {\n        throw new Error(\n            `Weight ${spec.name} has unknown ` +\n            `quantization dtype ${quantization.dtype}. ` +\n            `Supported quantization dtypes are: ` +\n            `'uint8', 'uint16', and 'float16'.`);\n      }\n      const quantizationSizeFactor = DTYPE_VALUE_SIZE_MAP[quantization.dtype];\n      const byteBuffer =\n          buffer.slice(offset, offset + size * quantizationSizeFactor);\n      const quantizedArray = (quantization.dtype === 'uint8') ?\n          new Uint8Array(byteBuffer) :\n          new Uint16Array(byteBuffer);\n      if (dtype === 'float32') {\n        if (quantization.dtype === 'uint8' || quantization.dtype === 'uint16') {\n          values = new Float32Array(quantizedArray.length);\n          for (let i = 0; i
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< quantizedArray.length; i++) {\n const v = quantizedArray[i];\n values[i] = v * quantization.scale + quantization.min;\n }\n } else if (quantization.dtype === 'float16') {\n if (float16Decode === undefined) {\n float16Decode = getFloat16Decoder();\n }\n values = float16Decode(quantizedArray as Uint16Array);\n } else {\n throw new Error(\n `Unsupported quantization type ${quantization.dtype} ` +\n `for weight type float32.`);\n }\n } else if (dtype === 'int32') {\n if (quantization.dtype !== 'uint8' && quantization.dtype !== 'uint16') {\n throw new Error(\n `Unsupported quantization
 type ${quantization.dtype} ` +\n `for weight type int32.`);\n }\n values = new Int32Array(quantizedArray.length);\n for (let i = 0; i < quantizedArray.length; i++) {\n const v = quantizedArray[i];\n values[i] = Math.round(v * quantization.scale + quantization.min);\n }\n } else {\n throw new Error(`Unsupported dtype in weight '${name}': ${dtype}`);\n }\n offset += size * quantizationSizeFactor;\n } else if (dtype === 'string') {\n const size = sizeFromShape(spec.shape);\n values = [];\n for (let i = 0; i < size; i++) {\n const byteLength = new Uint32Array(\n buffer.slice(offset, offset + NUM_BYTES_STRING_LENGTH))[0];\n offset += NUM_BYTES_STRING_LENGTH;\n const bytes = new Uint8Array(buffer.slice(offset, offset + byteLength));\n (values as Uint8Array[]).push(bytes);\n offset += byteLength;\n }\n } else {\n const dtypeFactor
 = DTYPE_VALUE_SIZE_MAP[dtype];\n const byteBuffer = buffer.slice(offset, offset + size * dtypeFactor);\n\n if (dtype === 'float32') {\n values = new Float32Array(byteBuffer);\n } else if (dtype === 'int32') {\n values = new Int32Array(byteBuffer);\n } else if (dtype === 'bool') {\n values = new Uint8Array(byteBuffer);\n } else if (dtype === 'complex64') {\n values = new Float32Array(byteBuffer);\n
  const real = new Float32Array(values.length / 2);\n const image = new Float32Array(values.length / 2);\n for (let i = 0; i < real.length; i++) {\n real[i] = values[i * 2];\n image[i] = values[i * 2 + 1];\n }\n const realTensor = tensor(real, shape, 'float32');\n const imageTensor = tensor(image, shape, 'float32');\n out[name] = complex(realTensor, imageTensor);\n realTensor.dispose();\n imageTensor.dispose();\n } else {\n throw new Error(`Unsupported
 dtype in weight '${name}': ${dtype}`);\n }\n offset += size * dtypeFactor;\n }\n if (dtype !== 'complex64') {\n out[name] = tensor(values, shape, dtype);\n }\n }\n return out;\n}\n\n/**\n * Concatenate TypedArrays into an ArrayBuffer.\n */\nexport function concatenateTypedArrays(xs: TypedArray[]): ArrayBuffer {\n // TODO(adarob, cais): Support quantization.\n if (xs === null) {\n throw new Error(`Invalid input value: ${JSON.stringify(xs)}`);\n }\n\n let totalByteLength = 0;\n\n // `normalizedXs` is here for this reason: a `TypedArray`'s `buffer'\n // can have a different byte length from that of the `TypedArray` itself,\n // for example, when the `TypedArray` is created from an offset in an\n // `ArrayBuffer`. `normliazedXs` holds `TypedArray`s whose `buffer`s match\n // the `TypedArray` in byte length. If an element of `xs` does not show\n // this property, a new `TypedArray` that satisfy this property will be\n // constructed and pushed
 into `normalizedXs`.\n const normalizedXs: TypedArray[] = [];\n xs.forEach((x: TypedArray) => {\n totalByteLength += x.byteLength;\n // tslint:disable:no-any\n normalizedXs.push(\n x.byteLength === x.buffer.byteLength ? x :\n new (x.constructor as any)(x));\n if (!(x as any instanceof Float32Array || x as any instanceof Int32Array ||\n x as any instanceof Uint8Array)) {\n throw new Error(`Unsupported TypedArray subtype: ${x.constructor.name}`);\n }\n // tslint:enable:no-any\n });\n\n const y = new Uint8Array(totalByteLength);\n let offset = 0;\n normalizedXs.forEach((x: TypedArray) => {\n y.set(new Uint8Array(x.buffer), offset);\n offset += x.byteLength;\n });\n\n return y.buffer;\n}\n\n// Use Buffer on Node.js instead of Blob/atob/btoa\nconst useNodeBuffer = typeof Buffer !== 'undefined' &&\n (typeof Blob === 'undefined' || typeof atob === 'undefined' ||\n typeof btoa === 'undefined');\n\n/**\n
 * Calculate the byte length of a JavaScript string.\n *\n * Note that a JavaScript string can contain wide characters, therefore the\n * length of the string is not necessarily equal to the byte length.\n *\n * @param str Input string.\n * @returns Byte length.\n */\nexport function stringByteLength(str: string): number {\n if (useNodeBuffer) {\n return Buffer.byteLength(str);\n }\n return new Blob([str]).size;\n}\n\n/**\n * Encode an ArrayBuffer as a base64 encoded string.\n *\n * @param buffer `ArrayBuffer` to be converted.\n * @returns A string that base64-encodes
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`buffer`.\n */\nexport function arrayBufferToBase64String(buffer: ArrayBuffer): string {\n if (useNodeBuffer) {\n return Buffer.from(buffer).toString('base64');\n }\n const buf = new Uint8Array(buffer);\n let s = '';\n for (let i = 0, l = buf.length; i < l; i++) {\n s += String.fromCharCode(buf[i]);\n }\n return btoa(s);\n}\n\n/**\n * Decode a base64 string as an ArrayBuffer.\n *\n * @param str Base64 string.\n * @returns Decoded `ArrayBuffer`.\n */\nexport function base64StringToArrayBuffer(str: string): ArrayBuffer {\n if (useNodeBuffer) {\n const buf = Buffer.from(str, 'base64');\n return buf.buffer.slice(buf.byteOffset, buf.byteOffset + buf.byteLength);\n }\n const s = atob(str);\n const buffer = new Uint8Array(s.length);\n for (let i = 0; i < s.length; ++i) {\n buffer.set([s.charCodeAt(i)], i);\n }\n return buffer.buffer;\n}\n\n/**\n * Concatenate a number of ArrayBuffers into one.\n *\n * @param buffers A number of array buffers to concatenate.\n * @returns Result of concatenating `buffers` in order.\n */\nexport function concatenateArrayBuffers(buffers: ArrayBuffer[]): ArrayBuffer {\n if (buffers.length === 1) {\n return buffers[0];\n }\n\n let totalByteLength = 0;\n buffers.forEach((buffer: ArrayBuffer) => {\n totalByteLength += buffer.byteLength;\n });\n\n const temp = new Uint8Array(totalByteLength);\n let offset = 0;\n buffers.forEach((buffer: ArrayBuffer) => {\n temp.set(new Uint8Array(buffer), offset);\n offset += buffer.byteLength;\n });\n return temp.buffer;\n}\n\n/**\n * Get the basename of a path.\n *\n * Behaves in a way analogous to Linux's basename command.\n *\n * @param path\n */\nexport function basename(path: string): string {\n const SEPARATOR = '/';\n path = path.trim();\n while (path.endsWith(SEPARATOR)) {\n path = path.slice(0, path.length - 1);\n }\n const items = path.split(SEPARATOR);\n return items[items.length - 1];\n}\n\n/**\n * Populate ModelArtifactsInfo fields for a model with JSON topology.\n * @param modelArtifacts\n * @returns A ModelArtifactsInfo object.\n */\nexport function getModelArtifactsInfoForJSON(modelArtifacts: ModelArtifacts):\n ModelArtifactsInfo {\n if (modelArtifacts.modelTopology instanceof ArrayBuffer) {\n throw new Error('Expected JSON model topology, received ArrayBuffer.');\n }\n\n return {\n dateSaved: new Date(),\n modelTopologyType: 'JSON',\n modelTopologyBytes: modelArtifacts.modelTopology == null ?\n 0 :\n stringByteLength(JSON.stringify(modelArtifacts.modelTopology)),\n weightSpecsBytes: modelArtifacts.weightSpecs == null ?\n 0 :\n stringByteLength(JSON.stringify(modelArtifacts.weightSpecs)),\n weightDataBytes: modelArtifacts.weightData == null ?\n 0 :\n modelArtifacts.weightData.byteLength,\n };\n}\n\n/**\n * Computes mantisa table for casting Float16 to Float32\n * See http://www.fox-toolkit.org/ftp/fasthalffloatconversion.pdf\n *\n * @returns Uint32Array, 2048 mantissa lookup values.\n */\nfunction computeFloat16MantisaTable(): Uint32Array {\n const convertMantissa = (i: number): number => {\n let m = i << 13;\n let e = 0;\n\n while ((m & 0x00800000) === 0) {\n e -= 0x00800000;\n m <<= 1;\n }\n m &= ~0x00800000;\n e += 0x38800000;\n\n return m | e;\n };\n\n const mantisaTable = new Uint32Array(2048);\n\n mantisaTable[0] = 0;\n for (let i = 1; i < 1024; i++) {\n mantisaTable[i] = convertMantissa(i);\n }\n for (let i = 1024; i < 2048; i++) {\n mantisaTable[i] = 0x38000000 + ((i - 1024) << 13);\n }\n\n return mantisaTable;\n}\n\n/**\n * Computes exponent table for casting Float16 to Float32\n * See http://www.fox-toolkit.org/ftp/fasthalffloatconversion.pdf\n *\n * @returns Uint32Array, 64 exponent lookup values.\n */\nfunction computeFloat16ExponentTable(): Uint32Array {\n const exponentTable = new Uint32Array(64);\n\n exponentTable[0] = 0;\n exponentTable[31] = 0x47800000;\n exponentTable[32] = 0x80000000;\n exponentTable[63] = 0xc7800000;\n for (let i = 1; i < 31; i++) {\n exponentTable[i] = i << 23;\n }\n for (let i = 33; i < 63; i++) {\n exponentTable[i] = 0x80000000 + ((i - 32) << 23);\n }\n\n return exponentTable;\n}\n\n/**\n * Computes offset table for casting Float16 to Float32\n * See http://www.fox-toolkit.org/ftp/fasthalffloatconversion.pdf\n *\n * @returns Uint32Array, 6d offset values.\n */\nfunction computeFloat16OffsetTable(): Uint32Array {\n const offsetTable = new Uint32Array(64);\n\n for (let i = 0; i < 64; i++) {\n offsetTable[i] = 1024;\n }\n offsetTable[0] = offsetTable[32] = 0;\n\n return offsetTable;\n}\n\n/**\n * Retrieve a Float16 decoder which will decode a ByteArray of Float16 values\n * to a Float32Array.\n *\n * @returns Function (buffer: Uint16Array) => Float32Array which decodes\n * the Uint16Array of Float16 bytes to a Float32Array.\n */\nexport function getFloat16Decoder(): (buffer:

Uint16Array) => Float32Array {\n // Algorithm is based off of\n // http://www.fox-toolkit.org/ftp/fasthalffloatconversion.pdf\n\n // Cache lookup tables\n const mantisaTable = computeFloat16MantisaTable();\n const exponentTable = computeFloat16ExponentTable();\n const offsetTable = computeFloat16OffsetTable();\n\n return (quantizedArray: Uint16Array) => {\n   const buffer = new ArrayBuffer(4 * quantizedArray.length);\n
    const bufferUint32View = new Uint32Array(buffer);\n   for (let index = 0; index < quantizedArray.length; index++) {\n   const float16Bits = quantizedArray[index];\n   const float32Bits =\n mantisaTable[offsetTable[float16Bits >> 10] + (float16Bits & 0x3ff)] +\n   exponentTable[float16Bits >> 10];\n
    bufferUint32View[index] = float32Bits;\n   }\n   return new Float32Array(buffer);\n };\n}\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language
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==\n
*/\n\nimport {IOHandler, LoadOptions} from './types';\n\nexport type IORouter = (url: string|string[], loadOptions?: LoadOptions) =>\n   IOHandler;\n\nexport class IORouterRegistry {\n // Singleton instance.\n private static instance: IORouterRegistry;\n\n private saveRouters: IORouter[];\n private loadRouters: IORouter[];\n\n private constructor() {\n   this.saveRouters = [];\n   this.loadRouters = [];\n }\n\n private static getInstance(): IORouterRegistry {\n   if (IORouterRegistry.instance == null) {\n   IORouterRegistry.instance = new IORouterRegistry();\n   }\n   return IORouterRegistry.instance;\n }\n\n /**\n   * Register a save-handler router.\n   *\n   * @param saveRouter A function that maps a URL-like string onto an instance\n   * of `IOHandler` with the `save` method defined or `null`.\n   */\n static registerSaveRouter(saveRouter:
 IORouter) {\n   IORouterRegistry.getInstance().saveRouters.push(saveRouter);\n }\n\n /**\n   * Register a load-handler router.\n   *\n   * @param loadRouter A function that maps a URL-like string onto an instance\n   * of `IOHandler` with the `load` method defined or `null`.\n   */\n static registerLoadRouter(loadRouter: IORouter) {\n IORouterRegistry.getInstance().loadRouters.push(loadRouter);\n }\n\n /**\n   * Look up IOHandler for saving, given a URL-like string.\n   *\n   * @param url\n   * @returns If only one match is found, an instance of IOHandler with the\n   * `save` method defined. If no match is found, `null`.\n   * @throws Error, if more than one match is found.\n   */\n static getSaveHandlers(url: string|string[]): IOHandler[] {\n   return IORouterRegistry.getHandlers(url, 'save');\n }\n\n /**\n   * Look up IOHandler for loading, given a URL-like string.\n   *\n   * @param url\n   * @param loadOptions Optional, custom load options.\n   *
 @returns All valid handlers for `url`, given the currently registered\n   *   handler routers.\n   */\n static getLoadHandlers(url: string|string[], loadOptions?: LoadOptions):\n   IOHandler[] {\n   return IORouterRegistry.getHandlers(url, 'load', loadOptions);\n }\n\n private static getHandlers(\n   url: string|string[], handlerType: 'save'|'load',\n   loadOptions?: LoadOptions): IOHandler[] {\n   const validHandlers: IOHandler[] = [];\n   const routers = handlerType === 'load' ?\n   IORouterRegistry.getInstance().loadRouters :\n IORouterRegistry.getInstance().saveRouters;\n   routers.forEach(router => {\n   const handler = router(url, loadOptions);\n   if (handler !== null) {\n   validHandlers.push(handler);\n   }\n   });\n   return validHandlers;\n }\n}\n\nexport const registerSaveRouter = (loudRouter: IORouter) =>\n IORouterRegistry.registerSaveRouter(loudRouter);\nexport const registerLoadRouter = (loudRouter: IORouter) =>\n   IORouterRegistry.registerLoadRouter(loudRouter);\nexport
 const getSaveHandlers = (url: string|string[]) =>\n   IORouterRegistry.getSaveHandlers(url);\nexport const getLoadHandlers =\n   (url: string|string[], loadOptions?: LoadOptions) =>\n IORouterRegistry.getLoadHandlers(url, loadOptions);\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this

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governing permissions and\n * limitations under the License.\n *
==========================================================================\n
 */\n\nimport '../flags';\n\nimport {env} from '../environment';\n\nimport {getModelArtifactsInfoForJSON} from
'./io_utils';\nimport {IORouter, IORouterRegistry} from './router_registry';\nimport {IOHandler, ModelArtifacts,
ModelArtifactsInfo, ModelStoreManager, SaveResult} from './types';\n\nconst DATABASE_NAME =
'tensorflowjs';\nconst DATABASE_VERSION = 1;\n\n// Model data and ModelArtifactsInfo (metadata) are stored
in two separate\n// stores for efficient access of the list of stored models and their metadata.\n// 1. The object store
for model data: topology, weights and weight manifests.\nconst MODEL_STORE_NAME = 'models_store';\n// 2.
The object store for ModelArtifactsInfo, including meta-information such\n//    as the type of topology (JSON vs
binary), byte size of the topology, byte\n//    size of the weights, etc.\nconst INFO_STORE_NAME =
'model_info_store';\n\n/**\n * Delete the entire database for tensorflow.js, including the models store.\n */\nexport
async
 function deleteDatabase(): Promise<void> {\n  const idbFactory = getIndexedDBFactory();\n\n  return new
Promise<void>((resolve, reject) => {\n    const deleteRequest =
idbFactory.deleteDatabase(DATABASE_NAME);\n    deleteRequest.onsuccess = () => resolve();\n
deleteRequest.onerror = error => reject(error);\n  });\n}\n\nfunction getIndexedDBFactory(): IDBFactory {\n  if
(!env().getBool('IS_BROWSER')) {\n    // TODO(cais): Add more info about what IOHandler subtypes are
available.\n    //   Maybe point to a doc page on the web and/or automatically determine\n    //   the available
IOHandlers and print them in the error message.\n    throw new Error(\n        'Failed to obtain IndexedDB factory
because the current environment' +\n        'is not a web browser.');\n  }\n  // tslint:disable-next-line:no-any\n  const
theWindow: any = typeof window === 'undefined' ? self : window;\n  const factory = theWindow.indexedDB ||
theWindow.mozIndexedDB ||\n      theWindow.webkitIndexedDB || theWindow.msIndexedDB
 ||\n      theWindow.shimIndexedDB;\n  if (factory == null) {\n    throw new Error(\n        'The current browser does
not appear to support IndexedDB.');\n  }\n  return factory;\n}\n\nfunction setUpDatabase(openRequest:
IDBRequest) {\n  const db = openRequest.result as IDBDatabase;\n
db.createObjectStore(MODEL_STORE_NAME, {keyPath: 'modelPath'});\n
db.createObjectStore(INFO_STORE_NAME, {keyPath: 'modelPath'});\n}\n\n/**\n * IOHandler subclass: Browser
IndexedDB.\n *\n * See the doc string of `browserIndexedDB` for more details.\n */\nexport class
BrowserIndexedDB implements IOHandler {\n  protected readonly indexedDB: IDBFactory;\n  protected readonly
modelPath: string;\n\n  static readonly URL_SCHEME = 'indexeddb://';\n\n  constructor(modelPath: string) {\n
this.indexedDB = getIndexedDBFactory();\n\n    if (modelPath == null || !modelPath) {\n      throw new Error(\n
 'For IndexedDB, modelPath must not be null, undefined or empty.');\n    }\n    this.modelPath
 = modelPath;\n  }\n\n  async save(modelArtifacts: ModelArtifacts): Promise<SaveResult> {\n    // TODO(cais):
Support saving GraphDef models.\n    if (modelArtifacts.modelTopology instanceof ArrayBuffer) {\n      throw new
Error(\n          'BrowserLocalStorage.save() does not support saving model topology ' +\n          'in binary formats
yet.');\n    }\n\n    return this.databaseAction(this.modelPath, modelArtifacts) as\n        Promise<SaveResult>;\n
}\n\n  async load(): Promise<ModelArtifacts> {\n    return this.databaseAction(this.modelPath) as
Promise<ModelArtifacts>;\n  }\n\n  /**\n   * Perform database action to put model artifacts into or read model
artifacts\n   * from IndexedDB object store.\n   *\n   * Whether the action is put or get depends on whether
`modelArtifacts` is\n   * specified. If it is specified, the action will be put; otherwise the action\n   * will be get.\n
*\n   * @param modelPath A unique string path for the model.\n   * @param modelArtifacts
 If specified, it will be the model artifacts to be\n   *   stored in IndexedDB.\n   * @returns A `Promise` of
`SaveResult`, if the action is put, or a `Promise`\n   *   of `ModelArtifacts`, if the action is get.\n   */\n  private
databaseAction(modelPath: string, modelArtifacts?: ModelArtifacts):\n      Promise<ModelArtifacts|SaveResult> {\n
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 return new Promise<ModelArtifacts|SaveResult>((resolve, reject) => {\n      const openRequest =
this.indexedDB.open(DATABASE_NAME, DATABASE_VERSION);\n      openRequest.onupgradeneeded = () =>
setUpDatabase(openRequest);\n\n      openRequest.onsuccess = () => {\n        const db = openRequest.result;\n\n
if (modelArtifacts == null) {\n          // Read model out from object store.\n          const modelTx =
db.transaction(MODEL_STORE_NAME, 'readonly');\n          const modelStore =
modelTx.objectStore(MODEL_STORE_NAME);\n          const getRequest = modelStore.get(this.modelPath);\n
 getRequest.onsuccess = () => {\n            if
 (getRequest.result == null) {\n              db.close();\n              return reject(new Error(\n                  `Cannot find
model with path '${this.modelPath}' ` +\n                  `in IndexedDB.`));\n            } else {\n
resolve(getRequest.result.modelArtifacts);\n            }\n          };\n          getRequest.onerror = error => {\n
db.close();\n            return reject(getRequest.error);\n          };\n          modelTx.oncomplete = () => db.close();\n
} else {\n          // Put model into object store.\n          const modelArtifactsInfo: ModelArtifactsInfo =\n
getModelArtifactsInfoForJSON(modelArtifacts);\n          // First, put ModelArtifactsInfo into info store.\n
const infoTx = db.transaction(INFO_STORE_NAME, 'readwrite');\n          let infoStore =
infoTx.objectStore(INFO_STORE_NAME);\n          const putInfoRequest =\n              infoStore.put({modelPath:
this.modelPath, modelArtifactsInfo});\n          let modelTx:
 IDBTransaction;\n          putInfoRequest.onsuccess = () => {\n            // Second, put model data into model store.\n
        modelTx = db.transaction(MODEL_STORE_NAME, 'readwrite');\n            const modelStore =
modelTx.objectStore(MODEL_STORE_NAME);\n            const putModelRequest = modelStore.put({\n
modelPath: this.modelPath,\n              modelArtifacts,\n              modelArtifactsInfo\n            });\n
putModelRequest.onsuccess = () => resolve({modelArtifactsInfo});\n            putModelRequest.onerror = error =>
{\n              // If the put-model request fails, roll back the info entry as\n              // well.\n              infoStore =
infoTx.objectStore(INFO_STORE_NAME);\n              const deleteInfoRequest =
infoStore.delete(this.modelPath);\n              deleteInfoRequest.onsuccess = () => {\n                db.close();\n
return reject(putModelRequest.error);\n              };\n              deleteInfoRequest.onerror
 = error => {\n                db.close();\n                return reject(putModelRequest.error);\n              };\n            };\n
};\n          putInfoRequest.onerror = error => {\n            db.close();\n            return reject(putInfoRequest.error);\n
  };\n          infoTx.oncomplete = () => {\n            if (modelTx == null) {\n              db.close();\n            } else {\n
    modelTx.oncomplete = () => db.close();\n            }\n          };\n        }\n      };\n      openRequest.onerror = error
=> reject(openRequest.error);\n    });\n  }\n}\n\nexport const indexedDBRouter: IORouter = (url: string|string[]) =>
{\n  if (!env().getBool('IS_BROWSER')) {\n    return null;\n  } else {\n    if (!Array.isArray(url) &&
url.startsWith(BrowserIndexedDB.URL_SCHEME)) {\n      return
browserIndexedDB(url.slice(BrowserIndexedDB.URL_SCHEME.length));\n    } else {\n      return null;\n    }\n
}\n};\nIORouterRegistry.registerSaveRouter(indexedDBRouter);\nIORouterRegistry.registerLoadRouter(indexedD
BRouter);\n\n/**\n
 * Creates a browser IndexedDB IOHandler for saving and loading models.\n *\n * ```js\n * const model =
tf.sequential();\n * model.add(\n *     tf.layers.dense({units: 1, inputShape: [100], activation: 'sigmoid'}));\n *\n *
const saveResult = await model.save('indexeddb://MyModel'));\n * console.log(saveResult);\n * ```\n *\n * @param
modelPath A unique identifier for the model to be saved. Must be a\n *    non-empty string.\n * @returns An
instance of `BrowserIndexedDB` (sublcass of `IOHandler`),\n *    which can be used with, e.g., `tf.Model.save`.\n
*/\nexport function browserIndexedDB(modelPath: string): IOHandler {\n  return new
BrowserIndexedDB(modelPath);\n}\n\nfunction maybeStripScheme(key: string) {\n  return
key.startsWith(BrowserIndexedDB.URL_SCHEME) ?\n      key.slice(BrowserIndexedDB.URL_SCHEME.length)
:\n      key;\n}\n\nexport class BrowserIndexedDBManager implements ModelStoreManager {\n  private
indexedDB:
 IDBFactory;\n\n  constructor() {\n    this.indexedDB = getIndexedDBFactory();\n  }\n\n  async listModels():
Promise<{[path: string]: ModelArtifactsInfo}> {\n    return new Promise<{[path: string]: ModelArtifactsInfo}>(\n
  (resolve, reject) => {\n          const openRequest =\n              this.indexedDB.open(DATABASE_NAME,
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DATABASE_VERSION);\n          openRequest.onupgradeneeded = () => setUpDatabase(openRequest);\n\n
openRequest.onsuccess = () => {\n            const db = openRequest.result;\n            const tx =
db.transaction(INFO_STORE_NAME, 'readonly');\n            const store = tx.objectStore(INFO_STORE_NAME);\n
        // tslint:disable:max-line-length\n            // Need to cast `store` as `any` here because TypeScript's DOM\n
 // library does not have the `getAll()` method even though the\n            // method is supported in the latest version of
most mainstream\n            // browsers:\n            // https://developer.mozilla.org/en-
US/docs/Web/API/IDBObjectStore/getAll\n
            // tslint:enable:max-line-length\n            // tslint:disable-next-line:no-any\n            const getAllInfoRequest =
(store as any).getAll() as IDBRequest;\n            getAllInfoRequest.onsuccess = () => {\n              const out: {[path:
string]: ModelArtifactsInfo} = {};\n              for (const item of getAllInfoRequest.result) {\n
out[item.modelPath] = item.modelArtifactsInfo;\n              }\n              resolve(out);\n            };\n
getAllInfoRequest.onerror = error => {\n              db.close();\n              return reject(getAllInfoRequest.error);\n
  };\n            tx.oncomplete = () => db.close();\n          };\n          openRequest.onerror = error =>
reject(openRequest.error);\n        });\n  }\n\n  async removeModel(path: string): Promise<ModelArtifactsInfo> {\n
path = maybeStripScheme(path);\n    return new Promise<ModelArtifactsInfo>((resolve, reject) => {\n      const
openRequest
 = this.indexedDB.open(DATABASE_NAME, DATABASE_VERSION);\n      openRequest.onupgradeneeded = ()
=> setUpDatabase(openRequest);\n\n      openRequest.onsuccess = () => {\n        const db = openRequest.result;\n
  const infoTx = db.transaction(INFO_STORE_NAME, 'readwrite');\n        const infoStore =
infoTx.objectStore(INFO_STORE_NAME);\n\n        const getInfoRequest = infoStore.get(path);\n        let modelTx:
IDBTransaction;\n        getInfoRequest.onsuccess = () => {\n          if (getInfoRequest.result == null) {\n
db.close();\n            return reject(new Error(\n                `Cannot find model with path '${path}' ` +\n                `in
IndexedDB.`));\n          } else {\n            // First, delete the entry in the info store.\n            const deleteInfoRequest =
infoStore.delete(path);\n            const deleteModelData = () => {\n              // Second, delete the entry in the model
store.\n              modelTx = db.transaction(MODEL_STORE_NAME,
 'readwrite');\n              const modelStore = modelTx.objectStore(MODEL_STORE_NAME);\n              const
deleteModelRequest = modelStore.delete(path);\n              deleteModelRequest.onsuccess = () =>\n
resolve(getInfoRequest.result.modelArtifactsInfo);\n              deleteModelRequest.onerror = error =>\n
reject(getInfoRequest.error);\n            };\n            // Proceed with deleting model data regardless of whether
deletion\n            // of info data succeeds or not.\n            deleteInfoRequest.onsuccess = deleteModelData;\n
deleteInfoRequest.onerror = error => {\n              deleteModelData();\n              db.close();\n              return
reject(getInfoRequest.error);\n            };\n          }\n        };\n        getInfoRequest.onerror = error => {\n
db.close();\n          return reject(getInfoRequest.error);\n        };\n\n        infoTx.oncomplete = () => {\n          if
(modelTx == null) {\n
      db.close();\n          } else {\n            modelTx.oncomplete = () => db.close();\n          }\n        };\n      };\n
openRequest.onerror = error => reject(openRequest.error);\n    });\n  }\n}\n","/**\n * @license\n * Copyright 2018
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==========================================================================\n
*/\n\nimport '../flags';\nimport {env} from '../environment';\n\nimport
 {assert} from '../util';\nimport {arrayBufferToBase64String, base64StringToArrayBuffer,
getModelArtifactsInfoForJSON} from './io_utils';\nimport {IORouter, IORouterRegistry} from
'./router_registry';\nimport {IOHandler, ModelArtifacts, ModelArtifactsInfo, ModelStoreManager, SaveResult}
from './types';\n\nconst PATH_SEPARATOR = '/';\nconst PATH_PREFIX = 'tensorflowjs_models';\nconst
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INFO_SUFFIX = 'info';\nconst MODEL_TOPOLOGY_SUFFIX = 'model_topology';\nconst
WEIGHT_SPECS_SUFFIX = 'weight_specs';\nconst WEIGHT_DATA_SUFFIX = 'weight_data';\nconst
MODEL_METADATA_SUFFIX = 'model_metadata';\n\n/**\n * Purge all tensorflow.js-saved model artifacts from
local storage.\n *\n * @returns Paths of the models purged.\n */\nexport function purgeLocalStorageArtifacts():
string[] {\n  if (!env().getBool('IS_BROWSER') || typeof window === 'undefined' ||\n      typeof
window.localStorage === 'undefined') {\n    throw new Error(\n        'purgeLocalStorageModels() cannot proceed
because local storage is
' +\n        'unavailable in the current environment.');\n  }\n  const LS = window.localStorage;\n  const
purgedModelPaths: string[] = [];\n  for (let i = 0; i < LS.length; ++i) {\n    const key = LS.key(i);\n    const prefix =
PATH_PREFIX + PATH_SEPARATOR;\n    if (key.startsWith(prefix) && key.length > prefix.length) {\n
LS.removeItem(key);\n      const modelName = getModelPathFromKey(key);\n      if
(purgedModelPaths.indexOf(modelName) === -1) {\n        purgedModelPaths.push(modelName);\n      }\n    }\n
}\n  return purgedModelPaths;\n}\n\nfunction getModelKeys(path: string): {\n  info: string,\n  topology: string,\n
weightSpecs: string,\n  weightData: string,\n  modelMetadata: string\n} {\n  return {\n    info: [PATH_PREFIX,
path, INFO_SUFFIX].join(PATH_SEPARATOR),\n    topology: [PATH_PREFIX, path,
MODEL_TOPOLOGY_SUFFIX].join(PATH_SEPARATOR),\n    weightSpecs: [PATH_PREFIX, path,
WEIGHT_SPECS_SUFFIX].join(PATH_SEPARATOR),\n    weightData: [PATH_PREFIX, path,
WEIGHT_DATA_SUFFIX].join(PATH_SEPARATOR),\n
   modelMetadata:\n        [PATH_PREFIX, path, MODEL_METADATA_SUFFIX].join(PATH_SEPARATOR)\n
};\n}\n\n/**\n * Get model path from a local-storage key.\n *\n * E.g., 'tensorflowjs_models/my/model/1/info' -->
'my/model/1'\n *\n * @param key\n */\nfunction getModelPathFromKey(key: string) {\n  const items =
key.split(PATH_SEPARATOR);\n  if (items.length < 3) {\n    throw new Error(`Invalid key format: ${key}`);\n  }\n
return items.slice(1, items.length - 1).join(PATH_SEPARATOR);\n}\n\nfunction maybeStripScheme(key: string)
{\n  return key.startsWith(BrowserLocalStorage.URL_SCHEME) ?\n
key.slice(BrowserLocalStorage.URL_SCHEME.length) :\n      key;\n}\n\ndeclare type LocalStorageKeys = {\n
info: string,\n  topology: string,\n  weightSpecs: string,\n  weightData: string,\n  modelMetadata: string\n};\n\n/**\n
* IOHandler subclass: Browser Local Storage.\n *\n * See the doc string to `browserLocalStorage` for more
details.\n */\nexport class BrowserLocalStorage
 implements IOHandler {\n  protected readonly LS: Storage;\n  protected readonly modelPath: string;\n  protected
readonly keys: LocalStorageKeys;\n\n  static readonly URL_SCHEME = 'localstorage://';\n\n
constructor(modelPath: string) {\n    if (!env().getBool('IS_BROWSER') || typeof window === 'undefined' ||\n
typeof window.localStorage === 'undefined') {\n      // TODO(cais): Add more info about what IOHandler subtypes
are\n      // available.\n      //   Maybe point to a doc page on the web and/or automatically determine\n      //   the
available IOHandlers and print them in the error message.\n      throw new Error(\n          'The current environment
does not support local storage.');\n    }\n    this.LS = window.localStorage;\n\n    if (modelPath == null || !modelPath)
{\n      throw new Error(\n          'For local storage, modelPath must not be null, undefined or empty.');\n    }\n
this.modelPath = modelPath;\n    this.keys = getModelKeys(this.modelPath);\n  }\n\n
  /**\n   * Save model artifacts to browser local storage.\n   *\n   * See the documentation to `browserLocalStorage`
for details on the saved\n   * artifacts.\n   *\n   * @param modelArtifacts The model artifacts to be stored.\n   *
@returns An instance of SaveResult.\n   */\n  async save(modelArtifacts: ModelArtifacts): Promise<SaveResult>
{\n    if (modelArtifacts.modelTopology instanceof ArrayBuffer) {\n      throw new Error(\n
'BrowserLocalStorage.save() does not support saving model topology ' +\n          'in binary formats yet.');\n    } else
{\n      const topology = JSON.stringify(modelArtifacts.modelTopology);\n      const weightSpecs =
JSON.stringify(modelArtifacts.weightSpecs);\n\n      const modelArtifactsInfo: ModelArtifactsInfo =\n
getModelArtifactsInfoForJSON(modelArtifacts);\n\n      try {\n        this.LS.setItem(this.keys.info,
JSON.stringify(modelArtifactsInfo));\n        this.LS.setItem(this.keys.topology, topology);\n
this.LS.setItem(this.keys.weightSpecs,
```

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 weightSpecs);\n        this.LS.setItem(\n            this.keys.weightData,\n
arrayBufferToBase64String(modelArtifacts.weightData));\n        const result: ModelArtifacts = {\n
format: modelArtifacts.format,\n            generatedBy: modelArtifacts.generatedBy,\n
convertedBy: modelArtifacts.convertedBy\n        };\n        if (modelArtifacts.signature != null) {\n
result.signature = modelArtifacts.signature;\n        }\n        if (modelArtifacts.userDefinedMetadata != null) {\n
result.userDefinedMetadata = modelArtifacts.userDefinedMetadata;\n        }\n        if
(modelArtifacts.modelInitializer != null) {\n            result.modelInitializer = modelArtifacts.modelInitializer;\n
}\n        this.LS.setItem(this.keys.modelMetadata, JSON.stringify(result));\n\n        return {modelArtifactsInfo};\n
} catch (err) {\n        // If saving failed, clean up all items saved so far.\n        this.LS.removeItem(this.keys.info);\n
        this.LS.removeItem(this.keys.topology);\n        this.LS.removeItem(this.keys.weightSpecs);\n
this.LS.removeItem(this.keys.weightData);\n        this.LS.removeItem(this.keys.modelMetadata);\n\n        throw new
Error(\n            `Failed to save model '${this.modelPath}' to local storage: ` +\n            `size quota being exceeded is
a possible cause of this failure: ` +\n            `modelTopologyBytes=${modelArtifactsInfo.modelTopologyBytes}, ` +\n
+\n            `weightSpecsBytes=${modelArtifactsInfo.weightSpecsBytes}, ` +\n
`weightDataBytes=${modelArtifactsInfo.weightDataBytes}.`);\n      }\n    }\n  }\n\n  /**\n   * Load a model from
local storage.\n   *\n   * See the documentation to `browserLocalStorage` for details on the saved\n   * artifacts.\n
*\n   * @returns The loaded model (if loading succeeds).\n   */\n  async load(): Promise<ModelArtifacts> {\n
const info =\n        JSON.parse(this.LS.getItem(this.keys.info)) as ModelArtifactsInfo;\n
    if (info == null) {\n      throw new Error(\n          `In local storage, there is no model with name
'${this.modelPath}'`);\n    }\n\n    if (info.modelTopologyType !== 'JSON') {\n      throw new Error(\n
'BrowserLocalStorage does not support loading non-JSON model ' +\n          'topology yet.');\n    }\n\n    const out:
ModelArtifacts = {};\n\n    // Load topology.\n    const topology =
JSON.parse(this.LS.getItem(this.keys.topology));\n    if (topology == null) {\n      throw new Error(\n          `In local
storage, the topology of model '${this.modelPath}' ` +\n          `is missing.`);\n    }\n    out.modelTopology =
topology;\n\n    // Load weight specs.\n    const weightSpecs =
JSON.parse(this.LS.getItem(this.keys.weightSpecs));\n    if (weightSpecs == null) {\n      throw new Error(\n
`In local storage, the weight specs of model '${this.modelPath}' ` +\n          `are missing.`);\n    }\n
out.weightSpecs = weightSpecs;\n\n    // Load meta-data fields.\n
    const metadataString = this.LS.getItem(this.keys.modelMetadata);\n    if (metadataString != null) {\n      const
metadata = JSON.parse(metadataString) as ModelArtifacts;\n      out.format = metadata['format'];\n
out.generatedBy = metadata['generatedBy'];\n      out.convertedBy = metadata['convertedBy'];\n      if
(metadata['signature'] != null) {\n        out.signature = metadata['signature'];\n      }\n      if
(metadata['userDefinedMetadata'] != null) {\n        out.userDefinedMetadata = metadata['userDefinedMetadata'];\n
  }\n      if (metadata['modelInitializer'] != null) {\n        out.modelInitializer = metadata['modelInitializer'];\n      }\n
}\n\n    // Load weight data.\n    const weightDataBase64 = this.LS.getItem(this.keys.weightData);\n    if
(weightDataBase64 == null) {\n      throw new Error(\n          `In local storage, the binary weight values of model ` +\n
`'${this.modelPath}' are missing.`);\n    }\n    out.weightData =
base64StringToArrayBuffer(weightDataBase64);\n\n
    return out;\n  }\n}\n\nexport const localStorageRouter: IORouter = (url: string|string[]) => {\n  if
(!env().getBool('IS_BROWSER')) {\n    return null;\n  } else {\n    if (!Array.isArray(url) &&
url.startsWith(BrowserLocalStorage.URL_SCHEME)) {\n      return browserLocalStorage(\n
url.slice(BrowserLocalStorage.URL_SCHEME.length));\n    } else {\n      return null;\n    }\n
}\n};\nIORouterRegistry.registerSaveRouter(localStorageRouter);\nIORouterRegistry.registerLoadRouter(localStor
ageRouter);\n\n/**\n * Factory function for local storage IOHandler.\n *\n * This `IOHandler` supports both `save`
and `load`.\n *\n * For each model's saved artifacts, four items are saved to local storage.\n *   -
`${PATH_SEPARATOR}/${modelPath}/info`: Contains meta-info about the\n *     model, such as date saved, type
of the topology, size in bytes, etc.\n *   - `${PATH_SEPARATOR}/${modelPath}/topology`: Model topology. For
Keras-\n *     style models, this is a
```

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stringized JSON.\n *   - `${PATH_SEPARATOR}/${modelPath}/weight_specs`: Weight specs of the\n *     model, can be used to decode the saved binary weight values (see\n *     item below).\n *   - `${PATH_SEPARATOR}/${modelPath}/weight_data`: Concatenated binary\n *     weight values, stored as a base64-encoded string.\n *\n * Saving may throw an `Error` if the total size of the artifacts exceed the\n * browser-specific quota.\n *\n * @param modelPath A unique identifier for the model to be saved. Must be a\n *   non-empty string.\n * @returns An instance of `IOHandler`, which can be used with, e.g.,\n *   `tf.Model.save`.\n */\nexport function browserLocalStorage(modelPath: string): IOHandler {\n  return new BrowserLocalStorage(modelPath);\n}\n\nexport class BrowserLocalStorageManager implements ModelStoreManager {\n  private readonly LS: Storage;\n\n  constructor() {\n    assert(\n        env().getBool('IS_BROWSER'),\n        () => 'Current environment is not a web browser');\n    assert(\n        typeof window === 'undefined' ||\n            typeof window.localStorage !== 'undefined',\n        () => 'Current browser does not appear to support localStorage');\n    this.LS = window.localStorage;\n  }\n\n  async listModels(): Promise<{[path: string]: ModelArtifactsInfo}> {\n    const out: {[path: string]: ModelArtifactsInfo} = {};\n    const prefix = PATH_PREFIX + PATH_SEPARATOR;\n    const suffix = PATH_SEPARATOR + INFO_SUFFIX;\n    for (let i = 0; i < this.LS.length; ++i) {\n      const key = this.LS.key(i);\n      if (key.startsWith(prefix) && key.endsWith(suffix)) {\n        const modelPath = getModelPathFromKey(key);\n        out[modelPath] = JSON.parse(this.LS.getItem(key)) as ModelArtifactsInfo;\n      }\n    }\n    return out;\n  }\n\n  async removeModel(path: string): Promise<ModelArtifactsInfo> {\n    path = maybeStripScheme(path);\n    const keys = getModelKeys(path);\n    if (this.LS.getItem(keys.info) == null) {\n      throw new Error(`Cannot find model at path '${path}'`);\n    }\n    const info = JSON.parse(this.LS.getItem(keys.info)) as ModelArtifactsInfo;\n\n    this.LS.removeItem(keys.info);\n    this.LS.removeItem(keys.topology);\n    this.LS.removeItem(keys.weightSpecs);\n    this.LS.removeItem(keys.weightData);\n    return info;\n  }\n}\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ============================================================================\n */\n\n/**\n * Classes and functions for model management across multiple storage mediums.\n *\n * Supported client actions:\n * - Listing models on all registered storage mediums.\n * - Remove model by URL from any registered storage mediums, by using URL\n *   string.\n * - Moving or copying model from one path to another in the same medium or from\n *   one medium to another, by using URL strings.\n */\n\nimport {assert} from '../util';\n\nimport {IORouterRegistry} from './router_registry';\nimport {ModelArtifactsInfo, ModelStoreManager} from './types';\n\nconst URL_SCHEME_SUFFIX = '://';\n\nexport class ModelStoreManagerRegistry {\n  // Singleton instance.\n  private static instance: ModelStoreManagerRegistry;\n\n  private managers: {[scheme: string]: ModelStoreManager};\n\n  private constructor() {\n    this.managers = {};\n  }\n\n  private static getInstance(): ModelStoreManagerRegistry {\n    if (ModelStoreManagerRegistry.instance == null) {\n      ModelStoreManagerRegistry.instance\n          = new ModelStoreManagerRegistry();\n    }\n    return ModelStoreManagerRegistry.instance;\n  }\n\n  /**\n   * Register a save-handler router.\n   *\n   * @param saveRouter A function that maps a URL-like string onto an instance\n   * of `IOHandler` with the `save` method defined or `null`.\n   */\n  static registerManager(scheme: string, manager: ModelStoreManager) {\n    assert(scheme != null, () => 'scheme must not be undefined or null.');\n    if (scheme.endsWith(URL_SCHEME_SUFFIX)) {\n      scheme = scheme.slice(0, scheme.indexOf(URL_SCHEME_SUFFIX));\n    }\n    assert(scheme.length > 0, () => 'scheme must not be an empty string.');\n    const registry = ModelStoreManagerRegistry.getInstance();\n    assert(\n        registry.managers[scheme] == null,\n        () => `A model store manager is already registered for scheme '${\n            scheme}'.`);\n    registry.managers[scheme] = manager;\n  }\n\n  static getManager(scheme: string):
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ModelStoreManager {\n
  const manager = this.getInstance().managers[scheme];\n    if (manager == null) {\n      throw new Error(`Cannot
find model manager for scheme '${scheme}'`);\n    }\n    return manager;\n  }\n\n  static getSchemes(): string[] {\n
return Object.keys(this.getInstance().managers);\n  }\n}\n\n/**\n * Helper method for parsing a URL string into a
scheme and a path.\n *\n * @param url E.g., 'localstorage://my-model'\n * @returns A dictionary with two fields:
scheme and path.\n *   Scheme: e.g., 'localstorage' in the example above.\n *   Path: e.g., 'my-model' in the example
above.\n */\nfunction parseURL(url: string): {scheme: string, path: string} {\n  if
(url.indexOf(URL_SCHEME_SUFFIX) === -1) {\n    throw new Error(\n        `The url string provided does not
contain a scheme. ` +\n        `Supported schemes are: ` +\n
`${ModelStoreManagerRegistry.getSchemes().join(',')}`);\n  }\n  return {\n    scheme:
url.split(URL_SCHEME_SUFFIX)[0],\n    path: url.split(URL_SCHEME_SUFFIX)[1],\n
  };\n}\n\nasync function cloneModelInternal(\n    sourceURL: string, destURL: string,\n    deleteSource = false):
Promise<ModelArtifactsInfo> {\n  assert(\n      sourceURL !== destURL,\n      () => `Old path and new path are the
same: '${sourceURL}'`);\n\n  const loadHandlers = IORouterRegistry.getLoadHandlers(sourceURL);\n  assert(\n
loadHandlers.length > 0,\n      () => `Copying failed because no load handler is found for source URL ${\n
sourceURL}.`);\n  assert(\n      loadHandlers.length < 2,\n      () => `Copying failed because more than one
(${loadHandlers.length}) ` +\n          `load handlers for source URL ${sourceURL}.`);\n  const loadHandler =
loadHandlers[0];\n\n  const saveHandlers = IORouterRegistry.getSaveHandlers(destURL);\n  assert(\n
saveHandlers.length > 0,\n      () => `Copying failed because no save handler is found for destination ` +\n
`URL ${destURL}.`);\n  assert(\n      saveHandlers.length < 2,\n      () => `Copying failed because
  more than one (${loadHandlers.length}) ` +\n          `save handlers for destination URL ${destURL}.`);\n  const
saveHandler = saveHandlers[0];\n\n  const sourceScheme = parseURL(sourceURL).scheme;\n  const sourcePath =
parseURL(sourceURL).path;\n  const sameMedium = sourceScheme === parseURL(sourceURL).scheme;\n\n
const modelArtifacts = await loadHandler.load();\n\n  // If moving within the same storage medium, remove the old
model as soon as\n  // the loading is done. Without doing this, it is possible that the combined\n  // size of the two
models will cause the cloning to fail.\n  if (deleteSource && sameMedium) {\n    await
ModelStoreManagerRegistry.getManager(sourceScheme)\n        .removeModel(sourcePath);\n  }\n\n  const
saveResult = await saveHandler.save(modelArtifacts);\n\n  // If moving between mediums, the deletion is done after
the save succeeds.\n  // This guards against the case in which saving to the destination medium\n  // fails.\n  if
(deleteSource && !sameMedium)
  {\n    await ModelStoreManagerRegistry.getManager(sourceScheme)\n        .removeModel(sourcePath);\n  }\n\n
return saveResult.modelArtifactsInfo;\n}\n\n/**\n * List all models stored in registered storage mediums.\n *\n *
For a web browser environment, the registered mediums are Local Storage and\n * IndexedDB.\n *\n * ```js\n * //
First create and save a model.\n * const model = tf.sequential();\n * model.add(tf.layers.dense(\n *     {units: 1,
inputShape: [10], activation: 'sigmoid'}));\n * await model.save('localstorage://demo/management/model1');\n *\n *
// Then list existing models.\n * console.log(JSON.stringify(await tf.io.listModels()));\n *\n * // Delete the model.\n
* await tf.io.removeModel('localstorage://demo/management/model1');\n *\n * // List models again.\n *
console.log(JSON.stringify(await tf.io.listModels()));\n * ```\n *\n * @returns A `Promise` of a dictionary mapping
URLs of existing models to\n * their model artifacts info. URLs include medium-specific schemes,
  e.g.,\n *   'indexeddb://my/model/1'. Model artifacts info include type of the\n * model's topology, byte sizes of the
topology, weights, etc.\n *\n * @doc {\n *   heading: 'Models',\n *   subheading: 'Management',\n *   namespace:
'io',\n *   ignoreCI: true\n * }\n */\nasync function listModels(): Promise<{[url: string]: ModelArtifactsInfo}> {\n
const schemes = ModelStoreManagerRegistry.getSchemes();\n  const out: {[url: string]: ModelArtifactsInfo} =
{};\n  for (const scheme of schemes) {\n    const schemeOut =\n        await
ModelStoreManagerRegistry.getManager(scheme).listModels();\n    for (const path in schemeOut) {\n      const url =
scheme + URL_SCHEME_SUFFIX + path;\n      out[url] = schemeOut[path];\n    }\n  }\n  return out;\n}\n\n/**\n *
Remove a model specified by URL from a reigstered storage medium.\n *\n * ```js\n * // First create and save a
model.\n * const model = tf.sequential();\n * model.add(tf.layers.dense(\n *     {units: 1, inputShape: [10],
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activation: 'sigmoid'}));\n
 * await model.save('localstorage://demo/management/model1');\n *\n * // Then list existing models.\n * console.log(JSON.stringify(await tf.io.listModels()));\n *\n * // Delete the model.\n * await tf.io.removeModel('localstorage://demo/management/model1');\n *\n * // List models again.\n * console.log(JSON.stringify(await tf.io.listModels()));\n * ```\n *\n * @param url A URL to a stored model, with a scheme prefix, e.g.,\n *   'localstorage://my-model-1', 'indexeddb://my/model/2'.\n * @returns ModelArtifactsInfo of the deleted model (if and only if deletion\n *   is successful).\n * @throws Error if deletion fails, e.g., if no model exists at `path`.\n *\n * @doc {\n *   heading: 'Models',\n *   subheading: 'Management',\n *   namespace: 'io',\n *   ignoreCI: true\n * }\n */\nasync function removeModel(url: string): Promise<ModelArtifactsInfo> {\n const schemeAndPath = parseURL(url);\n const manager = ModelStoreManagerRegistry.getManager(schemeAndPath.scheme);\n return manager.removeModel(schemeAndPath.path);\n}\n\n/**\n * Copy a model from one URL to another.\n *\n * This function supports:\n *\n * 1. Copying within a storage medium, e.g.,\n *   `tf.io.copyModel('localstorage://model-1', 'localstorage://model-2')`\n * 2. Copying between two storage mediums, e.g.,\n *   `tf.io.copyModel('localstorage://model-1', 'indexeddb://model-1')`\n *\n * ```js\n * // First create and save a model.\n * const model = tf.sequential();\n * model.add(tf.layers.dense(\n *   {units: 1, inputShape: [10], activation: 'sigmoid'}));\n * await model.save('localstorage://demo/management/model1');\n *\n * // Then list existing models.\n * console.log(JSON.stringify(await tf.io.listModels()));\n *\n * // Copy the model, from Local Storage to IndexedDB.\n * await tf.io.copyModel(\n *   'localstorage://demo/management/model1',\n *   'indexeddb://demo/management/model1');\n *\n * // List models again.\n * console.log(JSON.stringify(await tf.io.listModels()));\n *\n * // Remove both models.\n * await tf.io.removeModel('localstorage://demo/management/model1');\n * await tf.io.removeModel('indexeddb://demo/management/model1');\n * ```\n *\n * @param sourceURL Source URL of copying.\n * @param destURL Destination URL of copying.\n * @returns ModelArtifactsInfo of the copied model (if and only if copying\n *   is successful).\n * @throws Error if copying fails, e.g., if no model exists at `sourceURL`, or\n *   if `oldPath` and `newPath` are identical.\n *\n * @doc {\n *   heading: 'Models',\n *   subheading: 'Management',\n *   namespace: 'io',\n *   ignoreCI: true\n * }\n */\nasync function copyModel(\n   sourceURL: string, destURL: string): Promise<ModelArtifactsInfo> {\n const deleteSource = false;\n return cloneModelInternal(sourceURL, destURL, deleteSource);\n}\n\n/**\n * Move a model from one URL to another.\n *\n * This function supports:\n *\n * 1. Moving within a storage medium, e.g.,\n *   `tf.io.moveModel('localstorage://model-1', 'localstorage://model-2')`\n
 * 2. Moving between two storage mediums, e.g.,\n *   `tf.io.moveModel('localstorage://model-1', 'indexeddb://model-1')`\n *\n * ```js\n * // First create and save a model.\n * const model = tf.sequential();\n * model.add(tf.layers.dense(\n *   {units: 1, inputShape: [10], activation: 'sigmoid'}));\n * await model.save('localstorage://demo/management/model1');\n *\n * // Then list existing models.\n * console.log(JSON.stringify(await tf.io.listModels()));\n *\n * // Move the model, from Local Storage to IndexedDB.\n * await tf.io.moveModel(\n *   'localstorage://demo/management/model1',\n *   'indexeddb://demo/management/model1');\n *\n * // List models again.\n * console.log(JSON.stringify(await tf.io.listModels()));\n *\n * // Remove the moved model.\n * await tf.io.removeModel('indexeddb://demo/management/model1');\n * ```\n *\n * @param sourceURL Source URL of moving.\n * @param destURL Destination URL of moving.\n * @returns ModelArtifactsInfo of the copied model (if and only if copying\n *   is successful).\n * @throws Error if moving fails, e.g., if no model exists at `sourceURL`, or\n *   if `oldPath` and `newPath` are identical.\n *\n * @doc {\n *   heading: 'Models',\n *   subheading: 'Management',\n *   namespace: 'io',\n *   ignoreCI: true\n * }\n */\nasync function moveModel(\n   sourceURL: string, destURL: string): Promise<ModelArtifactsInfo> {\n const deleteSource = true;\n return cloneModelInternal(sourceURL, destURL, deleteSource);\n}\n\nexport {moveModel, copyModel, removeModel, listModels};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the

License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an
\"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport '../flags';\n\nimport {env} from '../environment';\nimport {BrowserIndexedDB, BrowserIndexedDBManager} from '../io/indexed_db';\nimport {BrowserLocalStorage, BrowserLocalStorageManager} from '../io/local_storage';\nimport {ModelStoreManagerRegistry} from '../io/model_management';\n\nimport {Platform} from './platform';\n\nexport class PlatformBrowser implements Platform {\n // According to the spec, the built-in encoder can do only UTF-8 encoding.\n // https://developer.mozilla.org/en-US/docs/Web/API/TextEncoder/TextEncoder\n private textEncoder: TextEncoder;\n\n fetch(path: string, init?: RequestInit): Promise<Response> {\n return fetch(path, init);\n }\n\n now(): number {\n return
performance.now();\n }\n\n encode(text: string, encoding: string): Uint8Array {\n if (encoding !== 'utf-8' && encoding !== 'utf8') {\n throw new Error(\n `Browser's encoder only supports utf-8, but got ${encoding}`);\n }\n if (this.textEncoder == null) {\n this.textEncoder = new TextEncoder();\n }\n return this.textEncoder.encode(text);\n }\n decode(bytes: Uint8Array, encoding: string): string {\n return new TextDecoder(encoding).decode(bytes);\n }\n}\n\nif (env().get('IS_BROWSER')) {\n env().setPlatform('browser', new PlatformBrowser());\n\n // Register LocalStorage IOHandler\n try {\n ModelStoreManagerRegistry.registerManager(\n BrowserLocalStorage.URL_SCHEME, new BrowserLocalStorageManager());\n } catch (err) {\n }\n\n // Register IndexedDB IOHandler\n try {\n ModelStoreManagerRegistry.registerManager(\n BrowserIndexedDB.URL_SCHEME, new BrowserIndexedDBManager());\n } catch (err) {\n }\n}\n","/**\n * @license\n
* Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\nimport {env} from '../environment';\n\nimport {Platform} from './platform';\n\n// We are wrapping this within an object so it can be stubbed by Jasmine.\nexport const getNodeFetch = {\n // tslint:disable-next-line:no-require-imports\n importFetch: () => require('node-fetch')\n};\n\ntype FetchFn
= (url: string, init?: RequestInit) => Promise<Response>;\nlet systemFetch: FetchFn;\n// These getters and setters are for testing so we don't export a mutable\n// variable.\nexport function resetSystemFetch() {\n systemFetch = null;\n}\nexport function setSystemFetch(fetchFn: FetchFn) {\n systemFetch = fetchFn;\n}\nexport function getSystemFetch(): FetchFn {\n return systemFetch;\n}\n\nexport class PlatformNode implements Platform {\n private textEncoder: TextEncoder;\n // tslint:disable-next-line:no-any\n util: any;\n\n constructor() {\n // tslint:disable-next-line:no-require-imports\n this.util = require('util');\n // According to the spec, the built-in encoder can do only UTF-8 encoding.\n // https://developer.mozilla.org/en-US/docs/Web/API/TextEncoder/TextEncoder\n this.textEncoder = new this.util.TextEncoder();\n }\n\n fetch(path: string, requestInits?: RequestInit): Promise<Response> {\n if (env().global.fetch != null) {\n return env().global.fetch(path,
requestInits);\n }\n\n if (systemFetch == null) {\n systemFetch = getNodeFetch.importFetch();\n }\n return systemFetch(path, requestInits);\n }\n\n now(): number {\n const time = process.hrtime();\n return time[0] * 1000 + time[1] / 1000000;\n }\n\n encode(text: string, encoding: string): Uint8Array {\n if (encoding !== 'utf-8' && encoding !== 'utf8') {\n throw new Error(\n `Node built-in encoder only supports utf-8, but

got ${encoding}`);\n }\n return this.textEncoder.encode(text);\n }\n decode(bytes: Uint8Array, encoding: string): string {\n if (bytes.length === 0) {\n return '';\n }\n return new this.util.TextDecoder(encoding).decode(bytes);\n }\n}\n\nif (env().get('IS_NODE')) {\n env().setPlatform('node', new PlatformNode());\n}\n","/**\n * @license\n * Copyright 2020 Google Inc. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ===\n */\n\nimport {TensorBuffer} from '../tensor';\nimport {DataType, DataTypeMap, Rank, ShapeMap} from '../types';\nimport * as util from '../util';\n\n/**\n * Creates an empty `tf.TensorBuffer` with the specified `shape` and `dtype`.\n *\n * The values are stored in CPU as `TypedArray`. Fill the buffer using\n * `buffer.set()`, or by modifying directly `buffer.values`.\n *\n * When done, call `buffer.toTensor()` to get an immutable `tf.Tensor` with\n *
those values.\n *\n * ```js\n * // Create a buffer and set values at particular indices.\n * const buffer = tf.buffer([2, 2]);\n * buffer.set(3, 0, 0);\n * buffer.set(5, 1, 0);\n *\n * // Convert the buffer back to a tensor.\n * buffer.toTensor().print();\n * ```\n *\n * @param shape An array of integers defining the output tensor shape.\n * @param dtype The dtype of the buffer. Defaults to 'float32'.\n * @param values The values of the buffer as `TypedArray`. Defaults to\n * zeros.\n *\n * @doc {heading: 'Tensors', subheading: 'Creation'}\n */\nexport function buffer<R extends Rank, D extends DataType = 'float32'>(\n shape: ShapeMap[R], dtype: D = 'float32' as D,\n values?: DataTypeMap[D]): TensorBuffer<R, D> {\n dtype = dtype || 'float32' as D;\n util.assertNonNegativeIntegerDimensions(shape);\n return new TensorBuffer<R, D>(shape, dtype, values);\n}\n","/**\n * @license\n * Copyright 2020 Google Inc. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the
\"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ===\n */\nimport {ENGINE} from '../engine';\nimport {Cast, CastAttrs, CastInputs} from '../kernel_names';\nimport {NamedAttrMap} from '../kernel_registry';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {DataType, TensorLike} from '../types';\nimport * as util from '../util';\n\nimport {op} from './operation';\n\n/**\n
* Casts a `tf.Tensor` to a new dtype.\n *\n * ```js\n * const x = tf.tensor1d([1.5, 2.5, 3]);\n * tf.cast(x, 'int32').print();\n * ```\n * @param x The input tensor to be casted.\n * @param dtype The dtype to cast the input tensor to.\n *\n * @doc {heading: 'Tensors', subheading: 'Transformations'}\n */\nfunction cast_<T extends Tensor>(x: T|TensorLike, dtype: DataType): T {\n const $x = convertToTensor(x, 'x', 'cast');\n\n // Sanity checks.\n if (!util.isValidDtype(dtype)) {\n throw new Error(`Failed to cast to unknown dtype ${dtype}`);\n }\n if (dtype === 'string' && $x.dtype !== 'string' ||\n dtype !== 'string' && $x.dtype === 'string') {\n throw new Error('Only strings can be casted to strings');\n }\n\n const inputs: CastInputs = {x: $x};\n const attrs: CastAttrs = {dtype};\n\n return ENGINE.runKernel(\n Cast, inputs as {} as NamedTensorMap, attrs as {} as NamedAttrMap);\n}\n\nexport const cast = op({cast_});\n","/**\n * @license\n * Copyright 2020
Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing,

software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {ENGINE} from '../engine';\nimport {Identity, IdentityInputs} from '../kernel_names';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\n\nimport {op} from './operation';\n\n/**\n * Creates a new tensor with the same values and shape as the specified\n * tensor.\n *\n * ```js\n * const x = tf.tensor([1, 2]);\n *\n * x.clone().print();\n * ```\n *\n * @param x The tensor to clone.\n *\n * @doc {heading: 'Tensors', subheading: 'Creation'}\n */\nfunction clone_<T extends Tensor>(x: T|TensorLike): T {\n const $x = convertToTensor(x, 'x', 'clone', 'string_or_numeric');\n const inputs: IdentityInputs = {x: $x};\n\n // Note this op is called tf.identity in python. Hence the kernel name used\n // here.\n return ENGINE.runKernel(Identity, inputs as {} as NamedTensorMap);\n}\n\nexport const clone = op({clone_});\n","/**\n * @license\n * Copyright 2020 Google Inc. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed
to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {Tensor} from '../tensor';\n\n/**\n * Prints information about the `tf.Tensor` including its data.\n *\n * ```js\n * const verbose = true;\n * tf.tensor2d([1, 2, 3, 4], [2, 2]).print(verbose);\n * ```\n * @param x The tensor to be printed.\n * @param verbose Whether to print verbose information about the ` Tensor`,\n * including dtype and size.\n *\n * @doc {heading: 'Tensors', subheading: 'Creation'}\n */\nexport function print<T extends Tensor>(x: T, verbose = false): void {\n console.log(x.toString(verbose));\n}\n","/**\n * @license\n * Copyright 2020 Google Inc. All Rights Reserved.\n * Licensed under the Apache
License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\n// Required side effectful code for tfjs-core\n\n// Set up Engine and ENV\nimport {getOrMakeEngine} from './engine';\ngetOrMakeEngine();\n\n// Register backend-agnostic flags.\nimport './flags';\n// Register platforms\nimport './platforms/platform_browser';\nimport './platforms/platform_node';\n\n// Set up OpHandler\nimport {buffer} from './ops/buffer';\nimport {cast}
from './ops/cast';\nimport {clone} from './ops/clone';\nimport {print} from './ops/print';\nimport {OpHandler, setOpHandler} from './tensor';\nconst opHandler: OpHandler = {\n buffer,\n cast,\n clone,\n print\n};\nsetOpHandler(opHandler);\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\n/**\n * IOHandlers related

```
 to files, such as browser-triggered file downloads,\n * user-selected files in browser.\n */\n\nimport
'../flags';\nimport {env} from '../environment';\n\nimport {basename, concatenateArrayBuffers,
getModelArtifactsInfoForJSON} from './io_utils';\nimport {IORouter, IORouterRegistry} from
'./router_registry';\nimport {IOHandler, ModelArtifacts, ModelJSON, SaveResult, WeightsManifestConfig,
WeightsManifestEntry} from './types';\n\nconst DEFAULT_FILE_NAME_PREFIX = 'model';\nconst
DEFAULT_JSON_EXTENSION_NAME = '.json';\nconst DEFAULT_WEIGHT_DATA_EXTENSION_NAME =
'.weights.bin';\n\nfunction defer<T>(f: () => T): Promise<T> {\n  return new Promise(resolve =>
setTimeout(resolve)).then(f);\n}\n\nexport class BrowserDownloads implements IOHandler {\n  private readonly
modelTopologyFileName: string;\n  private readonly weightDataFileName: string;\n  private readonly jsonAnchor:
HTMLAnchorElement;\n  private readonly weightDataAnchor: HTMLAnchorElement;\n\n  static readonly
URL_SCHEME = 'downloads://';\n\n
  constructor(fileNamePrefix?: string) {\n    if (!env().getBool('IS_BROWSER')) {\n      // TODO(cais): Provide info
on what IOHandlers are available under the\n      //   current environment.\n      throw new Error(\n
'browserDownloads() cannot proceed because the current environment ' +\n          'is not a browser.');\n    }\n\n    if
(fileNamePrefix.startsWith(BrowserDownloads.URL_SCHEME)) {\n      fileNamePrefix =
fileNamePrefix.slice(BrowserDownloads.URL_SCHEME.length);\n    }\n    if (fileNamePrefix == null ||
fileNamePrefix.length === 0) {\n      fileNamePrefix = DEFAULT_FILE_NAME_PREFIX;\n    }\n\n
this.modelTopologyFileName = fileNamePrefix + DEFAULT_JSON_EXTENSION_NAME;\n
this.weightDataFileName =\n        fileNamePrefix + DEFAULT_WEIGHT_DATA_EXTENSION_NAME;\n  }\n\n
async save(modelArtifacts: ModelArtifacts): Promise<SaveResult> {\n    if (typeof (document) === 'undefined') {\n
    throw new Error(\n          'Browser downloads are not supported in
' +\n          'this environment since `document` is not present');\n    }\n    const weightsURL =
window.URL.createObjectURL(new Blob(\n        [modelArtifacts.weightData], {type: 'application/octet-
stream'}));\n\n    if (modelArtifacts.modelTopology instanceof ArrayBuffer) {\n      throw new Error(\n
'BrowserDownloads.save() does not support saving model topology ' +\n          'in binary formats yet.');\n    } else {\n
    const weightsManifest: WeightsManifestConfig = [{\n        paths: ['./' + this.weightDataFileName],\n        weights:
modelArtifacts.weightSpecs\n      }];\n      const modelTopologyAndWeightManifest: ModelJSON = {\n
modelTopology: modelArtifacts.modelTopology,\n        format: modelArtifacts.format,\n        generatedBy:
modelArtifacts.generatedBy,\n        convertedBy: modelArtifacts.convertedBy,\n        weightsManifest\n      };\n
if (modelArtifacts.signature != null) {\n        modelTopologyAndWeightManifest.signature =
modelArtifacts.signature;\n
      }\n      if (modelArtifacts.userDefinedMetadata != null) {\n
modelTopologyAndWeightManifest.userDefinedMetadata =\n            modelArtifacts.userDefinedMetadata;\n      }\n
    if (modelArtifacts.modelInitializer != null) {\n        modelTopologyAndWeightManifest.modelInitializer =\n
 modelArtifacts.modelInitializer;\n      }\n      const modelTopologyAndWeightManifestURL =\n
window.URL.createObjectURL(new Blob(\n              [JSON.stringify(modelTopologyAndWeightManifest)],\n
    {type: 'application/json'}));\n\n      // If anchor elements are not provided, create them without attaching them\n
// to parents, so that the downloaded file names can be controlled.\n      const jsonAnchor = this.jsonAnchor == null
? document.createElement('a') :\n                                          this.jsonAnchor;\n      jsonAnchor.download =
this.modelTopologyFileName;\n      jsonAnchor.href = modelTopologyAndWeightManifestURL;\n
      // Trigger downloads by evoking a click event on the download anchors.\n      // When multiple downloads are
started synchronously, Firefox will only\n      // save the last one.\n      await defer(() =>
jsonAnchor.dispatchEvent(new MouseEvent('click')));\n\n      if (modelArtifacts.weightData != null) {\n        const
weightDataAnchor = this.weightDataAnchor == null ?\n            document.createElement('a') :\n
this.weightDataAnchor;\n        weightDataAnchor.download = this.weightDataFileName;\n
weightDataAnchor.href = weightsURL;\n        await defer(\n            () => weightDataAnchor.dispatchEvent(new
MouseEvent('click')));\n      }\n\n      return {modelArtifactsInfo:
getModelArtifactsInfoForJSON(modelArtifacts)};\n    }\n  }\n}\n\nclass BrowserFiles implements IOHandler {\n
```

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private readonly files: File[];\n\n  constructor(files: File[]) {\n    if (files == null || files.length < 1) {\n      throw new Error(\n          `When calling browserFiles, at least
 1 file is required, ` +\n          `but received ${files}`);\n    }\n    this.files = files;\n  }\n\n  async load(): Promise<ModelArtifacts> {\n    const jsonFile = this.files[0];\n    const weightFiles = this.files.slice(1);\n\n    return new Promise<ModelArtifacts>((resolve, reject) => {\n      const jsonReader = new FileReader();\n      jsonReader.onload = (event: Event) => {\n        // tslint:disable-next-line:no-any\n        const modelJSON = JSON.parse((event.target as any).result) as ModelJSON;\n        const modelTopology = modelJSON.modelTopology;\n        if (modelTopology == null) {\n          reject(new Error(\n              `modelTopology field is missing from file ${jsonFile.name}`));\n          return;\n        }\n\n        if (weightFiles.length === 0) {\n          resolve({modelTopology});\n        }\n\n        const weightsManifest = modelJSON.weightsManifest;\n        if (weightsManifest == null) {\n          reject(new Error(\n              `weightManifest field
 is missing from file ${jsonFile.name}`));\n          return;\n        }\n\n        let pathToFile: {[path: string]: File};\n        try {\n          pathToFile =\n              this.checkManifestAndWeightFiles(weightsManifest, weightFiles);\n        } catch (err) {\n          reject(err);\n          return;\n        }\n\n        const weightSpecs: WeightsManifestEntry[] = [];\n        const paths: string[] = [];\n        const perFileBuffers: ArrayBuffer[] = [];\n        weightsManifest.forEach(weightsGroup => {\n          weightsGroup.paths.forEach(path => {\n            paths.push(path);\n            perFileBuffers.push(null);\n          });\n          weightSpecs.push(...weightsGroup.weights);\n        });\n\n        weightsManifest.forEach(weightsGroup => {\n          weightsGroup.paths.forEach(path => {\n            const weightFileReader = new FileReader();\n            weightFileReader.onload = (event: Event) => {\n              // tslint:disable-next-line:no-any\n              const weightData = (event.target as any).result as ArrayBuffer;\n              const index = paths.indexOf(path);\n              perFileBuffers[index] = weightData;\n              if (perFileBuffers.indexOf(null) === -1) {\n                const result: ModelArtifacts = {\n                  modelTopology,\n                  weightSpecs,\n                  weightData: concatenateArrayBuffers(perFileBuffers),\n                  format: modelJSON.format,\n                  generatedBy: modelJSON.generatedBy,\n                  convertedBy: modelJSON.convertedBy\n                };\n                if (modelJSON.signature != null) {\n                  result.signature = modelJSON.signature;\n                }\n                if (modelJSON.userDefinedMetadata != null) {\n                  result.userDefinedMetadata = modelJSON.userDefinedMetadata;\n                }\n                if (modelJSON.modelInitializer != null) {\n                  result.modelInitializer = modelJSON.modelInitializer;\n                }\n                resolve(result);\n              }\n            };\n            weightFileReader.onerror = error =>\n                reject(`Failed to weights data from file of path '${path}'.`);\n            weightFileReader.readAsArrayBuffer(pathToFile[path]);\n          });\n        });\n      };\n      jsonReader.onerror = error => reject(\n          `Failed to read model topology and weights manifest JSON ` +\n          `from file '${jsonFile.name}'. BrowserFiles supports loading ` +\n          `Keras-style tf.Model artifacts only.`);\n      jsonReader.readAsText(jsonFile);\n    });\n  }\n\n  /**\n   * Check the compatibility between weights manifest and weight files.\n   */\n  private checkManifestAndWeightFiles(\n      manifest: WeightsManifestConfig, files: File[]): {[path: string]: File} {\n    const basenames: string[] = [];\n    const fileNames = files.map(file => basename(file.name));\n    const pathToFile: {[path: string]: File} = {};\n    for (const group of manifest) {\n      group.paths.forEach(path => {\n        const pathBasename = basename(path);\n        if (basenames.indexOf(pathBasename) !== -1) {\n          throw new Error(\n              `Duplicate file basename found in weights manifest: ` +\n              `'${pathBasename}'`);\n        }\n        basenames.push(pathBasename);\n        if (fileNames.indexOf(pathBasename) === -1) {\n          throw new Error(\n              `Weight file with basename '${pathBasename}' is not provided.`);\n        } else {\n          pathToFile[path] = files[fileNames.indexOf(pathBasename)];\n        }\n      });\n    }\n\n    if (basenames.length !== files.length) {\n      throw new Error(\n          `Mismatch in the number of files in weights manifest ` +\n          `(${basenames.length}) and the number of weight files provided ` +\n          `(${files.length}).`);\n    }\n    return pathToFile;\n  }\n}\n\nexport const browserDownloadsRouter: IORouter = (url: string|string[]) => {\n
```

```
 if (!env().getBool('IS_BROWSER')) {\n    return null;\n  } else {\n    if (!Array.isArray(url) &&
url.startsWith(BrowserDownloads.URL_SCHEME)) {\n      return
browserDownloads(url.slice(BrowserDownloads.URL_SCHEME.length));\n    } else {\n      return null;\n    }\n
}\n};\nIORouterRegistry.registerSaveRouter(browserDownloadsRouter);\n\n/**\n * Creates an IOHandler that
triggers file downloads from the browser.\n *\n * The returned `IOHandler` instance can be used as model exporting
methods such\n * as `tf.Model.save` and supports only saving.\n *\n * ```js\n * const model = tf.sequential();\n *
model.add(tf.layers.dense(\n *     {units: 1, inputShape: [10], activation: 'sigmoid'}));\n * const saveResult = await
model.save('downloads://mymodel');\n * // This will trigger downloading of two files:\n * //   'mymodel.json' and
'mymodel.weights.bin'.\n * console.log(saveResult);\n * ```\n *\n * @param fileNamePrefix Prefix name of the files
to be downloaded. For use with\n *   `tf.Model`,
 `fileNamePrefix` should follow either of the following two\n *   formats:\n *   1. `null` or `undefined`, in which
case the default file\n *      names will be used:\n *      - 'model.json' for the JSON file containing the model topology
and\n *        weights manifest.\n *      - 'model.weights.bin' for the binary file containing the binary weight\n *
values.\n *   2. A single string or an Array of a single string, as the file name prefix.\n *      For example, if `'foo'` is
provided, the downloaded JSON\n *      file and binary weights file will be named 'foo.json' and\n *
'foo.weights.bin', respectively.\n * @param config Additional configuration for triggering downloads.\n * @returns
An instance of `BrowserDownloads` `IOHandler`.\n *\n * @doc {\n *   heading: 'Models',\n *   subheading:
'Loading',\n *   namespace: 'io',\n *   ignoreCI: true\n * }\n */\nexport function browserDownloads(fileNamePrefix =
'model'): IOHandler {\n  return new BrowserDownloads(fileNamePrefix);\n}\n\n/**\n
 * Creates an IOHandler that loads model artifacts from user-selected files.\n *\n * This method can be used for
loading from files such as user-selected files\n * in the browser.\n * When used in conjunction with
`tf.loadLayersModel`, an instance of\n * `tf.LayersModel` (Keras-style) can be constructed from the loaded
artifacts.\n *\n * ```js\n * // Note: This code snippet won't run properly without the actual file input\n * //   elements
in the HTML DOM.\n *\n * // Suppose there are two HTML file input (`<input type=\"file\" ...>`)\n * // elements.\n
* const uploadJSONInput = document.getElementById('upload-json');\n * const uploadWeightsInput =
document.getElementById('upload-weights');\n * const model = await tf.loadLayersModel(tf.io.browserFiles(\n *
[uploadJSONInput.files[0], uploadWeightsInput.files[0]]));\n * ```\n *\n * @param files `File`s to load from.
Currently, this function supports only\n *   loading from files that contain Keras-style models (i.e., `tf.Model`s),
 for\n *   which an `Array` of `File`s is expected (in that order):\n *   - A JSON file containing the model topology
and weight manifest.\n *   - Optionally, One or more binary files containing the binary weights.\n *      These files
must have names that match the paths in the `weightsManifest`\n *      contained by the aforementioned JSON file, or
errors will be thrown\n *      during loading. These weights files have the same format as the ones\n *      generated by
`tensorflowjs_converter` that comes with the `tensorflowjs`\n *      Python PIP package. If no weights files are
provided, only the model\n *      topology will be loaded from the JSON file above.\n * @returns An instance of
`Files` `IOHandler`.\n *\n * @doc {\n *   heading: 'Models',\n *   subheading: 'Loading',\n *   namespace: 'io',\n *
ignoreCI: true\n * }\n */\nexport function browserFiles(files: File[]): IOHandler {\n  return new
BrowserFiles(files);\n}\n","/**\n * @license\n * Copyright 2019 Google LLC. All
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OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language
governing permissions and\n * limitations under the License.\n *
==========================================================================\n
*/\n\nimport {assert} from '../util';\n\nimport {OnProgressCallback} from './types';\n\n/**\n * Monitor Promise.all
progress, fire onProgress callback function.\n *\n * @param promises Promise list going to be monitored\n *
@param onProgress Callback function. Fired when a promise resolved.\n * @param startFraction Optional fraction
```

start. Default to 0.\n * @param endFraction Optional fraction end. Default to 1.\n */\nexport function monitorPromisesProgress(\n promises: Array<Promise<{}|void>>, onProgress: OnProgressCallback,\n startFraction?: number, endFraction?: number) {\n checkPromises(promises);\n startFraction = startFraction == null ? 0 : startFraction;\n endFraction = endFraction == null ? 1 : endFraction;\n checkFraction(startFraction, endFraction);\n let resolvedPromise = 0;\n\n const registerMonitor = (promise: Promise<{}>) => {\n promise.then(value => {\n const fraction = startFraction +\n ++resolvedPromise / promises.length * (endFraction - startFraction);\n // pass fraction as parameter to callback function.\n onProgress(fraction);\n return value;\n });\n return promise;\n };\n\n function checkPromises(promises: Array<Promise<{}|void>>): void {\n assert(\n promises != null && Array.isArray(promises) && promises.length > 0,\n () => 'promises must be a none empty array');\n }\n\n function checkFraction(startFraction: number, endFraction: number): void {\n assert(\n startFraction >= 0 && startFraction <= 1,\n () => `Progress fraction must be in range [0, 1], but ` +\n `got startFraction ${startFraction}`);\n assert(\n endFraction >= 0 && endFraction <= 1,\n () => `Progress fraction must be in range [0, 1], but ` +\n `got endFraction ${endFraction}`);\n assert(\n endFraction >= startFraction,\n () => `startFraction must be no more than endFraction, but ` +\n `got startFraction ${startFraction} and endFraction ` +\n `${endFraction}`);\n }\n\n return Promise.all(promises.map(registerMonitor));\n}\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {env} from '../environment';\n\nimport {NamedTensorMap} from '../tensor_types';\nimport * as util from '../util';\nimport {decodeWeights} from './io_utils';\nimport {monitorPromisesProgress} from './progress';\nimport {DTYPE_VALUE_SIZE_MAP, LoadOptions, WeightsManifestConfig, WeightsManifestEntry} from './types';\n\n/**\n * Reads binary weights data from a number of URLs.\n *\n * @param fetchURLs URLs to send the HTTP requests at, using `fetch` calls.\n * @param requestOptions RequestInit (options) for the HTTP requests.\n * @param fetchFunc Optional overriding value for the `window.fetch` function.\n * @param onProgress Optional, progress callback function, fired periodically\n * before the load is completed.\n * @returns A `Promise` of an Array of `ArrayBuffer`. The Array has the same\n * length as `fetchURLs`.\n */\nexport async function loadWeightsAsArrayBuffer(\n fetchURLs: string[], loadOptions?: LoadOptions): Promise<ArrayBuffer[]> {\n if (loadOptions == null) {\n loadOptions = {};\n }\n\n const fetchFunc = loadOptions.fetchFunc == null ? env().platform.fetch :\n loadOptions.fetchFunc;\n\n // Create the requests for all of the weights in parallel.\n const requests = fetchURLs.map(\n fetchURL =>\n fetchFunc(fetchURL, loadOptions.requestInit, {isBinary: true}));\n\n const fetchStartFraction = 0;\n const fetchEndFraction = 0.5;\n\n const responses = loadOptions.onProgress == null ?\n await Promise.all(requests) :\n await monitorPromisesProgress(\n requests, loadOptions.onProgress, fetchStartFraction,\n fetchEndFraction);\n\n const bufferPromises = responses.map(response => response.arrayBuffer());\n\n const bufferStartFraction = 0.5;\n const bufferEndFraction = 1;\n\n const buffers = loadOptions.onProgress == null ?\n await Promise.all(bufferPromises) :\n await monitorPromisesProgress(\n bufferPromises, loadOptions.onProgress, bufferStartFraction,\n bufferEndFraction);\n return buffers;\n}\n\n/**\n * Reads a weights manifest JSON configuration, fetches the weights and\n * returns them as `Tensor`s.\n *\n * @param manifest The weights manifest JSON.\n * @param filePathPrefix The path prefix for filenames given in the manifest.\n * Defaults to the empty string.\n * @param weightNames The names of the weights to be fetched.\n */\nexport async function loadWeights(\n manifest: WeightsManifestConfig,

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filePathPrefix = '',\n    weightNames?: string[],\n    requestInit?: RequestInit): Promise<NamedTensorMap> {\n  // TODO(nsthorat): Groups are currently fetched atomically. If you need a\n  // single weight from a group, the whole group will be fetched. At a future\n  // date, we should support fetching only the individual shards within a\n  // group that are needed to reconstruct the requested weight.\n  // TODO(cais): Use `decodeWeights` for implementation.\n\n  const fetchWeights = (fetchUrls: string[]) =>\n      loadWeightsAsArrayBuffer(fetchUrls, {requestInit});\n  const loadWeights = weightsLoaderFactory(fetchWeights);\n\n  return loadWeights(manifest, filePathPrefix, weightNames);\n}\n\n/**\n * Creates a function, which reads a weights manifest JSON configuration,\n * fetches the weight files using the specified function and returns them as\n * `Tensor`s.\n *\n * ```js\n * // example for creating a nodejs weight loader, which reads the weight files\n * // from disk using fs.readFileSync\n *\n * import * as fs from 'fs'\n *\n * const fetchWeightsFromDisk = (filePaths: string[]) =>\n * filePaths.map(filePath => fs.readFileSync(filePath).buffer)\n *\n * const loadWeights = tf.io.weightsLoaderFactory(fetchWeightsFromDisk)\n *\n * const manifest = JSON.parse(\n * fs.readFileSync('./my_model-weights_manifest').toString()\n * )\n * const weightMap = await loadWeights(manifest, './')\n * ```\n * @param fetchWeightsFunction The function used for fetching the weight files.\n * @returns Weight loading function.\n */\nexport function weightsLoaderFactory(\n    fetchWeightsFunction: (fetchUrls: string[]) => Promise<ArrayBuffer[]>):\n    (manifest: WeightsManifestConfig, filePathPrefix?: string,\n     weightNames?: string[]) => Promise<NamedTensorMap> {\n  return async(\n      manifest: WeightsManifestConfig, filePathPrefix = '',\n      weightNames?: string[]): Promise<NamedTensorMap> => {\n    // Collect all the groups, weights, and their relative offsets to be\n    // fetched.\n    const groupIndicesToFetchMap = manifest.map(() => false);\n    const groupWeightsToFetch: {\n      [group: number]: Array<{\n        manifestEntry: WeightsManifestEntry; groupOffset: number;\n        sizeBytes: number;\n      }>\n    } = {};\n    const weightsFound =\n        weightNames != null ? weightNames.map(() => false) : [];\n    const allManifestWeightNames: string[] = [];\n    manifest.forEach((manifestGroupConfig, groupIndex) => {\n      let groupOffset = 0;\n      manifestGroupConfig.weights.forEach(weightsEntry => {\n        const rawDtype = ('quantization' in weightsEntry)\n            ?\n            weightsEntry.quantization.dtype :\n            weightsEntry.dtype;\n\n        const weightsBytes = DTYPE_VALUE_SIZE_MAP[rawDtype] *\n            util.sizeFromShape(weightsEntry.shape);\n\n        const enqueueWeightsForFetchingFn = () => {\n          groupIndicesToFetchMap[groupIndex] = true;\n          if (groupWeightsToFetch[groupIndex] == null) {\n            groupWeightsToFetch[groupIndex] = [];\n          }\n\n          groupWeightsToFetch[groupIndex].push({\n            manifestEntry: weightsEntry,\n            groupOffset,\n            sizeBytes: weightsBytes\n          });\n        };\n\n        if (weightNames != null) {\n          weightNames.forEach((weightName, weightIndex) => {\n            if (weightName === weightsEntry.name) {\n              enqueueWeightsForFetchingFn();\n              weightsFound[weightIndex] = true;\n            }\n          });\n        } else {\n          enqueueWeightsForFetchingFn();\n        }\n\n        allManifestWeightNames.push(weightsEntry.name);\n        groupOffset += weightsBytes;\n      });\n    });\n\n    if (!weightsFound.every(found => found)) {\n      const weightsNotFound = weightNames.filter((_, i) => !weightsFound[i]);\n      throw new Error(\n          `Could not find weights in manifest with names: ` +\n          `${weightsNotFound.join(', ')}. \\n` +\n          `Manifest JSON has weights with names: ` +\n          `${allManifestWeightNames.join(', ')}.`);\n    }\n\n    // Convert the one-hot boolean groupId => shouldFetch map to a list of group\n    // IDs.\n    const groupIndicesToFetch =\n        groupIndicesToFetchMap.reduce((accumulator, shouldFetch, i) => {\n          if (shouldFetch) {\n            accumulator.push(i);\n          }\n          return accumulator;\n        }, []);\n\n    const fetchUrls: string[] = [];\n    groupIndicesToFetch.forEach(i => {\n      manifest[i].paths.forEach(filepath => {\n        const fetchUrl = filePathPrefix +\n            (!filePathPrefix.endsWith('/') ? '/' : '') + filepath;\n        fetchUrls.push(fetchUrl);\n      });\n    });\n    const buffers = await fetchWeightsFunction(fetchUrls);\n\n    const weightsTensorMap: NamedTensorMap = {};\n    let bufferIndexOffset = 0;\n    groupIndicesToFetch.forEach(i => {\n      const numBuffers = manifest[i].paths.length;\n\n      let groupBytes = 0;\n      for (let i = 0; i <
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numBuffers; i++) {\n groupBytes += buffers[bufferIndexOffset + i].byteLength;\n }\n\n // Create a buffer for the whole group.\n const groupBuffer = new ArrayBuffer(groupBytes);\n const groupByteBuffer = new Uint8Array(groupBuffer);\n let groupBufferOffset = 0;\n for (let i = 0; i < numBuffers; i++) {\n const buffer = new Uint8Array(buffers[bufferIndexOffset + i]);\n groupByteBuffer.set(buffer, groupBufferOffset);\n groupBufferOffset += buffer.byteLength;\n }\n\n const weightsEntries = groupWeightsToFetch[i];\n weightsEntries.forEach(weightsEntry => {\n const byteBuffer = groupBuffer.slice(\n weightsEntry.groupOffset,\n weightsEntry.groupOffset + weightsEntry.sizeBytes);\n const nameToTensorMap =\n decodeWeights(byteBuffer, [weightsEntry.manifestEntry]);\n for (const name in nameToTensorMap) {\n weightsTensorMap[name] = nameToTensorMap[name];\n }\n });\n\n bufferIndexOffset += numBuffers;\n });\n\n return weightsTensorMap;\n };\n}\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========================================================================\n
*/\n\n/**\n * IOHandler implementations based on HTTP requests in the web browser.\n *\n * Uses [`fetch`](https://developer.mozilla.org/en-US/docs/Web/API/Fetch_API).\n */\n\nimport
{env} from '../environment';\n\nimport {assert} from '../util';\nimport {concatenateArrayBuffers,
getModelArtifactsInfoForJSON} from './io_utils';\nimport {IORouter, IORouterRegistry} from
'./router_registry';\nimport {IOHandler, LoadOptions, ModelArtifacts, ModelJSON, OnProgressCallback,
SaveResult, WeightsManifestConfig, WeightsManifestEntry} from './types';\nimport {loadWeightsAsArrayBuffer}
from './weights_loader';\n\nconst OCTET_STREAM_MIME_TYPE = 'application/octet-stream';\nconst
JSON_TYPE = 'application/json';\nexport class HTTPRequest implements IOHandler {\n protected readonly path:
string;\n protected readonly requestInit: RequestInit;\n\n private readonly fetch: Function;\n private readonly
weightUrlConverter: (weightName: string) => Promise<string>;\n\n readonly DEFAULT_METHOD = 'POST';\n\n
static readonly URL_SCHEME_REGEX = /^https?:\\/\\//;\n\n private readonly weightPathPrefix: string;\n private
readonly onProgress: OnProgressCallback;\n\n constructor(path:
string, loadOptions?: LoadOptions) {\n if (loadOptions == null) {\n loadOptions = {};\n }\n
this.weightPathPrefix = loadOptions.weightPathPrefix;\n this.onProgress = loadOptions.onProgress;\n
this.weightUrlConverter = loadOptions.weightUrlConverter;\n\n if (loadOptions.fetchFunc != null) {\n
assert(\n typeof loadOptions.fetchFunc === 'function',\n () => 'Must pass a function that matches the
signature of ' +\n '`fetch` (see ' +\n 'https://developer.mozilla.org/en-
US/docs/Web/API/Fetch_API)');\n this.fetch = loadOptions.fetchFunc;\n } else {\n this.fetch =
env().platform.fetch;\n }\n\n assert(\n path != null && path.length > 0,\n () => 'URL path for http must
not be null, undefined or ' +\n 'empty.');\n\n if (Array.isArray(path)) {\n assert(\n path.length ===
2,\n () => 'URL paths for http must have a length of 2, ' +\n `(actual
length is ${path.length}).`);\n }\n this.path = path;\n\n if (loadOptions.requestInit != null &&\n
loadOptions.requestInit.body != null) {\n throw new Error(\n 'requestInit is expected to have no pre-
existing body, but has one.');\n }\n this.requestInit = loadOptions.requestInit || {};\n }\n\n async
save(modelArtifacts: ModelArtifacts): Promise<SaveResult> {\n if (modelArtifacts.modelTopology instanceof
ArrayBuffer) {\n throw new Error(\n 'BrowserHTTPRequest.save() does not support saving model topology
' +\n 'in binary formats yet.');\n }\n\n const init = Object.assign({method: this.DEFAULT_METHOD},
this.requestInit);\n init.body = new FormData();\n\n const weightsManifest: WeightsManifestConfig = [{\n
paths: ['./model.weights.bin'],\n weights: modelArtifacts.weightSpecs,\n }];\n const
modelTopologyAndWeightManifest: ModelJSON = {\n modelTopology: modelArtifacts.modelTopology,\n
format:
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 modelArtifacts.format,\n      generatedBy: modelArtifacts.generatedBy,\n      convertedBy:
modelArtifacts.convertedBy,\n      weightsManifest\n    };\n    if (modelArtifacts.signature != null) {\n
modelTopologyAndWeightManifest.signature = modelArtifacts.signature;\n    }\n    if
(modelArtifacts.userDefinedMetadata != null) {\n      modelTopologyAndWeightManifest.userDefinedMetadata =\n
      modelArtifacts.userDefinedMetadata;\n    }\n    if (modelArtifacts.modelInitializer != null) {\n
modelTopologyAndWeightManifest.modelInitializer =\n          modelArtifacts.modelInitializer;\n    }\n\n
init.body.append(\n          'model.json',\n          new Blob(\n
[JSON.stringify(modelTopologyAndWeightManifest)],\n            {type: JSON_TYPE}),\n          'model.json');\n\n    if
(modelArtifacts.weightData != null) {\n      init.body.append(\n          'model.weights.bin',\n          new
Blob([modelArtifacts.weightData], {type: OCTET_STREAM_MIME_TYPE}),\n          'model.weights.bin');\n
    }\n\n    const response = await this.fetch(this.path, init);\n\n    if (response.ok) {\n      return {\n
modelArtifactsInfo: getModelArtifactsInfoForJSON(modelArtifacts),\n        responses: [response],\n      };\n    } else
{\n      throw new Error(\n          `BrowserHTTPRequest.save() failed due to HTTP response status ` +\n
`${response.status}.`);\n    }\n  }\n\n  /**\n   * Load model artifacts via HTTP request(s).\n   *\n   * See the
documentation to `tf.io.http` for details on the saved\n   * artifacts.\n   *\n   * @returns The loaded model artifacts (if
loading succeeds).\n   */\n  async load(): Promise<ModelArtifacts> {\n    const modelConfigRequest = await
this.fetch(this.path, this.requestInit);\n\n    if (!modelConfigRequest.ok) {\n      throw new Error(\n          `Request to
${this.path} failed with status code ` +\n          `${modelConfigRequest.status}. Please verify this URL points to ` +\n
          `the model JSON of the model to
 load.`);\n    }\n    let modelConfig: ModelJSON;\n    try {\n      modelConfig = await modelConfigRequest.json();\n
 } catch (e) {\n      let message = `Failed to parse model JSON of response from ${this.path}.`;\n      //
TODO(nsthorat): Remove this after some time when we're comfortable that\n      // .pb files are mostly gone.\n      if
(this.path.endsWith('.pb')) {\n        message += ' Your path contains a .pb file extension. ' +\n            'Support for .pb
models have been removed in TensorFlow.js 1.0 ' +\n            'in favor of .json models. You can re-convert your
Python ' +\n            'TensorFlow model using the TensorFlow.js 1.0 conversion scripts ' +\n            'or you can
convert your.pb models with the \\'pb2json\\'' +\n            'NPM script in the tensorflow/tfjs-converter repository.';\n
 } else {\n        message += ' Please make sure the server is serving valid ' +\n            'JSON for this request.';\n
}\n      throw new Error(message);\n    }\n
    const modelTopology = modelConfig.modelTopology;\n    const weightsManifest =
modelConfig.weightsManifest;\n    const generatedBy = modelConfig.generatedBy;\n    const convertedBy =
modelConfig.convertedBy;\n    const format = modelConfig.format;\n    const signature = modelConfig.signature;\n
 const userDefinedMetadata = modelConfig.userDefinedMetadata;\n\n    // We do not allow both modelTopology
and weightsManifest to be missing.\n    if (modelTopology == null && weightsManifest == null) {\n      throw new
Error(\n          `The JSON from HTTP path ${this.path} contains neither model ` +\n          `topology or manifest for
weights.`);\n    }\n\n    let weightSpecs: WeightsManifestEntry[];\n    let weightData: ArrayBuffer;\n    if
(weightsManifest != null) {\n      const results = await this.loadWeights(weightsManifest);\n      [weightSpecs,
weightData] = results;\n    }\n\n    const artifacts: ModelArtifacts = {\n      modelTopology,\n      weightSpecs,\n
weightData,\n
      generatedBy,\n      convertedBy,\n      format\n    };\n\n    if (signature != null) {\n      artifacts.signature =
signature;\n    }\n    if (userDefinedMetadata != null) {\n      artifacts.userDefinedMetadata =
userDefinedMetadata;\n    }\n\n    const initializer = modelConfig.modelInitializer;\n    if (initializer) {\n
artifacts.modelInitializer = initializer;\n    }\n\n    return artifacts;\n  }\n\n  private async
loadWeights(weightsManifest: WeightsManifestConfig):\n      Promise<[WeightsManifestEntry[], ArrayBuffer]>
{\n    const weightPath = Array.isArray(this.path) ? this.path[1] : this.path;\n    const [prefix, suffix] =
parseUrl(weightPath);\n    const pathPrefix = this.weightPathPrefix || prefix;\n\n    const weightSpecs = [];\n    for
(const entry of weightsManifest) {\n      weightSpecs.push(...entry.weights);\n    }\n\n    const fetchURLs: string[] =
[];\n    const urlPromises: Array<Promise<string>> = [];\n    for (const weightsGroup of weightsManifest) {\n
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  for (const path of weightsGroup.paths) {\n        if (this.weightUrlConverter != null) {\n
urlPromises.push(this.weightUrlConverter(path));\n        } else {\n          fetchURLs.push(pathPrefix + path +
suffix);\n        }\n      }\n    }\n\n    if (this.weightUrlConverter) {\n      fetchURLs.push(...await
Promise.all(urlPromises));\n    }\n\n    const buffers = await loadWeightsAsArrayBuffer(fetchURLs, {\n
requestInit: this.requestInit,\n      fetchFunc: this.fetch,\n      onProgress: this.onProgress\n    });\n    return
[weightSpecs, concatenateArrayBuffers(buffers)];\n  }\n}\n\n/**\n * Extract the prefix and suffix of the url, where
the prefix is the path before\n * the last file, and suffix is the search params after the last file.\n * ```\n * const url =
'http://tfhub.dev/model/1/tensorflowjs_model.pb?tfjs-format=file'\n * [prefix, suffix] = parseUrl(url)\n * // prefix =
'http://tfhub.dev/model/1/'\n * // suffix = '?tfjs-format=file'\n * ```\n * @param url the model
 url to be parsed.\n */\nexport function parseUrl(url: string): [string, string] {\n  const lastSlash =
url.lastIndexOf('/');\n  const lastSearchParam = url.lastIndexOf('?');\n  const prefix = url.substring(0, lastSlash);\n
const suffix =\n      lastSearchParam > lastSlash ? url.substring(lastSearchParam) : '';\n  return [prefix + '/',
suffix];\n}\n\nexport function isHTTPScheme(url: string): boolean {\n  return
url.match(HTTPRequest.URL_SCHEME_REGEX) != null;\n}\n\nexport const httpRouter: IORouter =\n    (url:
string, loadOptions?: LoadOptions) => {\n      if (typeof fetch === 'undefined' &&\n          (loadOptions == null ||
loadOptions.fetchFunc == null)) {\n        // `http` uses `fetch` or `node-fetch`, if one wants to use it in\n        // an
environment that is not the browser or node they have to setup a\n        // global fetch polyfill.\n        return null;\n
} else {\n        let isHTTP = true;\n        if (Array.isArray(url)) {\n          isHTTP = url.every(urlItem
 => isHTTPScheme(urlItem));\n        } else {\n          isHTTP = isHTTPScheme(url);\n        }\n        if (isHTTP) {\n
      return http(url, loadOptions);\n        }\n      }\n      return null;\n
};\nIORouterRegistry.registerSaveRouter(httpRouter);\nIORouterRegistry.registerLoadRouter(httpRouter);\n\n/**\n
* Creates an IOHandler subtype that sends model artifacts to HTTP server.\n *\n * An HTTP request of the
`multipart/form-data` mime type will be sent to the\n * `path` URL. The form data includes artifacts that represent
the topology\n * and/or weights of the model. In the case of Keras-style `tf.Model`, two\n * blobs (files) exist in
form-data:\n *   - A JSON file consisting of `modelTopology` and `weightsManifest`.\n *   - A binary weights file
consisting of the concatenated weight values.\n * These files are in the same format as the one generated by\n *
[tfjs_converter](https://js.tensorflow.org/tutorials/import-keras.html).\n *\n * The following code snippet
exemplifies
 the client-side code that uses this\n * function:\n *\n * ```js\n * const model = tf.sequential();\n * model.add(\n *
tf.layers.dense({units: 1, inputShape: [100], activation: 'sigmoid'}));\n *\n * const saveResult = await
model.save(tf.io.http(\n *     'http://model-server:5000/upload', {requestInit: {method: 'PUT'}}));\n *
console.log(saveResult);\n * ```\n *\n * If the default `POST` method is to be used, without any custom parameters\n
* such as headers, you can simply pass an HTTP or HTTPS URL to `model.save`:\n *\n * ```js\n * const saveResult
= await model.save('http://model-server:5000/upload');\n * ```\n *\n * The following GitHub Gist\n *
https://gist.github.com/dsmilkov/1b6046fd6132d7408d5257b0976f7864\n * implements a server based on
[flask](https://github.com/pallets/flask) that\n * can receive the request. Upon receiving the model artifacts via the
requst,\n * this particular server reconsistutes instances of [Keras\n * Models](https://keras.io/models/model/) in
memory.\n
 *\n *\n * @param path A URL path to the model.\n *   Can be an absolute HTTP path (e.g.,\n *
'http://localhost:8000/model-upload)') or a relative path (e.g.,\n *   './model-upload').\n * @param requestInit
Request configurations to be used when sending\n *     HTTP request to server using `fetch`. It can contain fields
such as\n *     `method`, `credentials`, `headers`, `mode`, etc. See\n *     https://developer.mozilla.org/en-
US/docs/Web/API/Request/Request\n *     for more information. `requestInit` must not have a body, because the\n *
body will be set by TensorFlow.js. File blobs representing the model\n * topology (filename: 'model.json') and the
weights of the model (filename:\n * 'model.weights.bin') will be appended to the body. If `requestInit` has a\n *
`body`, an Error will be thrown.\n * @param loadOptions Optional configuration for the loading. It includes the\n *
following fields:\n *   - weightPathPrefix Optional, this specifies the path prefix for weight\n *
```

files, by default this is calculated from the path param.\n * - fetchFunc Optional, custom `fetch` function. E.g., in Node.js,\n * the `fetch` from node-fetch can be used here.\n * - onProgress Optional, progress callback function, fired periodically\n * before the load is completed.\n * @returns An instance of `IOHandler`.\n *\n * @doc {\n * heading: 'Models',\n * subheading: 'Loading',\n * namespace: 'io',\n * ignoreCI: true\n * }\n */\nexport function http(path: string, loadOptions?: LoadOptions): IOHandler {\n return new HTTPRequest(path, loadOptions);\n}\n\n/**\n * Deprecated. Use `tf.io.http`.\n * @param path\n * @param loadOptions\n */\nexport function browserHTTPRequest(\n path: string, loadOptions?: LoadOptions): IOHandler {\n return http(path, loadOptions);\n}\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ===\n */\n\n/**\n * IOHandlers that pass through the in-memory ModelArtifacts format.\n */\n\nimport {IOHandler, ModelArtifacts, SaveResult, TrainingConfig, WeightsManifestEntry} from './types';\n\nclass PassthroughLoader implements IOHandler {\n constructor(private readonly modelArtifacts?: ModelArtifacts) {}\n\n async load(): Promise<ModelArtifacts> {\n   return this.modelArtifacts;\n }\n}\n\nclass PassthroughSaver implements IOHandler {\n constructor(\n   private readonly saveHandler:\n   (artifacts: ModelArtifacts) => Promise<SaveResult>) {}\n\n async save(modelArtifacts: ModelArtifacts) {\n   return this.saveHandler(modelArtifacts);\n }\n}\n\n/**\n * Creates an IOHandler that loads model artifacts from memory.\n *\n * When used in conjunction with `tf.loadLayersModel`, an instance of\n * `tf.LayersModel` (Keras-style) can be constructed from the loaded artifacts.\n *\n * ```js\n * const model = await tf.loadLayersModel(tf.io.fromMemory(\n *   modelTopology, weightSpecs, weightData));\n * ```\n *\n * @param modelArtifacts a object containing model topology (i.e., parsed from\n * the JSON format).\n * @param weightSpecs An array of `WeightsManifestEntry` objects describing the\n * names, shapes, types, and quantization of the weight data.\n * @param weightData A single `ArrayBuffer` containing the weight data,\n * concatenated in the order described by the weightSpecs.\n * @param trainingConfig Model training configuration. Optional.\n *\n * @returns A passthrough `IOHandler` that simply loads the provided data.\n */\nexport function fromMemory(\n   modelArtifacts: {}|ModelArtifacts, weightSpecs?: WeightsManifestEntry[],\n   weightData?: ArrayBuffer, trainingConfig?: TrainingConfig): IOHandler {\n if (arguments.length === 1) {\n   const isModelArtifacts =\n   (modelArtifacts as ModelArtifacts).modelTopology != null ||\n   (modelArtifacts as ModelArtifacts).weightSpecs != null;\n   if (isModelArtifacts) {\n   return new PassthroughLoader(modelArtifacts as ModelArtifacts);\n   } else {\n   // Legacy support: with only modelTopology.\n   // TODO(cais): Remove this deprecated API.\n   console.warn(\n   'Please call tf.io.fromMemory() with only one argument. ' +\n   'The argument should be of type ModelArtifacts. ' +\n   'The multi-argument signature of tf.io.fromMemory() has been ' +\n   'deprecated and will be removed in a future release.');\n   return new PassthroughLoader({modelTopology: modelArtifacts as {}});\n   }\n } else {\n   // Legacy support.\n   // TODO(cais): Remove this deprecated API.\n   console.warn(\n   'Please call tf.io.fromMemory() with only one argument. ' +\n   'The argument should be of type ModelArtifacts. ' +\n   'The multi-argument signature of tf.io.fromMemory() has been ' +\n   'deprecated and will be removed in a future release.');\n   return new PassthroughLoader({\n   modelTopology: modelArtifacts as {},\n   weightSpecs,\n   weightData,\n   trainingConfig\n   });\n }\n}\n\n/**\n * Creates an IOHandler that passes saved model artifacts to a callback.\n *\n * ```js\n * function handleSave(artifacts) {\n * // ... do something with the artifacts ...\n * return {modelArtifactsInfo: {...}, ...};\n * }\n *\n * const saveResult = model.save(tf.io.withSaveHandler(handleSave));\n * ```\n *\n * @param saveHandler A function that accepts a `ModelArtifacts` and returns

a\n *   `SaveResult`.\n */\nexport function withSaveHandler(\n   saveHandler: (artifacts: ModelArtifacts) =>\n Promise<SaveResult>): IOHandler {\n return new PassthroughSaver(saveHandler);\n}\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\n// Importing local_storage and indexed_db is necessary for the routers
 to be\n// registered.\nimport './indexed_db';\nimport './local_storage';\n\nimport {browserFiles} from './browser_files';\nimport {browserHTTPRequest, http, isHTTPScheme} from './http';\nimport {concatenateArrayBuffers, decodeWeights, encodeWeights, getModelArtifactsInfoForJSON} from './io_utils';\nimport {fromMemory, withSaveHandler} from './passthrough';\nimport {getLoadHandlers, getSaveHandlers, registerLoadRouter, registerSaveRouter} from './router_registry';\nimport {IOHandler, LoadHandler, LoadOptions, ModelArtifacts, ModelArtifactsInfo, ModelJSON, ModelStoreManager, OnProgressCallback, RequestDetails, SaveConfig, SaveHandler, SaveResult, WeightGroup, WeightsManifestConfig, WeightsManifestEntry} from './types';\nimport {loadWeights, weightsLoaderFactory} from './weights_loader';\n\nexport {copyModel, listModels, moveModel, removeModel} from './model_management';\nexport {\n browserFiles,\n browserHTTPRequest,\n concatenateArrayBuffers,\n decodeWeights,\n encodeWeights,\n
  fromMemory,\n getLoadHandlers,\n getModelArtifactsInfoForJSON,\n getSaveHandlers,\n http,\n IOHandler,\n isHTTPScheme,\n LoadHandler,\n LoadOptions,\n loadWeights,\n ModelArtifacts,\n ModelArtifactsInfo,\n ModelJSON,\n ModelStoreManager,\n OnProgressCallback,\n registerLoadRouter,\n registerSaveRouter,\n RequestDetails,\n SaveConfig,\n SaveHandler,\n SaveResult,\n WeightGroup,\n weightsLoaderFactory,\n WeightsManifestConfig,\n WeightsManifestEntry,\n withSaveHandler\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY
 KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\nimport {ENGINE} from '../engine';\nimport {BatchMatMul, BatchMatMulAttrs, BatchMatMulInputs} from '../kernel_names';\nimport {NamedAttrMap} from '../kernel_registry';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {makeTypesMatch} from '../tensor_util';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\n\nimport {op} from './operation';\n\n/**\n * Computes the dot product of two matrices, A * B. These must be matrices.\n *\n * ```js\n * const a = tf.tensor2d([1, 2], [1, 2]);\n * const b = tf.tensor2d([1, 2, 3, 4], [2, 2]);\n *\n * a.matMul(b).print(); // or tf.matMul(a, b)\n * ```\n * @param a First matrix in dot product operation.\n * @param b Second matrix in dot product operation.\n
 * @param transposeA If true, `a` is transposed before multiplication.\n * @param transposeB If true, `b` is transposed before multiplication.\n *\n * @doc {heading: 'Operations', subheading: 'Matrices'}\n */\nfunction matMul_<T extends Tensor>(\n   a: Tensor|TensorLike, b: Tensor|TensorLike, transposeA = false,\n   transposeB = false): T {\n let $a = convertToTensor(a, 'a', 'matMul');\n let $b = convertToTensor(b, 'b', 'matMul');\n [$a, $b] = makeTypesMatch($a, $b);\n\n const inputs: BatchMatMulInputs = {a: $a, b: $b};\n const attrs: BatchMatMulAttrs = {transposeA, transposeB};\n\n return ENGINE.runKernel(\n   BatchMatMul, inputs as {} as NamedTensorMap,

attrs as {} as NamedAttrMap);\n}\n\nexport const matMul = op({matMul_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {ENGINE} from '../engine';\nimport {OneHot, OneHotAttrs, OneHotInputs} from '../kernel_names';\nimport {NamedAttrMap} from '../kernel_registry';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\n\nimport {op} from './operation';\n\n/**\n * Creates a one-hot `tf.Tensor`. The locations represented by `indices` take\n * value `onValue` (defaults to 1), while all other locations take value\n * `offValue` (defaults to 0). If `indices` is rank `R`, the output has rank\n * `R+1` with the last axis of size `depth`.\n *\n * ```js\n * tf.oneHot(tf.tensor1d([0, 1], 'int32'), 3).print();\n * ```\n *\n * @param indices `tf.Tensor` of indices with dtype `int32`.\n * @param depth The depth of the one hot dimension.\n * @param onValue A number used to fill in the output when the index matches\n * the location.\n * @param offValue A number used to fill in the output when the index does\n *   not match the location.\n *\n * @doc {heading: 'Tensors', subheading: 'Creation'}\n */\nfunction oneHot_(\n   indices: Tensor|TensorLike, depth: number, onValue = 1,\n   offValue = 0): Tensor {\n if (depth < 2) {\n   throw new Error(`Error in oneHot: depth must be >=2, but it is ${depth}`);\n }\n const $indices = convertToTensor(indices, 'indices', 'oneHot', 'int32');\n\n const inputs: OneHotInputs = {indices: $indices};\n const attrs: OneHotAttrs = {depth, onValue, offValue};\n\n\n return ENGINE.runKernel(\n   OneHot, inputs as unknown as NamedTensorMap,\n   attrs as unknown as NamedAttrMap);\n}\n\nexport const oneHot = op({oneHot_});\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {ENGINE} from '../engine';\nimport {Transpose, TransposeAttrs, TransposeInputs} from '../kernel_names';\nimport {NamedAttrMap} from '../kernel_registry';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\nimport * as util from '../util';\n\nimport {op} from './operation';\n\n/**\n * Transposes the `tf.Tensor`. Permutes the dimensions according to `perm`.\n *\n * The returned `tf.Tensor`'s dimension `i` will correspond to the input\n * dimension `perm[i]`. If `perm` is not given, it is set to `[n-1...0]`,\n * where `n` is the rank of the input `tf.Tensor`. Hence by default, this\n * operation performs a regular matrix transpose on 2-D input `tf.Tensor`s.\n *\n * ```js\n * const a = tf.tensor2d([1, 2, 3, 4, 5, 6], [2, 3]);\n *\n * a.transpose().print(); // or tf.transpose(a)\n * ```\n *\n * @param x The tensor to transpose.\n * @param perm The permutation of the dimensions of a.\n *\n * @doc {heading: 'Operations', subheading: 'Matrices'}\n */\nfunction transpose_<T extends Tensor>(x: T|TensorLike, perm?: number[]): T {\n const $x = convertToTensor(x, 'x', 'transpose');\n\n if (perm == null) {\n   perm = $x.shape.map((s, i) => i).reverse();\n }\n util.assert(\n $x.rank === perm.length,\n   () => `Error in transpose: rank of input ${$x.rank} ` +\n   `must match length of perm ${perm}.`);\n perm.forEach(axis => {\n   util.assert(\n   axis >= 0 && axis < $x.rank,\n   () => `All entries in 'perm' must be between 0 and ${$x.rank - 1}` +\n   ` but got ${perm}`);\n });\n\n if ($x.rank <= 1) {\n   return $x.clone();\n }\n\n const inputs: TransposeInputs = {x: $x};\n const attrs: TransposeAttrs = {perm};\n\n return

ENGINE.runKernel(\n Transpose, inputs as {} as NamedTensorMap, attrs as {} as NamedAttrMap);\n}\n\nexport const transpose = op({transpose_});\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ===\n */\n\nimport {Tensor1D, Tensor2D} from '../tensor';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\nimport * as util from '../util';\n\nimport {cast} from './cast';\nimport {matMul} from './mat_mul';\nimport {oneHot} from './one_hot';\nimport {op} from './operation';\nimport {transpose} from './transpose';\n\n/**\n * Computes the confusion matrix from true labels and predicted labels.\n *\n * ```js\n * const labels = tf.tensor1d([0, 1, 2, 1, 0], 'int32');\n * const predictions = tf.tensor1d([0, 2, 2, 1, 0], 'int32');\n * const numClasses = 3;\n * const out = tf.math.confusionMatrix(labels, predictions, numClasses);\n * out.print();\n * // Expected output matrix:\n * // [[2, 0, 0],\n * // [0, 1, 1],\n * // [0, 0, 1]]\n * ```\n *\n * @param labels The target labels, assumed to be 0-based integers\n * for the classes. The shape is `[numExamples]`, where\n * `numExamples` is the number of examples included.\n * @param predictions The predicted classes, assumed to be\n * 0-based integers for the classes. Must have the same shape as `labels`.\n * @param numClasses Number of all classes, as an integer.\n * Its value must be larger than the largest element in `labels` and\n * `predictions`.\n * @returns The confusion matrix as a int32-type 2D tensor. The value at\n * row `r` and column `c` is the number of times examples of actual class\n * `r` were predicted as class `c`.\n *\n * @doc {heading: 'Operations', subheading: 'Evaluation'}\n */\nexport function confusionMatrix_(\n labels: Tensor1D|TensorLike, predictions: Tensor1D|TensorLike,\n numClasses: number): Tensor2D {\n const $labels = convertToTensor(labels, 'labels', 'confusionMatrix');\n const $predictions =\n convertToTensor(predictions, 'predictions', 'confusionMatrix');\n\n util.assert(\n numClasses == null || numClasses > 0 && Number.isInteger(numClasses),\n () => `If provided, numClasses must be a positive integer, ` +\n `but got ${numClasses}`);\n util.assert(\n $labels.rank === 1,\n () => `Expected the rank of labels to be 1, but got ${$labels.rank}`);\n util.assert(\n $predictions.rank === 1,\n () => `Expected the rank of predictions to be 1, ` +\n `but got ${$predictions.rank}`);\n util.assert(\n $labels.shape[0] === $predictions.shape[0],\n () => `Mismatch in the number of examples: ` +\n `${$labels.shape[0]} vs. ${$predictions.shape[0]}. ` +\n `Labels and predictions should have the same number of elements.`);\n util.assert(\n numClasses > 0 && Number.isInteger(numClasses),\n () => `numClasses is required to be a positive integer, but got ` +\n `${numClasses}`);\n // TODO(cais): In the future, if oneHot supports tensors inputs for\n // `numClasses`, `confusionMatrix` can make `numClasses` optional.\n\n const oneHotLabels = oneHot(cast($labels, 'int32'), numClasses) as Tensor2D;\n const oneHotPredictions =\n oneHot(cast($predictions, 'int32'), numClasses) as Tensor2D;\n const oneHotLabelsT: Tensor2D = transpose(oneHotLabels);\n const product: Tensor2D = matMul(oneHotLabelsT, oneHotPredictions);\n return cast(product, 'int32');\n}\n\nexport const confusionMatrix = op({confusionMatrix_});\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ===\n */\n\n/**\n * Exports under the tf.math.* namespace.\n */\n\nimport {confusionMatrix} from

'./ops/confusion_matrix';\n\nexport {confusionMatrix};\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {Tensor3D} from '../tensor';\nimport {inferShape} from '../tensor_util_env';\nimport {TensorLike3D} from '../types';\nimport {DataType} from '../types';\nimport {assertNonNull} from '../util';\nimport {makeTensor} from './tensor_ops_util';\n\n/**\n * Creates rank-3 `tf.Tensor` with the provided values, shape and dtype.\n *\n * The same functionality can be achieved with `tf.tensor`, but in general\n * we recommend using `tf.tensor3d` as it makes the code more readable.\n *\n * ```js\n * // Pass a nested array.\n * tf.tensor3d([[[1], [2]], [[3], [4]]]).print();\n * ```\n * ```js\n * // Pass a flat array and specify a shape.\n * tf.tensor3d([1, 2, 3, 4], [2, 2, 1]).print();\n * ```\n *\n * @param values The values of the tensor. Can be nested array of numbers,\n * or a flat array, or a `TypedArray`.\n * @param shape The shape of the tensor. If not provided, it is inferred from\n * `values`.\n * @param dtype The data type.\n *\n * @doc {heading: 'Tensors', subheading: 'Creation'}\n */\nexport function tensor3d(\n values: TensorLike3D, shape?: [number, number, number],\n dtype?: DataType): Tensor3D {\n assertNonNull(values);\n if (shape != null && shape.length !== 3) {\n throw new Error('tensor3d() requires shape to have three numbers');\n }\n const inferredShape = inferShape(values, dtype);\n if (inferredShape.length !== 3 && inferredShape.length !== 1) {\n throw new Error(\n 'tensor3d() requires values to be number[][][] or flat/TypedArray');\n }\n if (inferredShape.length === 1 && shape == null) {\n throw new Error(\n 'tensor3d() requires shape to be provided when `values` ' +\n 'are a flat array');\n }\n return makeTensor(values, shape, inferredShape, dtype) as Tensor3D;\n}\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {ENGINE} from '../engine';\nimport {FromPixels, FromPixelsAttrs, FromPixelsInputs} from '../kernel_names';\nimport {getKernel, NamedAttrMap} from '../kernel_registry';\nimport {Tensor, Tensor2D, Tensor3D} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {PixelData, TensorLike} from '../types';\n\nimport {cast} from './cast';\nimport {op} from './operation';\nimport {tensor3d} from './tensor3d';\n\nlet fromPixels2DContext: CanvasRenderingContext2D;\n\n/**\n * Creates a `tf.Tensor` from an image.\n *\n * ```js\n * const image = new ImageData(1, 1);\n * image.data[0] = 100;\n * image.data[1] = 150;\n * image.data[2] = 200;\n * image.data[3] = 255;\n *\n * tf.browser.fromPixels(image).print();\n * ```\n *\n * @param pixels The input image to construct the tensor from. The\n * supported image types are all 4-channel. You can also pass in an image\n * object with following attributes:\n * `{data: Uint8Array; width: number; height: number}`\n * @param numChannels The number of channels of the output tensor. A\n * numChannels value less than 4 allows you to ignore channels. Defaults to\n * 3 (ignores alpha channel of input image).\n *\n * @doc {heading: 'Browser', namespace: 'browser', ignoreCI: true}\n */\nfunction fromPixels_(\n pixels: PixelData|ImageData|HTMLImageElement|HTMLCanvasElement|\n HTMLVideoElement|ImageBitmap,\n numChannels = 3): Tensor3D {\n // Sanity checks.\n if (numChannels > 4) {\n throw new Error(\n 'Cannot construct Tensor with more than 4 channels from pixels.');\n }\n if (pixels == null) {\n throw new Error('pixels passed to tf.browser.fromPixels() can not be null');\n }\n let isPixelData = false;\n let isImageData = false;\n let

```
isVideo = false;\n  let isImage = false;\n  let isCanvasLike = false;\n  let isImageBitmap = false;\n  if ((pixels as PixelData).data instanceof Uint8Array) {\n    isPixelData = true;\n  } else if (\n      typeof (ImageData) !== 'undefined' && pixels
 instanceof ImageData) {\n    isImageData = true;\n  } else if (\n      typeof (HTMLVideoElement) !== 'undefined' &&\n      pixels instanceof HTMLVideoElement) {\n    isVideo = true;\n  } else if (\n      typeof (HTMLImageElement) !== 'undefined' &&\n      pixels instanceof HTMLImageElement) {\n    isImage = true;\n    // tslint:disable-next-line: no-any\n  } else if ((pixels as any).getContext != null) {\n    isCanvasLike = true;\n  } else if (\n      typeof (ImageBitmap) !== 'undefined' &&\n      pixels instanceof ImageBitmap) {\n    isImageBitmap = true;\n  } else {\n    throw new Error(\n        'pixels passed to tf.browser.fromPixels() must be either an ' +\n        `HTMLVideoElement, HTMLImageElement, HTMLCanvasElement, ImageData ` +\n        `in browser, or OffscreenCanvas, ImageData in webworker` +\n        ` or {data: Uint32Array, width: number, height: number}, ` +\n        `but was ${(pixels as {}).constructor.name}`);\n  }\n  if (isVideo) {\n    const HAVE_CURRENT_DATA_READY_STATE
 = 2;\n    if (isVideo &&\n        (pixels as HTMLVideoElement).readyState <\n        HAVE_CURRENT_DATA_READY_STATE) {\n      throw new Error(\n          'The video element has not loaded data yet. Please wait for ' +\n          '`loadeddata` event on the <video> element.');\n    }\n  }\n  // If the current backend has 'FromPixels' registered, it has a more\n  // efficient way of handling pixel uploads, so we call that.\n  const kernel = getKernel(FromPixels, ENGINE.backendName);\n  if (kernel != null) {\n    const inputs: FromPixelsInputs = {pixels};\n    const attrs: FromPixelsAttrs = {numChannels};\n    return ENGINE.runKernel(\n        FromPixels, inputs as {} as NamedTensorMap,\n        attrs as {} as NamedAttrMap);\n  }\n\n  const [width, height] = isVideo ?\n      [\n        (pixels as HTMLVideoElement).videoWidth,\n        (pixels as HTMLVideoElement).videoHeight\n      ] :\n      [pixels.width, pixels.height];\n  let vals: Uint8ClampedArray|Uint8Array;\n\n  if (isCanvasLike)
 {\n    vals =\n        // tslint:disable-next-line:no-any\n        (pixels as any).getContext('2d').getImageData(0, 0, width, height).data;\n  } else if (isImageData || isPixelData) {\n    vals = (pixels as PixelData | ImageData).data;\n  } else if (isImage || isVideo || isImageBitmap) {\n    if (fromPixels2DContext == null) {\n      fromPixels2DContext = document.createElement('canvas').getContext('2d');\n    }\n    fromPixels2DContext.canvas.width = width;\n    fromPixels2DContext.canvas.height = height;\n    fromPixels2DContext.drawImage(\n        pixels as HTMLVideoElement, 0, 0, width, height);\n    vals = fromPixels2DContext.getImageData(0, 0, width, height).data;\n  }\n  let values: Int32Array;\n  if (numChannels === 4) {\n    values = new Int32Array(vals);\n  } else {\n    const numPixels = width * height;\n    values = new Int32Array(numPixels * numChannels);\n    for (let i = 0; i < numPixels; i++) {\n      for (let channel = 0; channel < numChannels; ++channel) {\n        values[i * numChannels + channel] = vals[i * 4 + channel];\n      }\n    }\n  }\n  const outShape: [number, number, number] = [height, width, numChannels];\n  return tensor3d(values, outShape, 'int32');\n}\n\n/**\n * Draws a `tf.Tensor` of pixel values to a byte array or optionally a\n * canvas.\n *\n * When the dtype of the input is 'float32', we assume values in the range\n * [0-1]. Otherwise, when input is 'int32', we assume values in the range\n * [0-255].\n *\n * Returns a promise that resolves when the canvas has been drawn to.\n *\n * @param img A rank-2 or rank-3 tensor. If rank-2, draws grayscale. If\n *     rank-3, must have depth of 1, 3 or 4. When depth of 1, draws\n * grayscale. When depth of 3, we draw with the first three components of\n * the depth dimension corresponding to r, g, b and alpha = 1. When depth of\n * 4, all four components of the depth dimension correspond to r, g, b, a.\n * @param canvas The canvas to draw to.\n *\n * @doc {heading: 'Browser', namespace:
 'browser'}\n */\nexport async function toPixels(\n    img: Tensor2D|Tensor3D|TensorLike,\n    canvas?:
HTMLCanvasElement): Promise<Uint8ClampedArray> {\n  let $img = convertToTensor(img, 'img', 'toPixels');\n  if (!(img instanceof Tensor)) {\n    // Assume int32 if user passed a native array.\n    const originalImgTensor = $img;\n    $img = cast(originalImgTensor, 'int32');\n    originalImgTensor.dispose();\n  }\n  if ($img.rank !== 2 && $img.rank !== 3) {\n    throw new Error(\n        `toPixels only supports rank 2 or 3 tensors, got rank ${$img.rank}.`);\n  }\n  const [height, width] = $img.shape.slice(0, 2);\n  const depth = $img.rank === 2 ? 1 : $img.shape[2];\n\n  if (depth > 4 || depth === 2) {\n    throw new Error(\n        `toPixels only supports depth of size `
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+\n `1, 3 or 4 but got ${depth}`);\n }\n\n if ($img.dtype !== 'float32' && $img.dtype !== 'int32') {\n throw new Error(\n `Unsupported type for toPixels: ${$img.dtype}.` +\n ` Please use
float32 or int32 tensors.`);\n }\n\n const data = await $img.data();\n const multiplier = $img.dtype === 'float32' ? 255 : 1;\n const bytes = new Uint8ClampedArray(width * height * 4);\n\n for (let i = 0; i < height * width; ++i) {\n const rgba = [0, 0, 0, 255];\n\n for (let d = 0; d < depth; d++) {\n const value = data[i * depth + d];\n\n if ($img.dtype === 'float32') {\n if (value < 0 || value > 1) {\n throw new Error(\n `Tensor values for a float32 Tensor must be in the ` +\n `range [0 - 1] but encountered ${value}.`);\n }\n } else if ($img.dtype === 'int32') {\n if (value < 0 || value > 255) {\n throw new Error(\n `Tensor values for a int32 Tensor must be in the ` +\n `range [0 - 255] but encountered ${value}.`);\n }\n }\n\n if (depth === 1) {\n rgba[0] = value * multiplier;\n rgba[1] = value * multiplier;\n rgba[2] = value * multiplier;\n
} else {\n rgba[d] = value * multiplier;\n }\n }\n\n const j = i * 4;\n bytes[j + 0] = Math.round(rgba[0]);\n bytes[j + 1] = Math.round(rgba[1]);\n bytes[j + 2] = Math.round(rgba[2]);\n bytes[j + 3] = Math.round(rgba[3]);\n }\n\n if (canvas != null) {\n canvas.width = width;\n canvas.height = height;\n const ctx = canvas.getContext('2d');\n const imageData = new ImageData(bytes, width, height);\n ctx.putImageData(imageData, 0, 0);\n }\n if ($img !== img) {\n $img.dispose();\n }\n return bytes;\n}\n\nexport const fromPixels = op({fromPixels_});\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n
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==\n
*/\nimport {TensorInfo} from '../kernel_registry';\nimport {computeStrides, sizeFromShape} from '../util';\n\n/**\n * Validate gather nd inputs.\n *\n * @param tensor The tensor contains the source values.\n * @param indices The tensor contains the indices to slice the source.\n *\n * @returns [resultShape, numUpdates, sliceSize, strides]\n */\nexport function prepareAndValidate(tensor: TensorInfo, indices: TensorInfo):\n [number[], number, number, number[]] {\n const tensorRank = tensor.shape.length;\n const indicesRank = indices.shape.length;\n if (tensorRank < 1) {\n throw new Error(\n 'tf.gatherND() expects the input to be rank
1 or higher,' +\n ` but the rank was ${tensorRank}.`);\n }\n if (indicesRank < 1) {\n throw new Error(\n 'tf.gatherND() expects the indices to be rank 1 or higher,' +\n ` but the rank was ${indicesRank}.`);\n }\n if (indices.dtype !== 'int32') {\n throw new Error(\n 'tf.gatherND() expects the indices to be int32 type,' +\n ` but the dtype was ${indices.dtype}.`);\n }\n if (indices.shape[indicesRank - 1] > tensorRank) {\n throw new Error(\n 'index innermost dimension length must be <= tensor rank; saw: ' +\n `${indices.shape[indicesRank - 1]} vs. ${tensorRank}`);\n }\n\n if (sizeFromShape(tensor.shape) === 0) {\n throw new Error(\n 'Requested more than 0 entries, but input is empty.' +\n ` Input shape: ${tensor.shape}.`);\n }\n\n const indicesShape = indices.shape;\n const sliceRank = indicesShape[indicesShape.length - 1];\n\n // The result shape is\n // indices.shape[:-1] + params.shape[indices.shape[-1]:]\n
let nResult = 1;\n for (let i = 0; i < indicesShape.length - 1; ++i) {\n nResult *= indicesShape[i];\n }\n\n const inputShape = tensor.shape;\n\n const resultShape = indicesShape.slice();\n resultShape.pop();\n\n let sliceSize = 1;\n for (let i = sliceRank; i < tensorRank; ++i) {\n sliceSize *= inputShape[i];\n resultShape.push(inputShape[i]);\n }\n\n const strides =\n [...computeStrides(tensor.shape).map(stride => stride / sliceSize),\n 1].slice(0, sliceRank);\n\n return [resultShape, nResult, sliceSize, strides];\n}\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a

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==========================================================================\n */\nimport {TensorInfo} from '../kernel_registry';\nimport {Tensor} from '../tensor';\nimport {computeStrides, sizeFromShape} from '../util';\n\n/**\n * Check whether updates.shape = indices.shape[:batchDim] +\n * shape[sliceDim:]\n *\n * @param x The input tensor.\n */\nexport function validateUpdateShape(\n    shape: number[], indices: Tensor, updates: Tensor) {\n  const sliceDim = (indices.rank > 1) ? indices.shape[indices.rank - 1] : 1;\n  const batchDim = (indices.rank > 1) ? indices.rank - 1 : 1;\n\n  const shapeError = 'Must have updates.shape = indices.shape[:batchDim] + ' +\n      `shape[sliceDim:], got updates.shape: ${updates.shape}` +\n      `, indices.shape: ${indices.shape}, shape: ${shape}`
 +\n      `, sliceDim: ${sliceDim}, and batchDim: ${batchDim}.`;\n\n  if (updates.rank < batchDim) {\n    throw new Error(shapeError + ` update.rank < ${batchDim}. `);\n  }\n  if (shape.length < sliceDim + (updates.rank - batchDim)) {\n    throw new Error(\n        shapeError +\n        ` Output shape length < ${sliceDim + (updates.rank - batchDim)}`);\n  }\n  if (updates.rank !== batchDim + shape.length - sliceDim) {\n    throw new Error(\n shapeError + ` update.rank != ${batchDim + shape.length - sliceDim}`);\n  }\n  for (let d = 0; d < batchDim; ++d) {\n    if (updates.shape[d] !== indices.shape[d]) {\n      throw new Error(\n          shapeError +\n          ` updates.shape[${d}] (${updates.shape[d]}) != indices.shape[${d}] (${\n              indices.shape[d]}).`);\n    }\n  }\n  for (let d = 0; d < updates.rank - batchDim; ++d) {\n    if (updates.shape[d + batchDim] !== shape[d + sliceDim]) {\n      throw new Error(\n          shapeError +\n          ` updates.shape[${d
 + batchDim}] (${\n              updates.shape[d + batchDim]}) != shape[${d + batchDim}] (${\n              shape[d + batchDim]})`);\n    }\n  }\n}\n\nexport interface ScatterShapeInfo {\n  sliceRank: number;\n  numUpdates: number;\n  sliceSize: number;\n  strides: number[];\n  outputSize: number;\n}\n/**\n * Validate scatter nd inputs.\n *\n * @param update The tensor contains the update values.\n * @param indices The tensor contains the indices for the update values.\n * @param shape The shape of the output tensor.\n */\nexport function validateInput(\n updates: Tensor, indices: Tensor, shape: number[]) {\n  if (indices.rank < 1) {\n    throw new Error(\n 'tf.scatterND() expects the indices to be rank 1 or higher,' +\n        ` but the rank was ${indices.rank}.`);\n  }\n  if (updates.rank < 1) {\n    throw new Error(\n        'tf.scatterND() expects the updates to be rank 1 or higher,' +\n        ` but the rank was ${updates.rank}.`);\n  }\n  if (indices.dtype !== 'int32')
 {\n    throw new Error(`The dtype of 'indices' should be int32, but got dtype: ${\n        indices.dtype}`);\n  }\n  if (shape.length < 1) {\n    throw new Error(\n        `Output rank must be greater or equal to 1, but got shape: ${shape}`);\n  }\n\n  if (shape.length === 0) {\n    if (indices.size === 0) {\n      throw new Error(`Indices specified for empty output. indices shape: ${\n          indices.shape}`);\n    }\n    if (updates.size === 0) {\n      throw new Error(`Updates specified for empty output. updates shape: ${\n          updates.shape}`);\n    }\n  }\n\n validateUpdateShape(shape, indices, updates);\n}\n\n/**\n * Calculate the shape information for the output.\n *\n * @param update The tensor contains the update values.\n * @param indices The tensor contains the indices for the update values.\n * @param shape The shape of the output tensor.\n *\n * @returns ScatterShapeInfo\n */\nexport function calculateShapes(\n    updates: TensorInfo, indices: TensorInfo,\n    shape:
 number[]): ScatterShapeInfo {\n  // Calculate the number of dimensions in indices\n  const indicesRank = indices.shape.length;\n  const sliceRank = (indicesRank > 1) ? indices.shape[indicesRank - 1] : 1;\n\n  // Calculate the number of elements that make up each slice of our updated\n  // tensor. This allows us to work with flattened tensors and copy over whole\n  // slices at a time.\n  const totalNd = shape.length;\n\n  let sliceSize = 1;\n  for (let i = sliceRank; i < totalNd; ++i) {\n    sliceSize *= shape[i];\n  }\n\n  const safeSliceDim = (sliceRank < 1) ? 1 : sliceRank;\n  const numUpdates = sizeFromShape(indices.shape) / safeSliceDim;\n\n  const strides = [...computeStrides(shape.slice(0, sliceRank)), 1];\n  const outputSize = sizeFromShape(shape);\n  return {sliceRank, numUpdates, sliceSize, strides, outputSize};\n}\n","/**\n * @license\n * Copyright 2017 Google LLC. All Rights
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governing permissions and\n * limitations under the License.\n *
==========================================================================\n
*/\n\nimport {TensorInfo} from '../kernel_registry';\nimport * as util from '../util';\n\nexport type SliceInfo = {\n
nonStrided: boolean,\n  $begin: number[],\n  $end: number[],\n  $strides: number[],\n  size: number[],\n  newShape:
number[],\n  outShape: number[]\n};\n\nexport function assertParamsValid(\n    input: TensorInfo, begin: number[],
size: number[]): void {\n  const inputRank = input.shape.length;\n  util.assert(\n
   inputRank === begin.length,\n      () => `Error in slice${inputRank}D: Length of begin ${begin} must ` +\n
`match the rank of the array (${inputRank}).`);\n  util.assert(\n      inputRank === size.length,\n      () => `Error in
slice${inputRank}D: Length of size ${size} must ` +\n          `match the rank of the array (${inputRank}).`);\n\n  for
(let i = 0; i < inputRank; ++i) {\n    util.assert(\n        begin[i] + size[i] <= input.shape[i],\n        () => `Error in
slice${inputRank}D: begin[${i}] + size[${i}] ` +\n            `(${begin[i] + size[i]}) would overflow input.shape[${i}]
(${\n                input.shape[i]})`);\n  }\n}\n\n/** Converts a binary mask to an array of axes. Used in stridedSlice().
*/\nexport function maskToAxes(mask: number): number[] {\n  const axes = [];\n  let axis = 0;\n  while (mask > 0)
{\n    if (mask & 1) {\n      axes.push(axis);\n    }\n    mask /= 2;\n    axis++;\n  }\n  return axes;\n}\n\n/** Computes
the output shape given the strided
 slice params. */\nexport function computeOutShape(\n    begin: number[], end: number[], strides: number[]):
number[] {\n  const size = [];\n  for (let axis = 0; axis < begin.length; axis++) {\n    size[axis] = Math.ceil((end[axis]
- begin[axis]) / strides[axis]);\n  }\n  return size;\n}\n\n// Creates full selection at the elided dimensions. If the
dimension matches\n// the ellipsis mask, override the current stride value. Otherwise, insert.\nexport function
stridesWithElidedDims(\n    strides: number[], ellipsisInsertionIndex: number, numElidedAxes: number,\n
inputShape: number[]): number[] {\n  const newStrides = [...strides];\n  for (let i = newStrides.length; i <
inputShape.length; i++) {\n    newStrides.push(1);\n  }\n  for (let i = 0; i < numElidedAxes; i++) {\n    if (i === 0)
{\n      newStrides[ellipsisInsertionIndex] = 1;\n    } else {\n      newStrides.splice(\n          ellipsisInsertionIndex, 0 /*
num elements to delete */,\n          1 /* element to add */);\n      newStrides.pop();\n
   }\n  }\n  return newStrides;\n}\n\nfunction unnormalizeAxis(\n    ellipsisInsertionIndex: number, numElidedAxes:
number,\n    normalizedAxis: number): number {\n  if (normalizedAxis <= ellipsisInsertionIndex) {\n    return
normalizedAxis;\n  }\n\n  return normalizedAxis - (numElidedAxes - 1);\n}\n\nfunction
getElidedAxes(numElidedAxes: number, ellipsisInsertionIndex: number) {\n  const elidedAxes = [];\n  for (let i = 0;
i < numElidedAxes; i++) {\n    elidedAxes.push(ellipsisInsertionIndex + i);\n  }\n  return elidedAxes;\n}\n\n//
Normalize the start, end and strides.\nexport function getNormalizedAxes(\n    inputShape: number[], ellipsisAxes:
number[], numInterpolatedAxes: number,\n    begin: number[], end: number[], strides: number[], beginMask:
number,\n    endMask: number,\n    ellipsisMask: number): {begin: number[], end: number[], strides: number[]} {\n
const inputRank = inputShape.length;\n  let normalizedBegin = new Array(inputRank),\n      normalizedEnd =
 new Array(inputRank),\n      normalizedStrides = new Array(inputRank);\n  if (ellipsisAxes.length &&
numInterpolatedAxes > 0) {\n    const fullIndex = ellipsisAxes[0];\n\n    // The ellipsis applies to the masked index
as well as any dimensions\n    // that are interpolated.\n    const numElidedAxes = numInterpolatedAxes + 1;\n
normalizedBegin = startIndicesWithElidedDims(\n        beginMask, fullIndex, numElidedAxes, begin,
inputShape);\n    normalizedEnd = stopIndicesWithElidedDims(\n        endMask, fullIndex, numElidedAxes, end,
inputShape);\n    normalizedStrides =\n        stridesWithElidedDims(strides, fullIndex, numElidedAxes,
inputShape);\n  } else {\n    for (let axis = 0; axis < inputRank; axis++) {\n      normalizedBegin[axis] =
startForAxis(\n          beginMask, begin, strides, inputShape, axis, ellipsisMask);\n      normalizedEnd[axis] =\n
stopForAxis(endMask, end, strides, inputShape, axis, ellipsisMask);\n      normalizedStrides[axis] =
stridesForAxis(strides,
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 axis, ellipsisMask);\n    }\n  }\n\n  return {\n    begin: normalizedBegin,\n    end: normalizedEnd,\n    strides: normalizedStrides\n  };\n}\n\n// Creates full selection at the elided dimensions. If the dimension matches\n// the ellipsis mask, override the current start value. Otherwise, insert.\nexport function startIndicesWithElidedDims(\n beginMask: number, ellipsisInsertionIndex: number, numElidedAxes: number,\n    originalBegin: number[], inputShape: number[]): number[] {\n  const newIndices = [...inputShape];\n  const elidedAxes = getElidedAxes(numElidedAxes, ellipsisInsertionIndex);\n\n  for (let axis = 0; axis < newIndices.length; axis++) {\n if (elidedAxes.indexOf(axis) > -1) {\n      newIndices[axis] = 0;\n    } else {\n      const originalAxis =\n unnormalizeAxis(ellipsisInsertionIndex, numElidedAxes, axis);\n      let originalValue = originalBegin[originalAxis];\n      if (beginMask & 1 << originalAxis) {\n        originalValue = 0;\n      }\n\n newIndices[axis]
 = originalValue;\n    }\n  }\n  return newIndices;\n}\n\n// Creates full selection at the elided dimensions. If the dimension matches\n// the ellipsis mask, override the current stop value. Otherwise, insert.\nexport function stopIndicesWithElidedDims(\n    endMask: number, ellipsisInsertionIndex: number, numElidedAxes: number,\n originalEnd: number[], inputShape: number[]): number[] {\n  const newIndices = [...inputShape];\n  const elidedAxes = getElidedAxes(numElidedAxes, ellipsisInsertionIndex);\n\n  for (let axis = 0; axis < newIndices.length; axis++) {\n    if (elidedAxes.indexOf(axis) > -1) {\n      newIndices[axis] = Number.MAX_SAFE_INTEGER;\n    } else {\n      const originalAxis =\n unnormalizeAxis(ellipsisInsertionIndex, numElidedAxes, axis);\n      let originalValue = originalEnd[originalAxis];\n      if (endMask & 1 << originalAxis) {\n        originalValue = Number.MAX_SAFE_INTEGER;\n      }\n      newIndices[axis] = originalValue;\n    }\n  }\n\n
  for (let i = 0; i < newIndices.length; i++) {\n    // Handle negative indices\n    const axisSize = inputShape[i];\n    if (newIndices[i] < 0) {\n      newIndices[i] += axisSize;\n    }\n    newIndices[i] = util.clamp(0, newIndices[i], inputShape[i]);\n  }\n  return newIndices;\n}\n\nexport function stridesForAxis(\n    strides: number[], axis: number, ellipsisMask: number): number {\n  let stride = strides[axis];\n  if (ellipsisMask & (1 << axis) || stride == null) {\n stride = 1;\n  }\n\n  return stride;\n}\n\nexport function startForAxis(\n    beginMask: number, startIndices: number[], strides: number[],\n    inputShape: number[], axis: number, ellipsisMask: number): number {\n  // Begin with the specified index\n  let start = startIndices[axis];\n  const stride = strides[axis] || 1;\n\n  // Check the axis bit from right of masked axes, or the begin index is not set\n  // for the axis.\n  if (beginMask & 1 << axis || ellipsisMask & 1 << axis || start == null) {\n    if (stride
 > 0) {\n      // Forward iteration - use the first element. These values will get\n      // clamped below (Note: We could have set them to 0 and axis_size-1, but\n      // use lowest() and max() to maintain symmetry with StopForAxis())\n
 start = Number.MIN_SAFE_INTEGER;\n    } else {\n      // Backward iteration - use the last element.\n      start = Number.MAX_SAFE_INTEGER;\n    }\n  }\n\n  // Handle negative indices\n  const axisSize = inputShape[axis];\n  if (start < 0) {\n    start += axisSize;\n  }\n\n  // Clamping\n  start = util.clamp(0, start, axisSize - 1);\n\n  return start;\n}\n\nexport function stopForAxis(\n    endMask: number, stopIndices: number[], strides: number[],\n inputShape: number[], axis: number, ellipsisMask: number): number {\n  // Begin with the specified index\n  let stop = stopIndices[axis];\n  const stride = strides[axis] || 1;\n\n  // Check the axis bit from right of masked axes, or if the stop index is not\n  // set for this axis.\n  if (endMask &
 (1 << axis) || ellipsisMask & (1 << axis) || stop == null) {\n    if (stride > 0) {\n      // Forward iteration - use the last element. These values will get\n      // clamped below\n      stop = Number.MAX_SAFE_INTEGER;\n    } else {\n      // Backward iteration - use the first element.\n      stop = Number.MIN_SAFE_INTEGER;\n    }\n  }\n\n  // Handle negative indices\n  const axisSize = inputShape[axis];\n  if (stop < 0) {\n    stop += axisSize;\n  }\n\n  // Clamping\n  // Because the end index points one past the last element, we need slightly\n  // different clamping ranges depending on the direction.\n  if (stride > 0) {\n    // Forward iteration\n    stop = util.clamp(0, stop, axisSize);\n  } else {\n    // Backward iteration\n    stop = util.clamp(-1, stop, axisSize - 1);\n  }\n\n  return stop;\n}\n\n/**\n * Returns true if the slice occupies a continous set of elements in the\n * 'flat' space.\n */\nexport function isSliceContinous(\n    shape: number[], begin: number[], size:
```

number[]) {\n // Index of the first axis that has size > 1.\n let firstNonOneAxis = size.length;\n for (let i = 0; i < size.length; i++) {\n   if (size[i] > 1) {\n   firstNonOneAxis = i;\n   break;\n   }\n }\n\n for (let i = firstNonOneAxis + 1; i < size.length; i++) {\n   if (begin[i] > 0 || size[i] !== shape[i]) {\n   return false;\n   }\n }\n return true;\n}\n\nexport function computeFlatOffset(begin: number[], strides: number[]): number {\n let flatOffset = begin.length > 0 ? begin[begin.length - 1] : 1;\n for (let i = 0; i < begin.length - 1; i++) {\n   flatOffset += begin[i] * strides[i];\n }\n return flatOffset;\n}\n\nexport function parseSliceParams(\n   x: TensorInfo, begin: number|number[], size?: number|number[]) {\n // The following logic allows for more ergonomic calls.\n let begin_: number[];\n const xRank = x.shape.length;\n if (typeof begin === 'number') {\n   begin_ = [begin, ...new Array(xRank - 1).fill(0)];\n } else if (begin.length < xRank) {\n   begin_ = begin.concat(new Array(xRank - begin.length).fill(0));\n } else {\n   begin_ = begin.slice();\n }\n begin_.forEach(d => {\n   util.assert(\n   d !== -1, () => 'slice() does not support negative begin indexing.');\n });\n let size_: number[];\n if (size == null) {\n   size_ = new Array(xRank).fill(-1);\n } else if (typeof size === 'number') {\n   size_ = [size, ...new Array(xRank - 1).fill(-1)];\n } else if (size.length < xRank) {\n   size_ = size.concat(new Array(xRank - size.length).fill(-1));\n } else {\n   size_ = size;\n }\n size_ = size_.map((d, i) => {\n   if (d >= 0) {\n   return d;\n   } else {\n   util.assert(\n   d === -1,\n   () => `Negative size values should be exactly -1 but got ` +\n   `${d} for the slice() size at index ${i}.`);\n   return x.shape[i] - begin_[i];\n   }\n });\n return [begin_, size_];\n}\n\nexport function sliceInfo(\n   xShape: number[], begin: number[], end: number[],
 strides: number[],\n   beginMask: number, endMask: number, ellipsisMask: number,\n   newAxisMask: number, shrinkAxisMask: number): SliceInfo {\n // make a copy because it may be modified further down.\n let $begin = begin.slice();\n let $end = end.slice();\n let $strides = strides;\n\n if (strides == null) {\n $strides = new Array($begin.length);\n }\n\n const ellipsisAxes = maskToAxes(ellipsisMask);\n if (ellipsisAxes.length > 1) {\n   throw new Error('Multiple ellipses in slice is not allowed.');\n }\n\n if (ellipsisMask !== 0 && newAxisMask !== 0) {\n   throw new Error(\n   'Using both ellipsisMask and newAxisMask is not yet supported.');\n }\n\n if (ellipsisMask !== 0 && shrinkAxisMask !== 0) {\n   throw new Error(\n   'Using both ellipsisMask and shrinkAxisMask is not yet supported.');\n }\n\n const numInterpolatedAxes = xShape.length - $begin.length;\n\n // Expand the dims of x based on the newAxisMask.\n const expandAxes = maskToAxes(newAxisMask);\n
  const newShape = xShape.slice();\n expandAxes.forEach(axis => {\n $begin[axis] = 0;\n $end[axis] = 1;\n   newShape.splice(axis, 0, 1);\n });\n\n const {\n   begin: normalizedBegin,\n   end: normalizedEnd,\n   strides: normalizedStrides\n } =\n   getNormalizedAxes(\n   newShape, ellipsisAxes, numInterpolatedAxes, $begin, $end, $strides,\n   beginMask, endMask, ellipsisMask);\n $begin = normalizedBegin;\n $end = normalizedEnd;\n $strides = normalizedStrides;\n\n const shrinkAxes = maskToAxes(shrinkAxisMask);\n // Adjust the ends based on the shrink mask.\n shrinkAxes.forEach(axis => {\n $end[axis] = $begin[axis] + 1;\n $strides[axis] = 1;\n });\n\n // Figure out the output shape.\n const size = computeOutShape($begin, $end, $strides);\n // Remove the axes based on shrinkMask.\n const outShape = size.filter((_, axis) => shrinkAxes.indexOf(axis) === -1);\n\n const nonStrided = $strides.every(v => v === 1);\n\n return {nonStrided, $begin,
 $end, $strides, size, newShape, outShape};\n}\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==\n */\n\nimport {assert} from './util';\n\n/**\n * Types to support JSON-esque data structures internally.\n *\n * Internally ConfigDict's use camelCase keys and values where the\n * values are class names to be instantiated. On

the python side, these\n * will be snake_case. Internally we allow Enums into the values for better\n * type safety, but these need to be converted to raw primitives (usually\n * strings) for round-tripping with python.\n *\n * toConfig returns the TS-friendly representation. model.toJSON() returns\n * the pythonic version as that's the portable format. If you need to\n * python-ify a non-model level toConfig output, you'll need to use a\n * convertTsToPythonic from serialization_utils in -Layers.\n *\n */\nexport declare type ConfigDictValue =\n boolean | number | string | null | ConfigDictArray | ConfigDict;\nexport declare interface ConfigDict {\n [key: string]: ConfigDictValue;\n}\nexport declare interface ConfigDictArray extends Array<ConfigDictValue> {}\n\n/**\n * Type to represent the class-type of Serializable objects.\n *\n * Ie the class prototype with access to the constructor and any\n * static members/methods. Instance methods are not listed here.\n *\n * Source for this idea: https://stackoverflow.com/a/43607255\n */\nexport declare type SerializableConstructor<T extends Serializable> = {\n // tslint:disable-next-line:no-any\n new (...args: any[]): T; className: string; fromConfig: FromConfigMethod<T>;\n};\nexport declare type FromConfigMethod<T extends Serializable> =\n (cls: SerializableConstructor<T>, config: ConfigDict) => T;\n\n/**\n * Serializable defines the serialization contract.\n *\n * TFJS requires serializable classes to return their className when asked\n * to avoid issues with minification.\n */\nexport abstract class Serializable {\n /**\n * Return the class name for this class to use in serialization contexts.\n *\n * Generally speaking this will be the same thing that constructor.name\n * would have returned. However, the class name needs to be robust\n * against minification for serialization/deserialization to work properly.\n *\n * There's also places such as initializers.VarianceScaling, where\n * implementation details between different languages led to different\n * class hierarchies and a non-leaf node is used for serialization purposes.\n */\n getClassName(): string {\n return (this.constructor as SerializableConstructor<Serializable>)\n .className;\n }\n\n /**\n * Return all the non-weight state needed to serialize this object.\n */\n abstract getConfig(): ConfigDict;\n\n /**\n * Creates an instance of T from a ConfigDict.\n *\n * This works for most descendants of serializable. A few need to\n * provide special handling.\n * @param cls A Constructor for the class to instantiate.\n * @param config The Configuration for the object.\n */\n /** @nocollapse */\n static fromConfig<T extends Serializable>(\n cls: SerializableConstructor<T>, config: ConfigDict): T {\n return new cls(config);\n }\n}\n\n/**\n * Maps string keys to class constructors.\n *\n * Used during (de)serialization from the cross-language JSON format, which\n * requires the class name in the serialization format matches the class\n * names as used in Python, should it exist.\n */\nexport class SerializationMap {\n private static instance: SerializationMap;\n classNameMap: {\n [className: string]:\n [SerializableConstructor<Serializable>, FromConfigMethod<Serializable>]\n };\n\n private constructor() {\n this.classNameMap = {};\n }\n\n /**\n * Returns the singleton instance of the map.\n */\n static getMap(): SerializationMap {\n if (SerializationMap.instance == null) {\n SerializationMap.instance = new SerializationMap();\n }\n return SerializationMap.instance;\n }\n\n /**\n * Registers the class as serializable.\n */\n static register<T extends Serializable>(cls: SerializableConstructor<T>) {\n SerializationMap.getMap().classNameMap[cls.className] =\n [cls, cls.fromConfig];\n }\n}\n\n/**\n * Register a class with the serialization map of TensorFlow.js.\n *\n * This is often used for registering custom Layers, so they can be\n * serialized and deserialized.\n *\n * Example:\n *\n * ```js\n * class MyCustomLayer extends tf.layers.Layer {\n * static className = 'MyCustomLayer';\n *\n * constructor(config) {\n * super(config);\n * }\n * }\n * tf.serialization.registerClass(MyCustomLayer);\n * ```\n *\n * @param cls The class to be registered. It must have a public static member\n * called `className` defined and the value must be a non-empty string.\n *\n * @doc {heading: 'Models', subheading: 'Serialization', ignoreCI: true}\n */\nexport function registerClass<T extends Serializable>(\n cls: SerializableConstructor<T>) {\n assert(\n cls.className != null,\n () => `Class being registered does not have the static className ` +\n `property defined.`);\n assert(\n typeof cls.className === 'string',\n () => `className is required to be a string, but got type ` +\n typeof cls.className);\n assert(\n cls.className.length > 0,\n () => `Class being registered has an empty-string as its className, ` +\n `which is disallowed.`);\n\n SerializationMap.register(cls);\n}\n","/**\n * @license\n * Copyright 2017 Google LLC. All Rights Reserved.\n *

Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {ENGINE} from './engine';\nimport {inferShape} from './tensor_util_env';\nimport {RecursiveArray, TensorLike,
TypedArray} from './types';\nimport {arraysEqual, encodeString, flatten, isString, isTypedArray} from './util';\n\nconst TEST_EPSILON_FLOAT32 = 1e-3;\nexport const TEST_EPSILON_FLOAT16 = 1e-1;\n\nexport function expectArraysClose(\n actual: TypedArray|number|RecursiveArray<number>,\n expected: TypedArray|number|RecursiveArray<number>, epsilon?: number) {\n if (epsilon == null) {\n epsilon = testEpsilon();\n }\n return expectArraysPredicate(\n actual, expected, (a, b) => areClose(a as number, b as number, epsilon));\n}\n\nexport function testEpsilon() {\n return ENGINE.backend.floatPrecision() === 32 ? TEST_EPSILON_FLOAT32 :\n TEST_EPSILON_FLOAT16;\n}\n\nfunction expectArraysPredicate(\n actual: TensorLike, expected: TensorLike,\n predicate: (a: {}, b: {}) => boolean) {\n let checkClassType = true;\n if (isTypedArray(actual) || isTypedArray(expected)) {\n checkClassType = false;\n }\n if (isTypedArray(actual)
&& isTypedArray(expected)) {\n checkClassType = true;\n }\n if (checkClassType) {\n const aType = actual.constructor.name;\n const bType = expected.constructor.name;\n\n if (aType !== bType) {\n throw new Error(\n `Arrays are of different type. Actual: ${aType}. ` +\n `Expected: ${bType}`);\n }\n }\n\n if (Array.isArray(actual) && Array.isArray(expected)) {\n const actualShape = inferShape(actual);\n const expectedShape = inferShape(expected);\n if (!arraysEqual(actualShape, expectedShape)) {\n throw new Error(\n `Arrays have different shapes. ` +\n `Actual: [${actualShape}]. Expected: [${expectedShape}]`);\n }\n }\n\n const actualFlat =\n isTypedArray(actual) ? actual : flatten(actual as RecursiveArray<number>);\n const expectedFlat = isTypedArray(expected) ?\n expected :\n flatten(expected as RecursiveArray<number>);\n\n if (actualFlat.length !== expectedFlat.length) {\n throw
new Error(\n `Arrays have different lengths actual: ${actualFlat.length} vs ` +\n `expected: ${expectedFlat.length}.\\n` +\n `Actual: ${actualFlat}.\\n` +\n `Expected: ${expectedFlat}.`);\n }\n for (let i = 0; i < expectedFlat.length; ++i) {\n const a = actualFlat[i];\n const e = expectedFlat[i];\n\n if (!predicate(a, e)) {\n throw new Error(\n `Arrays differ: actual[${i}] = ${a}, expected[${i}] = ${e}.\\n` +\n `Actual: ${actualFlat}.\\n` +\n `Expected: ${expectedFlat}.`);\n }\n }\n}\n\nexport interface DoneFn {\n (): void;\n fail: (message?: Error|string) => void;\n}\n\nexport function expectPromiseToFail(fn: () => Promise<{}>, done: DoneFn): void {\n fn().then(() => done.fail(), () => done());\n}\n\nexport function expectArraysEqual(actual: TensorLike, expected: TensorLike) {\n const exp = typeof expected === 'string' || typeof expected === 'number' ||\n typeof expected === 'boolean' ?\n [expected] as number[] :\n expected as number[];\n if (isString(actual) || isString((actual as string[])[0]) ||\n isString(expected) || isString((expected as string[])[0])) {\n // tslint:disable-next-line: triple-equals\n return expectArraysPredicate(actual, exp, (a, b) => a == b);\n }\n return expectArraysPredicate(\n actual, expected, (a, b) => areClose(a as number, b as number, 0));\n}\n\nexport function expectNumbersClose(a: number, e: number, epsilon?: number) {\n if (epsilon == null) {\n epsilon = testEpsilon();\n }\n if (!areClose(a, e, epsilon)) {\n throw new Error(`Numbers differ: actual === ${a}, expected === ${e}`);\n }\n}\n\nfunction areClose(a: number, e: number, epsilon: number): boolean {\n if (!isFinite(a) && !isFinite(e)) {\n return true;\n }\n if (isNaN(a) || isNaN(e) || Math.abs(a - e) > epsilon) {\n return false;\n }\n return true;\n}\n\nexport function expectValuesInRange(\n actual: TypedArray|number[], low: number,
high: number) {\n for (let i = 0; i < actual.length; i++) {\n if (actual[i] < low || actual[i] > high) {\n throw new Error(\n `Value out of range:${actual[i]} low: ${low}, high: ${high}`);\n }\n }\n}\n\nexport function

expectArrayBuffersEqual(\n   actual: ArrayBuffer, expected: ArrayBuffer) {\n // Safari & Jasmine don't like comparing ArrayBuffers directly. Wrapping in\n // a Float32Array solves this issue.\n expect(new Float32Array(actual)).toEqual(new Float32Array(expected));\n}\n\n/** Encodes strings into utf-8 bytes. */\nexport function encodeStrings(a: RecursiveArray<{}>):\n   RecursiveArray<Uint8Array> {\n for (let i = 0; i < (a as Array<{}>).length; i++) {\n   const val = a[i];\n   if (Array.isArray(val)) {\n   encodeStrings(val);\n   } else {\n   a[i] = encodeString(val as string);\n   }\n }\n return a as RecursiveArray<Uint8Array>;\n}\n","/** @license See the LICENSE file. */\n\n// This code is auto-generated, do not modify this file!\nconst
 version = '3.1.0';\nexport {version};\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n *
http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n
*/\n\nimport {KernelBackend} from './backends/backend';\nimport {ENGINE, Engine, MemoryInfo, ProfileInfo, ScopeFn, TimingInfo} from './engine';\nimport {env} from './environment';\n\nimport {Platform} from
'./platforms/platform';\nimport
 {setDeprecationWarningFn, Tensor} from './tensor';\nimport {TensorContainer} from './tensor_types';\nimport {getTensorsInContainer} from './tensor_util';\n\n/**\n * Enables production mode which disables correctness checks in favor of\n * performance.\n *\n * @doc {heading: 'Environment'}\n */\nexport function enableProdMode(): void {\n env().set('PROD', true);\n}\n\n/**\n * Enables debug mode which will log information about all executed kernels:\n * the elapsed time of the kernel execution, as well as the rank, shape, and\n * size of the output tensor.\n *\n * Debug mode will significantly slow down your application as it will\n * download the result of every operation to the CPU. This should not be used in\n * production. Debug mode does not affect the timing information of the kernel\n * execution as we do not measure download time in the kernel execution time.\n *\n * See also: `tf.profile`, `tf.memory`.\n *\n * @doc {heading: 'Environment'}\n */\nexport function enableDebugMode():
 void {\n env().set('DEBUG', true);\n}\n\n/** Globally disables deprecation warnings */\nexport function disableDeprecationWarnings(): void {\n env().set('DEPRECATION_WARNINGS_ENABLED', false);\n console.warn(`TensorFlow.js deprecation warnings have been disabled.`);\n}\n\n/** Warn users about deprecated functionality. */\nexport function deprecationWarn(msg: string) {\n if (env().getBool('DEPRECATION_WARNINGS_ENABLED')) {\n   console.warn(\n   msg + ' You can disable deprecation warnings with ' +\n   'tf.disableDeprecationWarnings().');\n }\n}\nsetDeprecationWarningFn(deprecationWarn);\n\n/**\n * Dispose all variables kept in backend engine.\n *\n * @doc {heading: 'Environment'}\n */\nexport function disposeVariables(): void {\n ENGINE.disposeVariables();\n}\n\n/**\n * It returns the global engine that keeps track of all tensors and backends.\n *\n * @doc {heading: 'Environment'}\n */\nexport function engine(): Engine {\n return ENGINE;\n}\n\n/**\n * Returns memory
 info at the current time in the program. The result is an\n * object with the following properties:\n *\n * - `numBytes`: Number of bytes allocated (undisposed) at this time.\n * - `numTensors`: Number of unique tensors allocated.\n * - `numDataBuffers`: Number of unique data buffers allocated\n *   (undisposed) at this time, which is the number of tensors\n *   (e.g. `a.reshape(newShape)` makes a new Tensor that shares the same\n *   data buffer with `a`).\n * - `unreliable`: True if the memory usage is unreliable. See `reasons` when\n *   `unreliable` is true.\n * - `reasons`: `string[]`, reasons why the memory is unreliable, present if\n *   `unreliable` is true.\n *\n * WebGL Properties:\n * - `numBytesInGPU`: Number of bytes allocated (undisposed) in the GPU only at\n *   this time.\n *\n * @doc {heading: 'Performance', subheading: 'Memory'}\n */\nexport function memory(): MemoryInfo {\n return ENGINE.memory();\n}\n\n/**\n * Executes the provided function `f()` and returns

a promise that resolves\n * with information about the function's memory use:\n * - `newBytes`: the number of new bytes allocated\n * - `newTensors`: the number of new tensors created\n * - `peakBytes`: the peak number of bytes allocated\n * - `kernels`: an array of objects for each kernel involved that reports\n * their input and output shapes, number of bytes used, and number of new\n * tensors created.\n * - `kernelNames`: an array of unique strings with just the names of the\n * kernels in the `kernels` array.\n *\n * ```js\n * const profile = await tf.profile(() => {\n * const x = tf.tensor1d([1, 2, 3]);\n * let x2 = x.square();\n * x2.dispose();\n * x2 = x.square();\n * x2.dispose();\n * return x;\n * });\n *\n * console.log(`newBytes: ${profile.newBytes}`);\n * console.log(`newTensors: ${profile.newTensors}`);\n * console.log(`byte usage over all kernels: ${profile.kernels.map(k =>\n * k.totalBytesSnapshot)}`);\n * ```\n *\n *\n * @doc {heading: 'Performance', subheading: 'Profile'}\n */\nexport function profile(f: () => (TensorContainer | Promise<TensorContainer>)):\n Promise<ProfileInfo> {\n return ENGINE.profile(f);\n}\n\n/**\n * Executes the provided function `fn` and after it is executed, cleans up all\n * intermediate tensors allocated by `fn` except those returned by `fn`.\n * `fn` must not return a Promise (async functions not allowed). The returned\n * result can be a complex object.\n *\n * Using this method helps avoid memory leaks. In general, wrap calls to\n * operations in `tf.tidy` for automatic memory cleanup.\n *\n * NOTE: Variables do *not* get cleaned up when inside a tidy(). If you want to\n * dispose variables, please use `tf.disposeVariables` or call dispose()\n * directly on variables.\n *\n * ```js\n * // y = 2 ^ 2 + 1\n * const y = tf.tidy(() => {\n * // a, b, and one will be cleaned up when the tidy ends.\n * const one = tf.scalar(1);\n * const a = tf.scalar(2);\n * const b = a.square();\n *\n * console.log('numTensors (in tidy): ' + tf.memory().numTensors);\n *\n * // The value returned inside the tidy function will return\n * // through the tidy, in this case to the variable y.\n * return b.add(one);\n * });\n *\n * console.log('numTensors (outside tidy): ' + tf.memory().numTensors);\n * y.print();\n * ```\n *\n * @param nameOrFn The name of the closure, or the function to execute.\n *   If a name is provided, the 2nd argument should be the function.\n *   If debug mode is on, the timing and the memory usage of the function\n *   will be tracked and displayed on the console using the provided name.\n * @param fn The function to execute.\n *\n * @doc {heading: 'Performance', subheading: 'Memory'}\n */\nexport function tidy<T extends TensorContainer>(\n nameOrFn: string|ScopeFn<T>, fn?: ScopeFn<T>): T {\n return ENGINE.tidy(nameOrFn, fn);\n}\n\n/**\n * Disposes any `tf.Tensor`s found within the provided object.\n *\n * @param container an object that may be a `tf.Tensor`
 or may directly\n *   contain `tf.Tensor`s, such as a `Tensor[]` or `{key: Tensor, ...}`. If\n *   the object is not a `tf.Tensor` or does not contain `Tensors`, nothing\n *   happens. In general it is safe to pass any object here, except that\n *   `Promise`s are not supported.\n *\n * @doc {heading: 'Performance', subheading: 'Memory'}\n */\nexport function dispose(container: TensorContainer) {\n const tensors = getTensorsInContainer(container);\n tensors.forEach(tensor => tensor.dispose());\n}\n\n/**\n * Keeps a `tf.Tensor` generated inside a `tf.tidy` from being disposed\n * automatically.\n *\n * ```js\n * let b;\n * const y = tf.tidy(() => {\n * const one = tf.scalar(1);\n * const a = tf.scalar(2);\n *\n * // b will not be cleaned up by the tidy. a and one will be cleaned up\n * // when the tidy ends.\n * b = tf.keep(a.square());\n *\n * console.log('numTensors (in tidy): ' + tf.memory().numTensors);\n *\n * // The value returned inside the tidy function
 will return\n * // through the tidy, in this case to the variable y.\n * return b.add(one);\n * });\n *\n * console.log('numTensors (outside tidy): ' + tf.memory().numTensors);\n * console.log('y:');\n * y.print();\n * console.log('b:');\n * b.print();\n * ```\n *\n * @param result The tensor to keep from being disposed.\n *\n * @doc {heading: 'Performance', subheading: 'Memory'}\n */\nexport function keep<T extends Tensor>(result: T): T {\n return ENGINE.keep(result);\n}\n\n/**\n * Executes `f()` and returns a promise that resolves with timing\n * information.\n *\n * The result is an object with the following properties:\n *\n * - `wallMs`: Wall execution time.\n * - `kernelMs`: Kernel execution time, ignoring data transfer. If using the\n * WebGL backend and the query timer extension is not available, this will\n * return an error object.\n * - On `WebGL` The following additional properties exist:\n * - `uploadWaitMs`: CPU blocking time on texture uploads.\n * - `downloadWaitMs`:
 CPU blocking time on texture downloads (readPixels).\n *\n * ```js\n * const x = tf.randomNormal([20, 20]);\n * const time = await tf.time(() => x.matMul(x));\n *\n * console.log(`kernelMs: ${time.kernelMs}, wallTimeMs: ${time.wallMs}`);\n * ```\n *\n * @param f The function to execute and time.\n *\n * @doc {heading:

'Performance', subheading: 'Timing'}\n */\nexport function time(f: () => void): Promise<TimingInfo> {\n return ENGINE.time(f);\n}\n\n/**\n * Sets the backend (cpu, webgl, wasm, etc) responsible for creating tensors and\n * executing operations on those tensors. Returns a promise that resolves\n * to a boolean if the backend initialization was successful.\n *\n * Note this disposes the current backend, if any, as well as any tensors\n * associated with it. A new backend is initialized, even if it is of the\n * same type as the previous one.\n *\n * @param backendName The name of the backend. Currently supports\n *   `'webgl'|'cpu'` in the browser, `'tensorflow'`
 under node.js\n *   (requires tfjs-node), and `'wasm'` (requires tfjs-backend-wasm).\n *\n * @doc {heading: 'Backends'}\n */\nexport function setBackend(backendName: string): Promise<boolean> {\n return ENGINE.setBackend(backendName);\n}\n\n/**\n * Returns a promise that resolves when the currently selected backend (or the\n * highest priority one) has initialized. Await this promise when you are using\n * a backend that has async initialization.\n *\n * @doc {heading: 'Backends'}\n */\nexport function ready(): Promise<void> {\n return ENGINE.ready();\n}\n\n/**\n * Returns the current backend name (cpu, webgl, etc). The backend is\n * responsible for creating tensors and executing operations on those tensors.\n *\n * @doc {heading: 'Backends'}\n */\nexport function getBackend(): string {\n return ENGINE.backendName;\n}\n\n/**\n * Removes a backend and the registered factory.\n *\n * @doc {heading: 'Backends'}\n */\nexport function removeBackend(name: string): void {\n ENGINE.removeBackend(name);\n}\n\n/**\n
 * Finds the backend registered under the provided name. Returns null if the\n * name is not in the registry, or the registration hasn't finished yet.\n */\nexport function findBackend(name: string): KernelBackend {\n return ENGINE.findBackend(name);\n}\n\n/**\n * Finds the backend factory registered under the provided name. Returns a\n * function that produces a new backend when called. Returns null if the name\n * is not in the registry.\n */\nexport function findBackendFactory(name: string): () =>\n   KernelBackend | Promise<KernelBackend> {\n return ENGINE.findBackendFactory(name);\n}\n\n/**\n * Registers a global backend. The registration should happen when importing\n * a module file (e.g. when importing `backend_webgl.ts`), and is used for\n * modular builds (e.g. custom tfjs bundle with only webgl support).\n *\n * @param factory The backend factory function. When called, it should\n * return a backend instance, or a promise of an instance.\n *
 @param priority The priority of the backend (higher = more important).\n *   In case multiple backends are registered, the priority is used to find\n *   the best backend. Defaults to 1.\n * @return False if there is already a registered backend under this name, true\n *   if not.\n *\n * @doc {heading: 'Backends'}\n */\nexport function registerBackend(\n   name: string, factory: () => KernelBackend | Promise<KernelBackend>,\n   priority = 1): boolean {\n return ENGINE.registerBackend(name, factory, priority);\n}\n\n/**\n * Gets the current backend. If no backends have been initialized, this will\n * attempt to initialize the best backend. Will throw an error if the highest\n * priority backend has async initialization, in which case, you should call\n * 'await tf.ready()' before running other code.\n *\n * @doc {heading: 'Backends'}\n */\nexport function backend(): KernelBackend {\n return ENGINE.backend;\n}\n\n/**\n * Sets the global platform.\n *\n * @param platformName The
 name of this platform.\n * @param platform A platform implementation.\n */\nexport function setPlatform(platformName: string, platform: Platform) {\n env().setPlatform(platformName, platform);\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
 ==\n
 */\nimport {ENGINE} from '../engine';\nimport {Add, AddInputs} from '../kernel_names';\nimport
 {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {makeTypesMatch} from '../tensor_util';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\n\nimport {op} from './operation';\n\n/**\n * Adds two `tf.Tensor`s element-wise, A + B. Supports broadcasting.\n *\n *\n * ```js\n * const a = tf.tensor1d([1, 2, 3, 4]);\n * const b = tf.tensor1d([10, 20, 30, 40]);\n *\n * a.add(b).print(); // or

tf.add(a, b)\n * ```\n *\n * ```js\n * // Broadcast add a with b.\n * const a = tf.scalar(5);\n * const b = tf.tensor1d([10, 20, 30, 40]);\n *\n * a.add(b).print(); // or tf.add(a, b)\n * ```\n * @param a The first `tf.Tensor` to add.\n * @param b The second `tf.Tensor` to add. Must have the same type as `a`.\n *\n * @doc {heading: 'Operations', subheading: 'Arithmetic'}\n */\nfunction add_<T extends Tensor>(a: Tensor|TensorLike, b: Tensor|TensorLike): T {\n let $a = convertToTensor(a, 'a', 'add');\n let $b =
 convertToTensor(b, 'b', 'add');\n [$a, $b] = makeTypesMatch($a, $b);\n\n const inputs: AddInputs = {a: $a, b: $b};\n\n return ENGINE.runKernel(Add, inputs as {} as NamedTensorMap);\n}\n\nexport const add = op({add_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {ENGINE} from '../engine';\nimport {FloorDiv,
 FloorDivInputs} from '../kernel_names';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {makeTypesMatch} from '../tensor_util';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\n\nimport {op} from './operation';\n\n/**\n * Divides two `tf.Tensor`s element-wise, A / B. Supports broadcasting.\n * The result is rounded with floor function.\n *\n *\n * ```js\n * const a = tf.tensor1d([1, 4, 9, 16]);\n * const b = tf.tensor1d([1, 2, 3, 4]);\n *\n * a.floorDiv(b).print(); // or tf.div(a, b)\n * ```\n *\n * ```js\n * // Broadcast div a with b.\n * const a = tf.tensor1d([2, 4, 6, 8]);\n * const b = tf.scalar(2);\n *\n * a.floorDiv(b).print(); // or tf.floorDiv(a, b)\n * ```\n *\n * @param a The first tensor as the numerator.\n * @param b The second tensor as the denominator. Must have the same dtype as\n * `a`.\n *\n * @doc {heading: 'Operations', subheading: 'Arithmetic'}\n */\nfunction floorDiv_<T extends
 Tensor>(\n   a: Tensor|TensorLike, b: Tensor|TensorLike): T {\n let $a = convertToTensor(a, 'a', 'floorDiv');\n let $b = convertToTensor(b, 'b', 'floorDiv');\n [$a, $b] = makeTypesMatch($a, $b);\n\n const inputs: FloorDivInputs = {a: $a, b: $b};\n\n return ENGINE.runKernel(FloorDiv, inputs as {} as NamedTensorMap);\n}\n\nexport const floorDiv = op({floorDiv_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under
 the License.\n *
==========\n */\n\nimport {ENGINE} from '../engine';\nimport {RealDiv, RealDivInputs} from '../kernel_names';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {makeTypesMatch} from '../tensor_util';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\n\nimport {floorDiv} from './floorDiv';\nimport {op} from './operation';\n\n/**\n * Divides two `tf.Tensor`s element-wise, A / B. Supports broadcasting.\n *\n * ```js\n * const a = tf.tensor1d([1, 4, 9, 16]);\n * const b = tf.tensor1d([1, 2, 3, 4]);\n *\n * a.div(b).print(); // or tf.div(a, b)\n * ```\n *\n * ```js\n * // Broadcast div a with b.\n * const a = tf.tensor1d([2, 4, 6, 8]);\n * const b = tf.scalar(2);\n *\n * a.div(b).print(); // or tf.div(a, b)\n * ```\n *\n * @param a The first tensor as the numerator.\n * @param b The second tensor as the denominator. Must have
 the same dtype as\n * `a`.\n *\n * @doc {heading: 'Operations', subheading: 'Arithmetic'}\n */\nfunction div_<T extends Tensor>(a: Tensor|TensorLike, b: Tensor|TensorLike): T {\n let $a = convertToTensor(a, 'a', 'div');\n let $b = convertToTensor(b, 'b', 'div');\n [$a, $b] = makeTypesMatch($a, $b);\n\n if ($a.dtype === 'int32' && $b.dtype

=== 'int32') {\n return floorDiv($a, $b);\n }\n\n const inputs: RealDivInputs = {a: $a, b: $b};\n const attrs = {};\n\n // tslint:disable-next-line: no-unnecessary-type-assertion\n return ENGINE.runKernel(RealDiv, inputs as {} as NamedTensorMap, attrs) as T;\n}\n\nexport const div = op({div_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {ENGINE} from '../engine';\nimport {Multiply, MultiplyInputs} from '../kernel_names';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {makeTypesMatch} from '../tensor_util';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\n\nimport {op} from './operation';\n\n/**\n * Multiplies two `tf.Tensor`s element-wise, A * B. Supports broadcasting.\n *\n * We also expose `tf.mulStrict` which has the same signature as this op and\n * asserts that `a` and `b` are the same shape (does not broadcast).\n *\n * ```js\n * const a = tf.tensor1d([1, 2, 3, 4]);\n * const b = tf.tensor1d([2, 3, 4, 5]);\n *\n * a.mul(b).print(); // or tf.mul(a, b)\n * ```\n *\n * ```js\n * // Broadcast mul a with b.\n * const a = tf.tensor1d([1, 2, 3, 4]);\n * const b = tf.scalar(5);\n *\n * a.mul(b).print(); // or tf.mul(a, b)\n * ```\n * @param a The first tensor to multiply.\n * @param b The second tensor to multiply. Must have the same dtype as `a`.\n *\n * @doc {heading: 'Operations', subheading: 'Arithmetic'}\n */\nfunction mul_<T extends Tensor>(a: Tensor|TensorLike, b: Tensor|TensorLike): T {\n let $a = convertToTensor(a, 'a', 'mul');\n let $b = convertToTensor(b, 'b', 'mul');\n [$a, $b] = makeTypesMatch($a, $b);\n\n const inputs: MultiplyInputs = {a: $a, b: $b};\n\n return ENGINE.runKernel(Multiply, inputs as {} as NamedTensorMap);\n}\nexport const mul = op({mul_});\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {ENGINE} from '../engine';\nimport {Abs, AbsInputs, ComplexAbs, ComplexAbsInputs} from '../kernel_names';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\n\nimport {op} from './operation';\n\n/**\n * Computes absolute value element-wise: `abs(x)`\n *\n * ```js\n * const x = tf.tensor1d([-1, 2, -3, 4]);\n *\n * x.abs().print(); // or tf.abs(x)\n * ```\n * @param x The input `tf.Tensor`.\n *\n * @doc {heading: 'Operations', subheading: 'Basic math'}\n */\nfunction abs_<T extends Tensor>(x: T|TensorLike): T {\n const $x = convertToTensor(x, 'x', 'abs');\n\n if ($x.dtype === 'complex64') {\n const inputs: ComplexAbsInputs = {x: $x};\n return ENGINE.runKernel(ComplexAbs, inputs as {} as NamedTensorMap);\n } else {\n const inputs: AbsInputs = {x: $x};\n return ENGINE.runKernel(Abs, inputs as {} as NamedTensorMap);\n }\n}\nexport const abs = op({abs_});\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *

```
==========================================================================\n
*/\nimport {ENGINE} from '../engine';\nimport {Acos, AcosInputs} from '../kernel_names';\nimport {Tensor} from
'../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from
'../tensor_util_env';\nimport {TensorLike} from '../types';\n\nimport {op} from './operation';\n\n/**\n * Computes
acos of the input `tf.Tensor` element-wise: `acos(x)`\n *\n * ```js\n * const x = tf.tensor1d([0, 1, -1, .7]);\n *\n *
x.acos().print();  // or tf.acos(x)\n * ```\n * @param x The input tensor.\n * @doc {heading: 'Operations',
subheading: 'Basic math'}\n */\nfunction acos_<T extends Tensor>(x: T|TensorLike): T {\n  const $x =
convertToTensor(x, 'x', 'acos');\n  const inputs:
 AcosInputs = {x: $x};\n\n  return ENGINE.runKernel(Acos, inputs as {} as NamedTensorMap);\n}\nexport const
acos = op({acos_});\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed
under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the
License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n *
Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed
on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or
implied.\n * See the License for the specific language governing permissions and\n * limitations under the
License.\n *
==========================================================================\n
*/\n\nimport {ENGINE} from '../engine';\nimport {Acosh, AcoshInputs} from '../kernel_names';\nimport {Tensor}
from '../tensor';\nimport {NamedTensorMap}
 from '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from
'../types';\n\nimport {op} from './operation';\n\n/**\n * Computes the inverse hyperbolic cos of the input `tf.Tensor`
element-wise:\n * `acosh(x)`\n *\n * ```js\n * const x = tf.tensor1d([10, 1, 3, 5.7]);\n *\n * x.acosh().print();  // or
tf.acosh(x)\n * ```\n * @param x The input tensor.\n *\n * @doc {heading: 'Operations', subheading: 'Basic math'}\n
*/\nfunction acosh_<T extends Tensor>(x: T|TensorLike): T {\n  const $x = convertToTensor(x, 'x', 'acosh');\n
const inputs: AcoshInputs = {x: $x};\n\n  return ENGINE.runKernel(Acosh, inputs as {} as
NamedTensorMap);\n}\nexport const acosh = op({acosh_});\n","/**\n * @license\n * Copyright 2020 Google LLC.
All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this
file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n *
http://www.apache.org/licenses/LICENSE-2.0\n
 *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is
distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either
express or implied.\n * See the License for the specific language governing permissions and\n * limitations under
the License.\n *
==========================================================================\n
*/\nimport {ENGINE} from '../engine';\nimport {AddN, AddNInputs} from '../kernel_names';\nimport {Tensor}
from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from
'../tensor_util_env';\nimport {TensorLike} from '../types';\nimport * as util from '../util';\n\nimport {op} from
'./operation';\n\n/**\n * Adds a list of `tf.Tensor`s element-wise, each with the same shape and dtype.\n *\n * ```js\n
* const a = tf.tensor1d([1, 2]);\n * const b = tf.tensor1d([3, 4]);\n * const c = tf.tensor1d([5, 6]);\n *\n * tf.addN([a,
 b, c]).print();\n * ```\n * @param tensors A list of tensors with the same shape and dtype.\n * @doc {heading:
'Operations', subheading: 'Arithmetic'}\n */\nfunction addN_<T extends Tensor>(tensors: Array<T|TensorLike>): T
{\n  util.assert(\n      Array.isArray(tensors),\n      () => 'The argument passed to tf.addN() must be a list of
tensors');\n  util.assert(\n      tensors.length >= 1,\n      () => `Must pass at least one tensor to tf.addN(), but got ` +\n
    `${tensors.length}`);\n\n  const $tensors =\n      tensors.map((t, i) => convertToTensor(t, `tensors${i}`,
'addN'));\n\n  const firstTensor = $tensors[0];\n  $tensors.forEach(t => {\n    if (t.dtype !== firstTensor.dtype) {\n
throw new Error(\n          'All tensors passed to tf.addN() must have the same dtype');\n    }\n  });\n\n
$tensors.forEach(t => {\n    if (!util.arraysEqual(t.shape, firstTensor.shape)) {\n      throw new Error(\n          'All
tensors passed to tf.addN() must have the same shape');\n    }\n
```

});\n\n const inputs: AddNInputs = $tensors;\n\n return ENGINE.runKernel(AddN, inputs as {} as NamedTensorMap);\n}\n\nexport const addN = op({addN_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {ENGINE} from '../engine';\nimport {All, AllAttrs, AllInputs} from '../kernel_names';\nimport {NamedAttrMap}
 from '../kernel_registry';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\n\nimport {op} from './operation';\n\n/**\n * Computes the logical and of elements across dimensions of a `tf.Tensor`.\n *\n * Reduces the input along the dimensions given in `axes`. Unless `keepDims`\n * is true, the rank of the `tf.Tensor` is reduced by 1 for each entry in\n * `axes`. If `keepDims` is true, the reduced dimensions are retained with\n * length 1. If `axes` has no entries, all dimensions are reduced, and an\n * `tf.Tensor` with a single element is returned.\n *\n * ```js\n * const x = tf.tensor1d([1, 1, 1], 'bool');\n *\n * x.all().print(); // or tf.all(x)\n * ```\n *\n * ```js\n * const x = tf.tensor2d([1, 1, 0, 0], [2, 2], 'bool');\n *\n * const axis = 1;\n * x.all(axis).print(); // or tf.all(x, axis)\n * ```\n *\n * @param x The input tensor. Must be of dtype bool.\n
 * @param axis The dimension(s) to reduce. By default it reduces\n *   all dimensions.\n * @param keepDims If true, retains reduced dimensions with size 1.\n *\n * @doc {heading: 'Operations', subheading: 'Reduction'}\n */\nfunction all_<T extends Tensor>(\n   x: Tensor|TensorLike, axis: number|number[] = null, keepDims = false): T {\n const $x = convertToTensor(x, 'x', 'all', 'bool');\n\n const inputs: AllInputs = {x: $x};\n const attrs: AllAttrs = {axis, keepDims};\n\n return ENGINE.runKernel(\n   All, inputs as {} as NamedTensorMap, attrs as {} as NamedAttrMap);\n}\n\nexport const all = op({all_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n
 * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {ENGINE} from '../engine';\nimport {Any, AnyAttrs, AnyInputs} from '../kernel_names';\nimport {NamedAttrMap} from '../kernel_registry';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\n\nimport {op} from './operation';\n\n/**\n * Computes the logical or of elements across dimensions of a `tf.Tensor`.\n *\n * Reduces the input along the dimensions given in `axes`. Unless `keepDims`\n * is true, the rank of the `tf.Tensor` is reduced by 1 for each entry in\n * `axes`. If `keepDims` is true, the reduced dimensions are
 retained with\n * length 1. If `axes` has no entries, all dimensions are reduced, and an\n * `tf.Tensor` with a single element is returned.\n *\n * ```js\n * const x = tf.tensor1d([1, 1, 1], 'bool');\n *\n * x.any().print(); // or tf.any(x)\n * ```\n *\n * ```js\n * const x = tf.tensor2d([1, 1, 0, 0], [2, 2], 'bool');\n *\n * const axis = 1;\n * x.any(axis).print(); // or tf.any(x, axis)\n * ```\n *\n * @param x The input tensor. Must be of dtype bool.\n * @param axis The dimension(s) to reduce. By default it reduces\n *   all dimensions.\n * @param keepDims If true, retains reduced dimensions with size 1.\n *\n * @doc {heading: 'Operations', subheading: 'Reduction'}\n */\nfunction any_<T extends Tensor>(\n   x: Tensor|TensorLike, axis: number|number[] = null, keepDims = false): T {\n const $x = convertToTensor(x, 'x', 'any', 'bool');\n\n const inputs: AnyInputs = {x: $x};\n const attrs: AnyAttrs = {axis,

keepDims};\n\n return ENGINE.runKernel(\n   Any, inputs as {} as NamedTensorMap,
 attrs as {} as NamedAttrMap);\n}\n\n// tslint:disable-next-line:variable-name\nexport const any =
op({any_});\n","/**\n * @license\n * Copyright 2020 Google Inc. All Rights Reserved.\n * Licensed under the
Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the
License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n *
Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed
on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or
implied.\n * See the License for the specific language governing permissions and\n * limitations under the
License.\n *
==\n
*/\n\nimport {ENGINE} from '../engine';\nimport {ArgMax, ArgMaxAttrs, ArgMaxInputs} from
'../kernel_names';\nimport {NamedAttrMap} from '../kernel_registry';\nimport
 {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from
'../tensor_util_env';\nimport {TensorLike} from '../types';\n\nimport {op} from './operation';\n\n/**\n * Returns the
indices of the maximum values along an `axis`.\n *\n * The result has the same shape as `input` with the dimension
along `axis`\n * removed.\n *\n * ```js\n * const x = tf.tensor1d([1, 2, 3]);\n *\n * x.argMax().print(); // or
tf.argMax(x)\n * ```\n *\n * ```js\n * const x = tf.tensor2d([1, 2, 4, 3], [2, 2]);\n *\n * const axis = 1;\n *
x.argMax(axis).print(); // or tf.argMax(x, axis)\n * ```\n *\n * @param x The input tensor.\n * @param axis The
dimension to reduce. Defaults to 0 (outer-most dimension).\n *\n * @doc {heading: 'Operations', subheading:
'Reduction'}\n */\nfunction argMax_<T extends Tensor>(x: Tensor|TensorLike, axis = 0): T {\n const $x =
convertToTensor(x, 'x', 'argMax');\n\n const inputs: ArgMaxInputs = {x: $x};\n const attrs: ArgMaxAttrs
 = {axis};\n\n return ENGINE.runKernel(\n   ArgMax, inputs as {} as NamedTensorMap, attrs as {} as
NamedAttrMap);\n}\n\nexport const argMax = op({argMax_});\n","/**\n * @license\n * Copyright 2020 Google
Inc. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not
use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n *
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OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language
governing permissions and\n * limitations under the License.\n *
==\n
*/\n\nimport {ENGINE} from '../engine';\nimport {ArgMin, ArgMinAttrs, ArgMinInputs} from
'../kernel_names';\nimport
 {NamedAttrMap} from '../kernel_registry';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from
'../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from
'../types';\n\nimport {op} from './operation';\n\n/**\n * Returns the indices of the minimum values along an `axis`.\n
*\n * The result has the same shape as `input` with the dimension along `axis`\n * removed.\n *\n * ```js\n * const x
= tf.tensor1d([1, 2, 3]);\n *\n * x.argMin().print(); // or tf.argMin(x)\n * ```\n *\n * ```js\n * const x = tf.tensor2d([1,
2, 4, 3], [2, 2]);\n *\n * const axis = 1;\n * x.argMin(axis).print(); // or tf.argMin(x, axis)\n * ```\n *\n * @param x
The input tensor.\n * @param axis The dimension to reduce. Defaults to 0 (outer-most dimension).\n *\n * @doc
{heading: 'Operations', subheading: 'Reduction'}\n */\nfunction argMin_<T extends Tensor>(x: Tensor|TensorLike,
axis = 0): T {\n const $x = convertToTensor(x, 'x', 'argMin');\n\n const inputs:
 ArgMinInputs = {x: $x};\n const attrs: ArgMinAttrs = {axis};\n\n return ENGINE.runKernel(\n   ArgMin,
inputs as {} as NamedTensorMap, attrs as {} as NamedAttrMap);\n}\n\nexport const argMin =
op({argMin_});\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the
Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the
License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n *
Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed
on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or

implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==========\n */\n\nimport {ENGINE} from '../engine';\nimport {Asin, AsinInputs} from '../kernel_names';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\n\nimport {op} from './operation';\n\n/**\n * Computes asin of the input `tf.Tensor` element-wise: `asin(x)`\n *\n * ```js\n * const x = tf.tensor1d([0, 1, -1, .7]);\n *\n * x.asin().print(); // or tf.asin(x)\n * ```\n * @param x The input tensor.\n * @doc {heading: 'Operations', subheading: 'Basic math'}\n */\nfunction asin_<T extends Tensor>(x: T|TensorLike): T {\n const $x = convertToTensor(x, 'x', 'asin');\n const inputs: AsinInputs = {x: $x};\n\n return ENGINE.runKernel(Asin, inputs as {} as NamedTensorMap);\n}\nexport const asin = op({asin_});\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==========\n */\n\nimport {ENGINE} from '../engine';\nimport {Asinh, AsinhInputs} from '../kernel_names';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\n\nimport {op} from './operation';\n\n/**\n * Computes inverse hyperbolic sin of the input `tf.Tensor` element-wise:\n * `asinh(x)`\n *\n * ```js\n * const x = tf.tensor1d([0, 1, -1, .7]);\n *\n * x.asinh().print(); // or tf.asinh(x)\n * ```\n * @param x The input tensor.\n *\n * @doc {heading: 'Operations', subheading: 'Basic math'}\n */\nfunction asinh_<T extends Tensor>(x: T|TensorLike): T {\n const $x = convertToTensor(x, 'x', 'asinh');\n\n const inputs: AsinhInputs = {x: $x};\n\n return ENGINE.runKernel(Asinh, inputs as {} as NamedTensorMap);\n}\nexport const asinh = op({asinh_});\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==========\n */\n\nimport {ENGINE} from '../engine';\nimport {Atan, AtanInputs} from '../kernel_names';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\n\nimport {op} from './operation';\n\n/**\n * Computes atan of the input `tf.Tensor` element-wise: `atan(x)`\n *\n * ```js\n * const x = tf.tensor1d([0, 1, -1, .7]);\n *\n * x.atan().print(); // or tf.atan(x)\n * ```\n * @param x The input tensor.\n *\n * @doc {heading: 'Operations', subheading: 'Basic math'}\n */\nfunction atan_<T extends Tensor>(x: T|TensorLike): T {\n const $x = convertToTensor(x, 'x', 'atan');\n\n const inputs: AtanInputs = {x: $x};\n\n return ENGINE.runKernel(Atan, inputs as {} as NamedTensorMap);\n}\nexport const atan = op({atan_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or

implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {ENGINE} from '../engine';\nimport {Atan2, Atan2Inputs} from '../kernel_names';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {makeTypesMatch} from '../tensor_util';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\n\nimport {op} from './operation';\n\n/**\n * Computes
arctangent of `tf.Tensor`s a / b element-wise: `atan2(a, b)`.\n * Supports broadcasting.\n *\n * ```js\n * const a = tf.tensor1d([1.0, 1.0, -1.0, .7]);\n * const b = tf.tensor1d([2.0, 13.0, 3.5, .21]);\n *\n * tf.atan2(a, b).print()\n * ```\n *\n * @param a The first tensor.\n * @param b The second tensor. Must have the same dtype as `a`.\n *\n * @doc {heading: 'Operations', subheading: 'Basic math'}\n */\nfunction atan2_<T extends Tensor>(\n a: Tensor|TensorLike, b: Tensor|TensorLike): T {\n let $a = convertToTensor(a, 'a', 'atan2');\n let $b = convertToTensor(b, 'b', 'atan2');\n [$a, $b] = makeTypesMatch($a, $b);\n\n const inputs: Atan2Inputs = {a: $a, b: $b};\n\n return ENGINE.runKernel(Atan2, inputs as {} as NamedTensorMap);\n}\n\nexport const atan2 = op({atan2_});\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n
* You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {ENGINE} from '../engine';\nimport {Atanh, AtanhInputs} from '../kernel_names';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\n\nimport {op} from './operation';\n\n/**\n * Computes inverse hyperbolic tan of the input `tf.Tensor` element-wise:\n * `atanh(x)`\n *\n * ```js\n * const x = tf.tensor1d([0, .1, -.1, .7]);\n *\n * x.atanh().print();
// or tf.atanh(x)\n * ```\n * @param x The input tensor.\n *\n * @doc {heading: 'Operations', subheading: 'Basic math'}\n */\nfunction atanh_<T extends Tensor>(x: T|TensorLike): T {\n const $x = convertToTensor(x, 'x', 'atanh');\n\n const inputs: AtanhInputs = {x: $x};\n\n return ENGINE.runKernel(Atanh, inputs as {} as NamedTensorMap);\n}\nexport const atanh = op({atanh_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations
under the License.\n *
==========\n */\n\ntype PadType = 'SAME'|'VALID'|'NUMBER'|'EXPLICIT';\n\n// For NHWC should be in the following form:\n// [[0, 0], [pad_top,pad_bottom], [pad_left, pad_right], [0, 0]]\n// For NCHW should be in the following form:\n// [[0, 0], [0, 0], [pad_top,pad_bottom], [pad_left, pad_right]]\n// Reference: https://www.tensorflow.org/api_docs/python/tf/nn/conv2d\nexport type ExplicitPadding =\n [[number, number], [number, number], [number, number], [number, number]];\n\nexport type PadInfo = {\n top: number,\n left: number,\n right: number,\n bottom: number,\n type: PadType\n};\n\nexport type PadInfo3D = {\n top: number,\n left: number,\n right: number,\n bottom: number,\n front: number,\n back: number,\n type: PadType\n};\n\n/**\n * Information about the forward pass of a convolution/pooling operation.\n * It includes input and output shape, strides, filter size and padding\n

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 * information.\n */\nexport type Conv2DInfo = {\n  batchSize: number,\n  inHeight: number,\n  inWidth: number,\n inChannels: number,\n  outHeight: number,\n  outWidth: number,\n  outChannels: number,\n  dataFormat: 'channelsFirst'|'channelsLast',\n  strideHeight: number,\n  strideWidth: number,\n  dilationHeight: number,\n dilationWidth: number,\n  filterHeight: number,\n  filterWidth: number,\n  effectiveFilterHeight: number,\n effectiveFilterWidth: number,\n  padInfo: PadInfo,\n  inShape: [number, number, number, number],\n  outShape: [number, number, number, number],\n  filterShape: [number, number, number, number]\n};\n\n/**\n *\n * @param inputShape Input tensor shape is of the following dimensions:\n *     `[batch, height, width, inChannels]`.\n * @param filterShape The filter shape is of the following dimensions:\n *     `[filterHeight, filterWidth, depth]`.\n * @param strides The strides of the sliding window for each dimension of the\n *     input tensor: `[strideHeight, strideWidth]`.\n
 *     If `strides` is a single number,\n *     then `strideHeight == strideWidth`.\n * @param pad The type of padding algorithm.\n *    - `same` and stride 1: output will be of same size as input,\n *       regardless of filter size.\n *    - `valid`: output will be smaller than input if filter is larger\n *       than 1*1x1.\n *    - For more info, see this guide:\n *     [https://www.tensorflow.org/api_guides/python/nn#Convolution](\n * https://www.tensorflow.org/api_guides/python/nn#Convolution)\n * @param dataFormat The data format of the input and output data.\n *     Defaults to 'NHWC'.\n * @param dilations The dilation rates: `[dilationHeight, dilationWidth]`.\n *     Defaults to `[1, 1]`. If `dilations` is a single number, then\n *     `dilationHeight == dilationWidth`.\n */\nexport function computeDilation2DInfo(\n    inputShape: [number, number, number, number],\n    filterShape: [number, number, number], strides: number|[number, number],\n    pad: 'same'|'valid'|number,
 dataFormat: 'NHWC' = 'NHWC',\n    dilations: number|[number, number]) {\n  // `computerConv2DInfo` require filterShape to be in the dimension of:\n  // `[filterHeight, filterWidth, depth, outDepth]`, dilation2d doesn't have\n  // outDepth, it should have the same depth as the input.\n  // Input shape: [batch, height, width, inChannels]\n  const inputChannels = inputShape[3];\n  const $filterShape =\n      [...filterShape, inputChannels] as [number, number, number, number];\n  const $dataFormat = convertConv2DDataFormat(dataFormat);\n\n  return computeConv2DInfo(\n      inputShape, $filterShape, strides, dilations, pad,\n      null /* roundingMode */, null /* depthWise */, $dataFormat);\n}\n\nexport function computePool2DInfo(\n    inShape: [number, number, number, number],\n    filterSize: [number, number]|number, strides: number|[number, number],\n    dilations: number|[number, number], pad: 'same'|'valid'|number,\n    roundingMode?: 'floor'|'round'|'ceil',\n    dataFormat:
 'channelsFirst'|'channelsLast' = 'channelsLast'): Conv2DInfo {\n  const [filterHeight, filterWidth] = parseTupleParam(filterSize);\n\n  let filterShape: [number, number, number, number];\n  if (dataFormat ===
 'channelsLast') {\n    filterShape = [filterHeight, filterWidth, inShape[3], inShape[3]];\n  } else if (dataFormat ===
 'channelsFirst') {\n    filterShape = [filterHeight, filterWidth, inShape[1], inShape[1]];\n  } else {\n    throw new Error(`Unknown dataFormat ${dataFormat}`);\n  }\n\n  return computeConv2DInfo(\n      inShape, filterShape, strides, dilations, pad, roundingMode, false,\n      dataFormat);\n}\n\n/**\n * Computes the information for a forward pass of a pooling3D operation.\n */\nexport function computePool3DInfo(\n    inShape: [number, number, number, number, number],\n    filterSize: number|[number, number, number],\n    strides: number|[number, number, number],\n    dilations: number|[number, number, number], pad: 'same'|'valid'|number,\n    roundingMode?:
 'floor'|'round'|'ceil',\n    dataFormat: 'NDHWC'|'NCDHW' = 'NDHWC'): Conv3DInfo {\n  const [filterDepth, filterHeight, filterWidth] = parse3TupleParam(filterSize);\n\n  let filterShape: [number, number, number, number, number];\n  let $dataFormat: 'channelsFirst'|'channelsLast';\n  if (dataFormat === 'NDHWC') {\n    $dataFormat = 'channelsLast';\n    filterShape =\n        [filterDepth, filterHeight, filterWidth, inShape[4], inShape[4]];\n  } else if (dataFormat === 'NCDHW') {\n    $dataFormat = 'channelsFirst';\n    filterShape =\n        [filterDepth, filterHeight, filterWidth, inShape[1], inShape[1]];\n  } else {\n    throw new Error(`Unknown dataFormat ${dataFormat}`);\n  }\n\n  return computeConv3DInfo(\n      inShape, filterShape, strides, dilations, pad, false, $dataFormat,\n roundingMode);\n}\n\n/**\n * Computes the information for a forward pass of a convolution/pooling\n * operation.\n */\nexport function computeConv2DInfo(\n    inShape: [number, number, number, number],\n
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 filterShape: [number, number, number, number],\n  strides: number|[number, number], dilations:
number|[number, number],\n  pad: 'same'|'valid'|number|ExplicitPadding,\n  roundingMode?: 'floor'|'round'|'ceil',
depthwise = false,\n  dataFormat: 'channelsFirst'|'channelsLast' = 'channelsLast'): Conv2DInfo {\n  let [batchSize,
inHeight, inWidth, inChannels] = [-1, -1, -1, -1];\n  if (dataFormat === 'channelsLast') {\n  [batchSize, inHeight,
inWidth, inChannels] = inShape;\n  } else if (dataFormat === 'channelsFirst') {\n  [batchSize, inChannels,
inHeight, inWidth] = inShape;\n  } else {\n  throw new Error(`Unknown dataFormat ${dataFormat}`);\n  }\n\n
const [filterHeight, filterWidth, , filterChannels] = filterShape;\n  const [strideHeight, strideWidth] =
parseTupleParam(strides);\n  const [dilationHeight, dilationWidth] = parseTupleParam(dilations);\n\n  const
effectiveFilterHeight =\n  getEffectiveFilterSize(filterHeight, dilationHeight);\n  const effectiveFilterWidth
 =\n  getEffectiveFilterSize(filterWidth, dilationWidth);\n  const {padInfo, outHeight, outWidth} =
getPadAndOutInfo(\n  pad, inHeight, inWidth, strideHeight, strideWidth, effectiveFilterHeight,\n
effectiveFilterWidth, roundingMode, dataFormat);\n\n  const outChannels = depthwise ? filterChannels *
inChannels : filterChannels;\n\n  let outShape: [number, number, number, number];\n  if (dataFormat ===
'channelsFirst') {\n  outShape = [batchSize, outChannels, outHeight, outWidth];\n  } else if (dataFormat ===
'channelsLast') {\n  outShape = [batchSize, outHeight, outWidth, outChannels];\n  }\n\n  return {\n  batchSize,\n
dataFormat,\n  inHeight,\n  inWidth,\n  inChannels,\n  outHeight,\n  outWidth,\n  outChannels,\n
padInfo,\n  strideHeight,\n  strideWidth,\n  filterHeight,\n  filterWidth,\n  effectiveFilterHeight,\n
effectiveFilterWidth,\n  dilationHeight,\n  dilationWidth,\n  inShape,\n  outShape,\n  filterShape\n
};\n}\n\n/**\n
 * Information about the forward pass of a 3D convolution/pooling operation.\n * It includes input and output shape,
strides, filter size and padding\n * information.\n */\nexport type Conv3DInfo = {\n  batchSize: number,\n  inDepth:
number,\n  inHeight: number,\n  inWidth: number,\n  inChannels: number,\n  outDepth: number,\n  outHeight:
number,\n  outWidth: number,\n  outChannels: number,\n  dataFormat: 'channelsFirst'|'channelsLast',\n  strideDepth:
number,\n  strideHeight: number,\n  strideWidth: number,\n  dilationDepth: number,\n  dilationHeight: number,\n
dilationWidth: number,\n  filterDepth: number,\n  filterHeight: number,\n  filterWidth: number,\n
effectiveFilterDepth: number,\n  effectiveFilterHeight: number,\n  effectiveFilterWidth: number,\n  padInfo:
PadInfo3D,\n  inShape: [number, number, number, number, number],\n  outShape: [number, number, number,
number, number],\n  filterShape: [number, number, number, number, number]\n};\n\n/**\n * Computes the
information
 for a forward pass of a 3D convolution/pooling\n * operation.\n */\nexport function computeConv3DInfo(\n
inShape: [number, number, number, number, number],\n  filterShape: [number, number, number, number,
number],\n  strides: number|[number, number, number],\n  dilations: number|[number, number, number], pad:
'same'|'valid'|number,\n  depthwise = false,\n  dataFormat: 'channelsFirst'|'channelsLast' = 'channelsLast',\n
roundingMode?: 'floor'|'round'|'ceil'): Conv3DInfo {\n  let [batchSize, inDepth, inHeight, inWidth, inChannels] =\n
 [-1, -1, -1, -1, -1];\n  if (dataFormat === 'channelsLast') {\n  [batchSize, inDepth, inHeight, inWidth, inChannels]
= inShape;\n  } else if (dataFormat === 'channelsFirst') {\n  [batchSize, inChannels, inDepth, inHeight, inWidth] =
inShape;\n  } else {\n  throw new Error(`Unknown dataFormat ${dataFormat}`);\n  }\n\n  const [filterDepth,
filterHeight, filterWidth, , filterChannels] =\n  filterShape;\n  const [strideDepth,
 strideHeight, strideWidth] = parse3TupleParam(strides);\n  const [dilationDepth, dilationHeight, dilationWidth] =\n
  parse3TupleParam(dilations);\n\n  const effectiveFilterDepth =\n  getEffectiveFilterSize(filterDepth,
dilationDepth);\n  const effectiveFilterHeight =\n  getEffectiveFilterSize(filterHeight, dilationHeight);\n  const
effectiveFilterWidth =\n  getEffectiveFilterSize(filterWidth, dilationWidth);\n  const {padInfo, outDepth,
outHeight, outWidth} = get3DPadAndOutInfo(\n  pad, inDepth, inHeight, inWidth, strideDepth, strideHeight,
strideWidth,\n  effectiveFilterDepth, effectiveFilterHeight, effectiveFilterWidth,\n  roundingMode);\n\n  const
outChannels = depthwise ? filterChannels * inChannels : filterChannels;\n\n  let outShape: [number, number,
number, number, number];\n  if (dataFormat === 'channelsFirst') {\n  outShape = [batchSize, outChannels,
outDepth, outHeight, outWidth];\n  } else if (dataFormat === 'channelsLast') {\n  outShape = [batchSize,
```

outDepth, outHeight, outWidth, outChannels];\n }\n\n return {\n batchSize,\n dataFormat,\n inDepth,\n inHeight,\n inWidth,\n inChannels,\n outDepth,\n outHeight,\n outWidth,\n outChannels,\n padInfo,\n strideDepth,\n strideHeight,\n strideWidth,\n filterDepth,\n filterHeight,\n filterWidth,\n effectiveFilterDepth,\n effectiveFilterHeight,\n effectiveFilterWidth,\n dilationDepth,\n dilationHeight,\n dilationWidth,\n inShape,\n outShape,\n filterShape\n };\n}\n\nfunction computeOutputShape2D(\n inShape: [number, number], fieldSize: number, stride: number,\n zeroPad?: number, roundingMode?:\n 'floor'|'round'|'ceil'): [number, number] {\n if (zeroPad == null) {\n zeroPad = computeDefaultPad(inShape, fieldSize, stride);\n }\n const inputRows = inShape[0];\n const inputCols = inShape[1];\n\n const outputRows =\n round((inputRows - fieldSize + 2 * zeroPad) / stride + 1, roundingMode);\n\n const outputCols =\n round((inputCols - fieldSize + 2 * zeroPad) / stride + 1, roundingMode);\n\n return [outputRows, outputCols];\n}\n\nfunction computeOutputShape4D(\n inShape: [number, number, number, number], fieldSize: number,\n outChannels: number, stride: number, zeroPad?: number,\n roundingMode?:\n 'floor'|'round'|'ceil'): [number, number, number, number] {\n if (zeroPad == null) {\n zeroPad = computeDefaultPad(inShape, fieldSize, stride);\n }\n const inputDepth = inShape[0];\n const inputRows = inShape[1];\n const inputCols = inShape[2];\n\n const outputDepths =\n round((inputDepth - fieldSize + 2 * zeroPad) / stride + 1, roundingMode);\n const outputRows =\n round((inputRows - fieldSize + 2 * zeroPad) / stride + 1, roundingMode);\n const outputCols =\n round((inputCols - fieldSize + 2 * zeroPad) / stride + 1, roundingMode);\n\n return [outputDepths, outputRows, outputCols, outChannels];\n}\n\nexport function computeDefaultPad(\n inputShape:\n [number, number]|[number, number, number, number],\n fieldSize: number, stride: number, dilation = 1): number {\n const effectiveFieldSize = getEffectiveFilterSize(fieldSize, dilation);\n return Math.floor(\n (inputShape[0] * (stride - 1) - stride + effectiveFieldSize) / 2);\n}\n\nfunction parseTupleParam(param: number|number[]): [number, number, number] {\n if (typeof param === 'number') {\n return [param, param, param];\n }\n if (param.length === 2) {\n return [param[0], param[1], 1];\n }\n return param as [number, number, number];\n}\n\nfunction parse3TupleParam(param: number|[number, number, number]):\n [number, number, number] {\n return typeof param === 'number' ? [param, param, param] : param;\n}\n\n/* See https://www.tensorflow.org/api_docs/python/tf/nn/atrous_conv2d\n * Atrous convolution is equivalent to standard convolution with upsampled\n * filters with effective_filter_height =\n * filter_height + (filter_height - 1) * (dilation - 1)\n * and effective_filter_width =\n * filter_width + (filter_width - 1) * (dilation - 1),\n * produced by inserting dilation - 1 zeros along consecutive elements across\n * the filters' spatial dimensions.\n * When there is a dilation, this converts a filter dimension to the\n * effective filter dimension, so it can be used in a standard convolution.\n */\nfunction getEffectiveFilterSize(filterSize: number, dilation: number) {\n if (dilation <= 1) {\n return filterSize;\n }\n\n return filterSize + (filterSize - 1) * (dilation - 1);\n}\n\nfunction getPadAndOutInfo(\n pad: 'same'|'valid'|number|ExplicitPadding, inHeight: number,\n inWidth: number, strideHeight: number, strideWidth: number,\n filterHeight: number, filterWidth: number,\n roundingMode: 'floor'|'round'|'ceil',\n dataFormat: 'channelsFirst'|\n 'channelsLast'): {padInfo: PadInfo, outHeight: number, outWidth: number} {\n let padInfo: PadInfo;\n let outHeight: number;\n let outWidth: number;\n\n if (typeof\n pad === 'number') {\n const padType = (pad === 0) ? 'VALID' : 'NUMBER';\n padInfo = {top: pad, bottom: pad, left: pad, right: pad, type: padType};\n const outShape = computeOutputShape2D(\n [inHeight, inWidth], filterHeight, strideHeight, pad, roundingMode);\n outHeight = outShape[0];\n outWidth = outShape[1];\n } else if (pad === 'same') {\n outHeight = Math.ceil(inHeight / strideHeight);\n outWidth = Math.ceil(inWidth / strideWidth);\n const padAlongHeight =\n Math.max(0, (outHeight - 1) * strideHeight + filterHeight - inHeight);\n const padAlongWidth =\n Math.max(0, (outWidth - 1) * strideWidth + filterWidth - inWidth);\n const top = Math.floor(padAlongHeight / 2);\n const bottom = padAlongHeight - top;\n const left = Math.floor(padAlongWidth / 2);\n const right = padAlongWidth - left;\n padInfo = {top, bottom, left, right, type: 'SAME'};\n } else if (pad === 'valid') {\n padInfo = {top: 0, bottom: 0, left: 0, right:

0, type: 'VALID'};\n outHeight = Math.ceil((inHeight - filterHeight + 1) / strideHeight);\n outWidth = Math.ceil((inWidth - filterWidth + 1) / strideWidth);\n } else if (typeof pad === 'object') {\n const top = dataFormat === 'channelsLast' ? pad[1][0] : pad[2][0];\n const bottom = dataFormat === 'channelsLast' ? pad[1][1] : pad[2][1];\n const left = dataFormat === 'channelsLast' ? pad[2][0] : pad[3][0];\n const right = dataFormat === 'channelsLast' ? pad[2][1] : pad[3][1];\n const padType = (top === 0 && bottom === 0 && left === 0 && right === 0) ?\n 'VALID' :\n 'EXPLICIT';\n padInfo = {top, bottom, left, right, type: padType};\n outHeight = round(\n (inHeight - filterHeight + top + bottom) / strideHeight + 1,\n roundingMode);\n outWidth = round(\n (inWidth - filterWidth + left + right) / strideWidth + 1, roundingMode);\n } else {\n throw Error(`Unknown padding parameter: ${pad}`);\n }\n return {padInfo, outHeight,
outWidth};\n}\n\nfunction get3DPadAndOutInfo(\n pad: 'same'|'valid'|number, inDepth: number, inHeight: number,\n inWidth: number, strideDepth: number, strideHeight: number,\n strideWidth: number, filterDepth: number, filterHeight: number,\n filterWidth: number, roundingMode?: 'floor'|'round'|'ceil'): {\n padInfo: PadInfo3D,\n outDepth: number,\n outHeight: number,\n outWidth: number\n} {\n let padInfo: PadInfo3D;\n let outDepth: number;\n let outHeight: number;\n let outWidth: number;\n\n if (typeof pad === 'number') {\n const padType = (pad === 0) ? 'VALID' : 'NUMBER';\n padInfo = {\n top: pad,\n bottom: pad,\n left: pad,\n right: pad,\n front: pad,\n back: pad,\n type: padType\n };\n const outShape = computeOutputShape4D(\n [inDepth, inHeight, inWidth, 1], filterDepth, 1, strideDepth, pad,\n roundingMode);\n outDepth = outShape[0];\n outHeight = outShape[1];\n outWidth = outShape[2];\n } else if (pad === 'same') {\n outDepth = Math.ceil(inDepth / strideDepth);\n outHeight = Math.ceil(inHeight / strideHeight);\n outWidth = Math.ceil(inWidth / strideWidth);\n const padAlongDepth = (outDepth - 1) * strideDepth + filterDepth - inDepth;\n const padAlongHeight =\n (outHeight - 1) * strideHeight + filterHeight - inHeight;\n const padAlongWidth = (outWidth - 1) * strideWidth + filterWidth - inWidth;\n const front = Math.floor(padAlongDepth / 2);\n const back = padAlongDepth - front;\n const top = Math.floor(padAlongHeight / 2);\n const bottom = padAlongHeight - top;\n const left = Math.floor(padAlongWidth / 2);\n const right = padAlongWidth - left;\n\n padInfo = {top, bottom, left, right, front, back, type: 'SAME'};\n } else if (pad === 'valid') {\n padInfo = {\n top: 0,\n bottom: 0,\n left: 0,\n right: 0,\n front: 0,\n back: 0,\n type: 'VALID'\n };\n outDepth = Math.ceil((inDepth - filterDepth + 1) / strideDepth);\n outHeight = Math.ceil((inHeight - filterHeight + 1) / strideHeight);\n outWidth = Math.ceil((inWidth - filterWidth + 1) / strideWidth);\n } else {\n throw Error(`Unknown padding parameter: ${pad}`);\n }\n return {padInfo, outDepth, outHeight, outWidth};\n}\n\n/**\n * Rounds a value depending on the rounding mode\n * @param value\n * @param roundingMode A string from: 'ceil', 'round', 'floor'. If none is\n * provided, it will default to truncate.\n */\nfunction round(value: number, roundingMode?: 'floor'|'round'|'ceil') {\n if (!roundingMode) {\n return Math.trunc(value);\n }\n switch (roundingMode) {\n case 'round':\n // used for Caffe Conv\n return Math.round(value);\n case 'ceil':\n // used for Caffe Pool\n return Math.ceil(value);\n case 'floor':\n return Math.floor(value);\n default:\n throw new Error(`Unknown roundingMode ${roundingMode}`);\n }\n}\n\nexport function tupleValuesAreOne(param: number|number[]): boolean {\n const [dimA, dimB, dimC] = parseTupleParam(param);\n return dimA === 1 && dimB === 1 && dimC === 1;\n}\n\nexport function eitherStridesOrDilationsAreOne(\n strides: number|number[], dilations: number|number[]): boolean {\n return tupleValuesAreOne(strides) || tupleValuesAreOne(dilations);\n}\n\n/**\n * Convert Conv2D dataFormat from 'NHWC'|'NCHW' to\n * 'channelsLast'|'channelsFirst'\n * @param dataFormat in 'NHWC'|'NCHW' mode\n * @return dataFormat in 'channelsLast'|'channelsFirst' mode\n * @throws unknown dataFormat\n */\nexport function convertConv2DDataFormat(dataFormat: 'NHWC'|'NCHW'):\n 'channelsLast'|'channelsFirst' {\n if (dataFormat === 'NHWC') {\n return 'channelsLast';\n } else if (dataFormat === 'NCHW') {\n return 'channelsFirst';\n } else {\n throw new Error(`Unknown dataFormat ${dataFormat}`);\n }\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License,

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==========\n */\n\nimport {ENGINE} from '../engine';\nimport {Reshape, ReshapeAttrs, ReshapeInputs} from '../kernel_names';\nimport {NamedAttrMap} from '../kernel_registry';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {Rank, ShapeMap, TensorLike} from '../types';\n\nimport {op} from './operation';\n\n/**\n * Reshapes a `tf.Tensor` to a given shape.\n *\n * Given an input tensor, returns a new tensor with the same values as the\n * input tensor with shape `shape`.\n *\n * If one component of shape is the special value -1, the size of that\n * dimension is computed so that the total size remains constant. In\n * particular, a shape of [-1] flattens into 1-D. At most one component of\n * shape can be -1.\n *\n * If shape is 1-D or higher, then the operation returns a tensor with shape\n * shape filled with the values of tensor. In this case, the number of\n * elements implied by shape must be the same as the number of elements in\n * tensor.\n *\n * ```js\n * const x = tf.tensor1d([1, 2, 3, 4]);\n * x.reshape([2, 2]).print();\n * ```\n *\n * @param x The input tensor to be reshaped.\n * @param shape An array of integers defining the output tensor shape.\n *\n * @doc {heading: 'Tensors', subheading: 'Transformations'}\n */\nfunction reshape_<R extends Rank>(\n x: Tensor|TensorLike,
 shape: ShapeMap[R]): Tensor<R> {\n const $x = convertToTensor(x, 'x', 'reshape', 'string_or_numeric');\n\n const inputs: ReshapeInputs = {x: $x};\n const attrs: ReshapeAttrs = {shape};\n return ENGINE.runKernel(\n Reshape, inputs as {} as NamedTensorMap, attrs as {} as NamedAttrMap);\n}\nexport const reshape = op({reshape_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {ENGINE} from '../engine';\nimport {AvgPool, AvgPoolAttrs, AvgPoolInputs} from '../kernel_names';\nimport {NamedAttrMap} from '../kernel_registry';\nimport {Tensor3D, Tensor4D} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\nimport * as util from '../util';\n\nimport {cast} from './cast';\nimport * as conv_util from './conv_util';\nimport {op} from './operation';\nimport {reshape} from './reshape';\n\n/**\n * Computes the 2D average pooling of an image.\n *\n * @param x The input tensor, of rank 4 or rank 3 of shape\n * `[batch, height, width, inChannels]`. If rank 3, batch of 1 is assumed.\n * @param filterSize The filter size: `[filterHeight, filterWidth]`. If\n * `filterSize` is a single number, then `filterHeight == filterWidth`.\n * @param strides The strides of the pooling: `[strideHeight,
 strideWidth]`. If\n * `strides` is a single number, then `strideHeight == strideWidth`.\n * @param pad The type of padding algorithm:\n * - `same` and stride 1: output will be of same size as input,\n * regardless of filter size.\n * - `valid`: output will be smaller than input if filter is larger\n * than 1x1.\n * - For more info, see this guide:\n * [https://www.tensorflow.org/api_guides/python/nn#Convolution](\n * https://www.tensorflow.org/api_guides/python/nn#Convolution)\n * @param dimRoundingMode A string from: 'ceil', 'round', 'floor'. If none is\n * provided, it will default to truncate.\n */\nfunction avgPool_<T extends Tensor3D|Tensor4D>(\n x: T|TensorLike, filterSize: [number, number]|number,\n strides: [number, number]|number, pad: 'valid'|'same'|number,\n dimRoundingMode?: 'floor'|'round'|'ceil'): T {\n const $x = convertToTensor(x, 'x', 'avgPool', 'float32');\n const dilations = 1;\n\n util.assert(\n

```
conv_util.eitherStridesOrDilationsAreOne(strides,
 dilations),\n      () => 'Error in avgPool: Either strides or dilations must be 1. ' +\n          `Got strides ${strides} and
dilations '${dilations}'`);\n\n  let x4D = $x as Tensor4D;\n  let reshapedTo4D = false;\n  if ($x.rank === 3) {\n
reshapedTo4D = true;\n    x4D = reshape($x, [1, $x.shape[0], $x.shape[1], $x.shape[2]]);\n  }\n\n  util.assert(\n
x4D.rank === 4,\n      () => `Error in avgPool: x must be rank 4 but got rank ${x4D.rank}.`);\n\n  if
(dimRoundingMode != null) {\n    util.assert(\n        util.isInt(pad as number),\n        () => `Error in avgPool: pad
must be an integer when using, ` +\n            `dimRoundingMode ${dimRoundingMode} but got pad ${pad}.`);\n
}\n\n  const inputs: AvgPoolInputs = {x: x4D};\n\n  const attrs: AvgPoolAttrs = {filterSize, strides, pad,
dimRoundingMode};\n\n  // tslint:disable-next-line: no-unnecessary-type-assertion\n  let res =
ENGINE.runKernel(\n              AvgPool, inputs as {} as NamedTensorMap,\n
          attrs as {} as NamedAttrMap) as T;\n\n  res = cast(res, $x.dtype);\n\n  if (reshapedTo4D) {\n    return
reshape(res, [res.shape[1], res.shape[2], res.shape[3]]) as T;\n  }\n\n  return res;\n}\n\nexport const avgPool =
op({avgPool_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under
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Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed
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implied.\n * See the License for the specific language governing permissions and\n * limitations under the
License.\n *
==========================================================================\n
*/\n\nimport {ENGINE}
 from '../engine';\nimport {AvgPool3D, AvgPool3DAttrs, AvgPool3DInputs} from '../kernel_names';\nimport
{NamedAttrMap} from '../kernel_registry';\nimport {Tensor4D, Tensor5D} from '../tensor';\nimport
{NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport
{TensorLike} from '../types';\nimport * as util from '../util';\n\nimport {cast} from './cast';\nimport {op} from
'./operation';\nimport {reshape} from './reshape';\n\n/**\n * Computes the 3D average pooling.\n *\n * ```js\n * const
x = tf.tensor5d([1, 2, 3, 4, 5, 6, 7, 8], [1, 2, 2, 2, 1]);\n * const result = tf.avgPool3d(x, 2, 1, 'valid');\n *
result.print();\n * ```\n *\n * @param x The input tensor, of rank 5 or rank 4 of shape\n *     `[batch, depth, height,
width, inChannels]`.\n * @param filterSize The filter size:\n *     `[filterDepth, filterHeight, filterWidth]`.\n *     If
`filterSize` is a single number,\n *     then `filterDepth == filterHeight == filterWidth`.\n * @param
 strides The strides of the pooling:\n *     `[strideDepth, strideHeight, strideWidth]`.\n *     If `strides` is a single
number,\n *     then `strideDepth == strideHeight == strideWidth`.\n * @param pad The type of padding
algorithm.\n *    - `same` and stride 1: output will be of same size as input,\n *       regardless of filter size.\n *    -
`valid`: output will be smaller than input if filter is larger\n *       than 1*1x1.\n *    - For more info, see this guide:\n
*     [https://www.tensorflow.org/api_guides/python/nn#Convolution](\n *
https://www.tensorflow.org/api_guides/python/nn#Convolution)\n * @param dimRoundingMode A string from:
'ceil', 'round', 'floor'. If none is\n *     provided, it will default to truncate.\n * @param dataFormat An optional string
from: \"NDHWC\", \"NCDHW\". Defaults to\n *     \"NDHWC\". Specify the data format of the input and output
data. With the\n *     default format \"NDHWC\", the data is stored in the order of: [batch,\n *     depth,
 height, width, channels]. Only \"NDHWC\" is currently supported.\n *\n * @doc {heading: 'Operations',
subheading: 'Convolution'}\n */\nfunction avgPool3d_<T extends Tensor4D|Tensor5D>(\n    x: T|TensorLike,
filterSize: [number, number, number]|number,\n    strides: [number, number, number]|number, pad:
'valid'|'same'|number,\n    dimRoundingMode?: 'floor'|'round'|'ceil',\n    dataFormat: 'NDHWC'|'NCDHW' =
'NDHWC'): T {\n  const $x = convertToTensor(x, 'x', 'avgPool3d', 'float32');\n\n  let x5D = $x as Tensor5D;\n  let
reshapedTo5D = false;\n  if ($x.rank === 4) {\n    reshapedTo5D = true;\n    x5D = reshape($x, [1, $x.shape[0],
$x.shape[1], $x.shape[2], $x.shape[3]]);\n  }\n\n  util.assert(\n      x5D.rank === 5,\n      () => `Error in avgPool3d: x
must be rank 5 but got rank ${x5D.rank}.`);\n  util.assert(\n      dataFormat === 'NDHWC',\n      () => `Error in
avgPool3d: Only NDHWC is currently supported, ` +\n          `but got dataFormat of ${dataFormat}`);\n\n  if
```

(dimRoundingMode
!= null) {\n util.assert(\n util.isInt(pad as number),\n () => `Error in avgPool3d: pad must be an integer when using, ` +\n `dimRoundingMode ${dimRoundingMode} but got pad ${pad}.`);\n }\n\n const inputs: AvgPool3DInputs = {x: x5D};\n\n const attrs:\n AvgPool3DAttrs = {filterSize, strides, pad, dimRoundingMode, dataFormat};\n\n // tslint:disable-next-line: no-unnecessary-type-assertion\n let res = ENGINE.runKernel(\n AvgPool3D, inputs as {} as NamedTensorMap,\n attrs as {} as NamedAttrMap) as T;\n\n res = cast(res, x5D.dtype);\n\n if (reshapedTo5D) {\n return reshape(\n res, [res.shape[1], res.shape[2], res.shape[3], res.shape[4]]) as\n T;\n }\n\n return res;\n}\n\nexport const avgPool3d = op({avgPool3d_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance
with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\nimport {ENGINE} from '../engine';\nimport {Concat, ConcatAttrs, ConcatInputs} from '../kernel_names';\nimport {NamedAttrMap} from '../kernel_registry';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensorArray} from '../tensor_util_env';\nimport {TensorLike} from '../types';\nimport {assert} from '../util';\n\nimport {clone} from './clone';\nimport {op} from './operation';\n\n/**\n * Concatenates a list
of `tf.Tensor`s along a given axis.\n *\n * The tensors ranks and types must match, and their sizes must match in all\n * dimensions except `axis`.\n *\n * Also available are stricter rank-specific methods that assert that\n * `tensors` are of the given rank:\n * - `tf.concat1d`\n * - `tf.concat2d`\n * - `tf.concat3d`\n * - `tf.concat4d`\n *\n * Except `tf.concat1d` (which does not have axis param), all methods have\n * same signature as this method.\n *\n * ```js\n * const a = tf.tensor1d([1, 2]);\n * const b = tf.tensor1d([3, 4]);\n * a.concat(b).print(); // or a.concat(b)\n * ```\n *\n * ```js\n * const a = tf.tensor1d([1, 2]);\n * const b = tf.tensor1d([3, 4]);\n * const c = tf.tensor1d([5, 6]);\n * tf.concat([a, b, c]).print();\n * ```\n *\n * ```js\n * const a = tf.tensor2d([[1, 2], [10, 20]]);\n * const b = tf.tensor2d([[3, 4], [30, 40]]);\n * const axis = 1;\n * tf.concat([a, b], axis).print();\n * ```\n * @param tensors A list of tensors to concatenate.\n * @param
axis The axis to concate along. Defaults to 0 (the first dim).\n *\n * @doc {heading: 'Tensors', subheading: 'Slicing and Joining'}\n */\nfunction concat_<T extends Tensor>(tensors: Array<T|TensorLike>, axis = 0): T {\n assert(tensors.length >= 1, () => 'Pass at least one tensor to concat');\n\n const $tensors =\n convertToTensorArray(tensors, 'tensors', 'concat', 'string_or_numeric');\n\n if ($tensors[0].dtype === 'complex64') {\n $tensors.forEach(tensor => {\n if (tensor.dtype !== 'complex64') {\n throw new Error(`Cannot concatenate complex64 tensors with a tensor\n with dtype ${tensor.dtype}. `);\n }\n });\n }\n\n if ($tensors.length === 1) {\n return clone($tensors[0]);\n }\n\n const inputs: ConcatInputs = $tensors;\n const attr: ConcatAttrs = {axis};\n\n return ENGINE.runKernel(\n Concat, inputs as {} as NamedTensorMap, attr as {} as NamedAttrMap);\n}\n\nexport const concat = op({concat_});\n","/**\n * @license\n * Copyright 2018
Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {ENGINE} from '../engine';\nimport {Sigmoid, SigmoidInputs} from '../kernel_names';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from

'../tensor_util_env';\nimport {TensorLike} from '../types';\n\nimport {op} from './operation';\n\n/**\n * Computes sigmoid element-wise, `1 / (1 + exp(-x))`\n *\n * ```js\n * const x = tf.tensor1d([0, -1, 2, -3]);\n *\n * x.sigmoid().print(); // or tf.sigmoid(x)\n * ```\n * @param x The input tensor.\n *\n * @doc {heading: 'Operations', subheading: 'Basic math'}\n */\nfunction sigmoid_<T extends Tensor>(x: T|TensorLike): T {\n const $x = convertToTensor(x, 'x', 'sigmoid');\n\n const inputs: SigmoidInputs = {x: $x};\n\n return ENGINE.runKernel(Sigmoid, inputs as {} as NamedTensorMap);\n}\nexport const sigmoid = op({sigmoid_});\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT
 WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
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*/\n\nimport {ENGINE} from '../engine';\nimport {Slice, SliceAttrs, SliceInputs} from '../kernel_names';\nimport {NamedAttrMap} from '../kernel_registry';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {Rank, TensorLike} from '../types';\n\nimport {op} from './operation';\n\n/**\n * Extracts a slice from a `tf.Tensor` starting at coordinates `begin`\n * and is of size `size`.\n *\n * Also available are stricter rank-specific methods with the same signature\n * as this method that assert that `x` is of the given rank:\n *   - `tf.slice1d`\n *   - `tf.slice2d`\n *   - `tf.slice3d`\n *   - `tf.slice4d`\n *\n * ```js\n * const x = tf.tensor1d([1,
 2, 3, 4]);\n *\n * x.slice([1], [2]).print();\n * ```\n *\n * ```js\n * const x = tf.tensor2d([1, 2, 3, 4], [2, 2]);\n *\n * x.slice([1, 0], [1, 2]).print();\n * ```\n * @param x The input `tf.Tensor` to slice from.\n * @param begin The coordinates to start the slice from. The length can be\n *   less than the rank of x - the rest of the axes will have implicit 0 as\n *   start. Can also be a single number, in which case it specifies the\n *   first axis.\n * @param size The size of the slice. The length can be less than the rank of\n *   x - the rest of the axes will have implicit -1. A value of -1 requests\n *   the rest of the dimensions in the axis. Can also be a single number,\n *   in which case it specifies the size of the first axis.\n *\n * @doc {heading: 'Tensors', subheading: 'Slicing and Joining'}\n */\nfunction slice_<R extends Rank, T extends Tensor<R>>(\n   x: T|TensorLike, begin: number|number[], size?: number|number[]): T {\n const $x = convertToTensor(x,
 'x', 'slice', 'string_or_numeric');\n\n if ($x.rank === 0) {\n   throw new Error('Slicing scalar is not possible');\n }\n\n const inputs: SliceInputs = {x: $x};\n const attrs: SliceAttrs = {begin, size};\n\n return ENGINE.runKernel(\n   Slice, inputs as {} as NamedTensorMap, attrs as {} as NamedAttrMap);\n}\n\nexport const slice = op({slice_});\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n
 * ==\n
*/\n\nimport {ENGINE} from '../engine';\nimport {Tanh, TanhInputs} from '../kernel_names';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\n\nimport {op} from './operation';\n\n/**\n * Computes hyperbolic tangent of the input `tf.Tensor` element-wise: `tanh(x)`\n *\n * ```js\n * const x = tf.tensor1d([0, 1, -1, 70]);\n *\n * x.tanh().print(); // or tf.tanh(x)\n * ```\n * @param x The input tensor.\n *\n * @doc {heading: 'Operations', subheading: 'Basic math'}\n */\nfunction tanh_<T extends Tensor>(x: T|TensorLike): T {\n const $x = convertToTensor(x, 'x', 'tanh');\n\n const inputs: TanhInputs = {x: $x};\n\n return ENGINE.runKernel(Tanh, inputs

as {} as NamedTensorMap);\n}\nexport const tanh = op({tanh_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n
 * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
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*/\n\nimport {Scalar, Tensor1D, Tensor2D} from '../tensor';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\n\nimport {add} from './add';\nimport {concat} from './concat';\nimport {matMul} from './mat_mul';\nimport {mul} from './mul';\nimport {op} from './operation';\nimport {sigmoid} from './sigmoid';\nimport
 {slice} from './slice';\nimport {tanh} from './tanh';\n\n/**\n * Computes the next state and output of a BasicLSTMCell.\n *\n * Returns `[newC, newH]`.\n *\n * Derived from tf.contrib.rnn.BasicLSTMCell.\n *\n * @param forgetBias Forget bias for the cell.\n * @param lstmKernel The weights for the cell.\n * @param lstmBias The bias for the cell.\n * @param data The input to the cell.\n * @param c Previous cell state.\n * @param h Previous cell output.\n *\n * @doc {heading: 'Operations', subheading: 'RNN'}\n */\nfunction basicLSTMCell_(\n forgetBias: Scalar|TensorLike, lstmKernel: Tensor2D|TensorLike,\n   lstmBias: Tensor1D|TensorLike, data: Tensor2D|TensorLike,\n   c: Tensor2D|TensorLike, h: Tensor2D|TensorLike): [Tensor2D, Tensor2D] {\n const $forgetBias =\n   convertToTensor(forgetBias, 'forgetBias', 'basicLSTMCell');\n const $lstmKernel =\n convertToTensor(lstmKernel, 'lstmKernel', 'basicLSTMCell');\n const $lstmBias = convertToTensor(lstmBias, 'lstmBias',
 'basicLSTMCell');\n const $data = convertToTensor(data, 'data', 'basicLSTMCell');\n const $c = convertToTensor(c, 'c', 'basicLSTMCell');\n const $h = convertToTensor(h, 'h', 'basicLSTMCell');\n\n const combined = concat([$data, $h], 1);\n const weighted = matMul(combined, $lstmKernel);\n const res: Tensor2D = add(weighted, $lstmBias);\n\n // i = input_gate, j = new_input, f = forget_gate, o = output_gate\n const batchSize = res.shape[0];\n const sliceCols = res.shape[1] / 4;\n const sliceSize: [number, number] = [batchSize, sliceCols];\n const i = slice(res, [0, 0], sliceSize);\n const j = slice(res, [0, sliceCols], sliceSize);\n const f = slice(res, [0, sliceCols * 2], sliceSize);\n const o = slice(res, [0, sliceCols * 3], sliceSize);\n\n const newC: Tensor2D =\n add(mul(sigmoid(i), tanh(j)),\n   mul($c, sigmoid(add($forgetBias, f)) as Tensor2D));\n const newH: Tensor2D = mul(tanh(newC), sigmoid(o));\n return [newC, newH];\n}\n\nexport const basicLSTMCell
 = op({basicLSTMCell_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
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*/\n\nimport {ENGINE} from '../engine';\nimport {BatchToSpaceND, BatchToSpaceNDAttrs, BatchToSpaceNDInputs} from '../kernel_names';\nimport {NamedAttrMap} from '../kernel_registry';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport
 {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\nimport * as util from '../util';\n\nimport {op} from './operation';\n\n/**\n * This operation reshapes the \"batch\" dimension 0 into `M + 1` dimensions of\n * shape `blockShape + [batch]`, interleaves these blocks back into the grid\n * defined by the spatial dimensions `[1, ..., M]`, to obtain a result with\n * the same rank as the input. The spatial dimensions of this intermediate\n * result are then optionally cropped according to `crops` to produce the\n * output. This is the reverse

of `tf.spaceToBatchND`. See below for a precise\n * description.\n *\n * ```js\n * const x = tf.tensor4d([1, 2, 3, 4], [4, 1, 1, 1]);\n * const blockShape = [2, 2];\n * const crops = [[0, 0], [0, 0]];\n *\n * x.batchToSpaceND(blockShape, crops).print();\n * ```\n *\n * @param x A `tf.Tensor`. N-D with `x.shape` = `[batch] + spatialShape +\n * remainingShape`, where spatialShape has `M` dimensions.\n
 * @param blockShape A 1-D array. Must have shape `[M]`, all values must\n * be >= 1.\n * @param crops A 2-D array. Must have shape `[M, 2]`, all values must be >= 0.\n * `crops[i] = [cropStart, cropEnd]` specifies the amount to crop from input\n * dimension `i + 1`, which corresponds to spatial dimension `i`. It is required\n * that `cropStart[i] + cropEnd[i] <= blockShape[i] * inputShape[i + 1]`\n *\n * This operation is equivalent to the following steps:\n *\n * 1. Reshape `x` to `reshaped` of shape: `[blockShape[0], ...,\n * blockShape[M-1], batch / prod(blockShape), x.shape[1], ...,\n * x.shape[N-1]]`\n *\n * 2. Permute dimensions of `reshaped`to produce `permuted` of shape `[batch /\n * prod(blockShape),x.shape[1], blockShape[0], ..., x.shape[M],\n * blockShape[M-1],x.shape[M+1], ..., x.shape[N-1]]`\n *\n * 3. Reshape `permuted` to produce `reshapedPermuted` of shape `[batch /\n * prod(blockShape),x.shape[1] * blockShape[0], ..., x.shape[M] *\n * blockShape[M-1],x.shape[M+1],
 ..., x.shape[N-1]]`\n *\n * 4. Crop the start and end of dimensions `[1, ..., M]` of `reshapedPermuted`\n * according to `crops` to produce the output of shape: `[batch /\n * prod(blockShape),x.shape[1] * blockShape[0] - crops[0,0] - crops[0,1],\n * ..., x.shape[M] * blockShape[M-1] - crops[M-1,0] -\n * crops[M-1,1],x.shape[M+1], ..., x.shape[N-1]]`\n *\n * @doc {heading: 'Tensors', subheading: 'Transformations'}\n */\nfunction batchToSpaceND_<T extends Tensor>(\n   x: T|TensorLike, blockShape: number[], crops: number[][]): T {\n const $x = convertToTensor(x, 'x', 'batchToSpaceND');\n const prod = blockShape.reduce((a, b) => a * b);\n\n util.assert(\n $x.rank >= 1 + blockShape.length,\n   () => `input rank is ${$x.rank} but should be > than blockShape.length ${\n blockShape.length}`);\n\n util.assert(\n   crops.length === blockShape.length,\n   () => `crops.length is ${\n  crops.length} but should be equal to blockShape.length  ${\n          blockShape.length}`);\n\n
  util.assert(\n $x.shape[0] % prod === 0,\n   () => `input tensor batch is ${\n              $x.shape[0]} but is not divisible by the product of ` +\n   `the elements of blockShape ${blockShape.join(' * ')} === ${prod}`);\n\n const inputs: BatchToSpaceNDInputs = {x: $x};\n const attrs: BatchToSpaceNDAttrs = {blockShape, crops};\n\n return ENGINE.runKernel(\n   BatchToSpaceND, inputs as {} as NamedTensorMap,\n   attrs as {} as NamedAttrMap);\n}\n\nexport const batchToSpaceND = op({batchToSpaceND_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n
 * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
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*/\nimport {Tensor, Tensor4D} from '../tensor';\nimport {Rank} from '../types';\nimport {reshape} from './reshape';\n\nexport function xAs4D<R extends Rank>(x: Tensor<R>) {\n let x4D: Tensor4D;\n if (x.rank === 0 || x.rank === 1) {\n   x4D = reshape(x, [1, 1, 1, x.size]);\n } else if (x.rank === 2) {\n   x4D = reshape(x, [1, 1, x.shape[0], x.shape[1]]);\n } else if (x.rank === 3) {\n   x4D = reshape(x, [1, x.shape[0], x.shape[1], x.shape[2]]);\n } else {\n   x4D = x as Tensor4D;\n }\n\n return x4D;\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n
 * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n
*/\n\nimport {ENGINE} from '../engine';\nimport {FusedBatchNorm, FusedBatchNormAttrs, FusedBatchNormInputs} from '../kernel_names';\nimport {NamedAttrMap} from '../kernel_registry';\nimport

{Tensor, Tensor1D, Tensor4D} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {Rank, TensorLike} from '../types';\nimport * as util from '../util';\n\nimport {xAs4D} from './batchnorm_util';\nimport {op} from './operation';\nimport {reshape} from './reshape';\n\n/**\n * Batch normalization.\n *\n * As described in\n * http://arxiv.org/abs/1502.03167.\n *\n * Mean, variance, scale, and offset can be of two shapes:\n *   - The same shape as the input.\n *   - In the common case, the depth dimension is the last dimension of x, so\n *   the values would be an `tf.Tensor1D` of shape [depth].\n *\n * Also available are stricter rank-specific methods with the same signature\n * as this method that assert that parameters passed are of given rank\n *   - `tf.batchNorm2d`\n *   - `tf.batchNorm3d`\n *   - `tf.batchNorm4d`\n *\n * @param x The input Tensor.\n * @param mean A mean Tensor.\n * @param variance A variance Tensor.\n * @param offset An offset Tensor.\n * @param scale A scale Tensor.\n * @param varianceEpsilon A small float number to avoid dividing by 0.\n *\n * @doc {heading: 'Operations', subheading: 'Normalization'}\n */\nfunction batchNorm_<R extends Rank>(\n x: Tensor<R>|TensorLike, mean: Tensor<R>|Tensor1D|TensorLike,\n   variance: Tensor<R>|Tensor1D|TensorLike,\n   offset?: Tensor<R>|Tensor1D|TensorLike,\n   scale?: Tensor<R>|Tensor1D|TensorLike,\n   varianceEpsilon?: number): Tensor<R> {\n if (varianceEpsilon == null) {\n   varianceEpsilon = 0.001;\n }\n const $x = convertToTensor(x, 'x', 'batchNorm');\n const $mean = convertToTensor(mean, 'mean', 'batchNorm');\n const $variance = convertToTensor(variance, 'variance', 'batchNorm');\n let $scale: Tensor<R>|Tensor1D;\n if (scale != null) {\n $scale = convertToTensor(scale, 'scale', 'batchNorm');\n }\n let $offset: Tensor<R>|Tensor1D;\n if (offset != null) {\n $offset = convertToTensor(offset, 'offset', 'batchNorm');\n }\n\n util.assert(\n $mean.rank === $variance.rank,\n   () => 'Batch normalization gradient requires mean and variance to have ' +\n   'equal ranks.');\n util.assert(\n $offset == null || $mean.rank === $offset.rank,\n   () =>
'Batch normalization gradient requires mean and offset to have ' +\n   'equal ranks.');\n util.assert(\n $scale == null || $mean.rank === $scale.rank,\n   () => 'Batch normalization gradient requires mean and scale to have ' +\n   'equal ranks.');\n\n const x4D: Tensor4D = xAs4D($x);\n\n const inputs: FusedBatchNormInputs = {\n   x: x4D,\n   scale: $scale,\n   offset: $offset,\n   mean: $mean,\n   variance: $variance\n };\n\n const attrs: FusedBatchNormAttrs = {varianceEpsilon};\n\n // tslint:disable-next-line: no-unnecessary-type-assertion\n const res = ENGINE.runKernel(\n   FusedBatchNorm, inputs as {} as NamedTensorMap,\n   attrs as {} as NamedAttrMap) as Tensor<R>;\n\n return reshape(res, $x.shape);\n}\n\nexport const batchNorm = op({batchNorm_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file
except in compliance with the License.\n * You may obtain a copy of the License at\n *\n *
http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n */\nimport {Tensor1D, Tensor2D} from '../tensor';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\nimport * as util from '../util';\n\nimport {batchNorm} from './batchnorm';\nimport {op} from './operation';\n\n/**\n * Batch normalization, strictly for 2D. For the more relaxed version, see\n * `tf.batchNorm`.\n *\n * @param x The input Tensor.\n * @param mean A mean Tensor.\n * @param variance A variance
Tensor.\n * @param offset An offset Tensor.\n * @param scale A scale Tensor.\n * @param varianceEpsilon A small float number to avoid dividing by 0.\n */\nfunction batchNorm2d_(\n   x: Tensor2D|TensorLike, mean: Tensor2D|Tensor1D|TensorLike,\n   variance: Tensor2D|Tensor1D|TensorLike,\n   offset?: Tensor2D|Tensor1D|TensorLike, scale?: Tensor2D|Tensor1D|TensorLike,\n   varianceEpsilon?: number): Tensor2D {\n const $x = convertToTensor(x, 'x', 'batchNorm');\n const $mean = convertToTensor(mean, 'mean',

'batchNorm');\n const $variance = convertToTensor(variance, 'variance', 'batchNorm');\n let $scale: Tensor2D|Tensor1D;\n if (scale != null) {\n $scale = convertToTensor(scale, 'scale', 'batchNorm');\n }\n let $offset: Tensor2D|Tensor1D;\n if (offset != null) {\n $offset = convertToTensor(offset, 'offset', 'batchNorm');\n }\n util.assert(\n $x.rank === 2,\n   () => `Error in batchNorm2D: x must be rank 2 but got rank ` +\n   `${$x.rank}.`);\n util.assert(\n $mean.rank === 2 || $mean.rank === 1,\n   () => `Error in batchNorm2D: mean must be rank 2 or rank 1 but ` +\n   `got rank ${$mean.rank}.`);\n util.assert(\n $variance.rank === 2 || $variance.rank === 1,\n   () => `Error in batchNorm2D: variance must be rank 2 or rank 1 ` +\n   `but got rank ${$variance.rank}.`);\n if ($scale != null) {\n   util.assert(\n $scale.rank === 2 || $scale.rank === 1,\n   () => `Error in batchNorm2D: scale must be rank 2 or rank 1 ` +\n   `but got rank ${$scale.rank}.`);\n }\n if ($offset != null) {\n   util.assert(\n $offset.rank === 2 || $offset.rank === 1,\n   () => `Error in batchNorm2D: offset must be rank 2 or rank 1 ` +\n   `but got rank ${$offset.rank}.`);\n }\n\n return batchNorm($x, $mean, $variance, $offset, $scale, varianceEpsilon);\n}\n\nexport const batchNorm2d = op({batchNorm2d_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed
 under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n */\nimport {Tensor1D, Tensor3D} from '../tensor';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\nimport * as util from '../util';\n\nimport {batchNorm} from './batchnorm';\nimport {op} from './operation';\n\n/**\n * Batch normalization, strictly for 3D. For the more relaxed version, see\n * `tf.batchNorm`.\n *\n
 * @param x The input Tensor.\n * @param mean A mean Tensor.\n * @param variance A variance Tensor.\n * @param offset An offset Tensor.\n * @param scale A scale Tensor.\n * @param varianceEpsilon A small float number to avoid dividing by 0.\n */\nfunction batchNorm3d_(\n   x: Tensor3D|TensorLike, mean: Tensor3D|Tensor1D|TensorLike,\n   variance: Tensor3D|Tensor1D|TensorLike,\n   offset?: Tensor3D|Tensor1D|TensorLike, scale?: Tensor3D|Tensor1D|TensorLike,\n   varianceEpsilon?: number): Tensor3D {\n const $x = convertToTensor(x, 'x', 'batchNorm');\n const $mean = convertToTensor(mean, 'mean', 'batchNorm');\n const $variance = convertToTensor(variance, 'variance', 'batchNorm');\n let $scale: Tensor3D|Tensor1D;\n if (scale != null) {\n $scale = convertToTensor(scale, 'scale', 'batchNorm');\n }\n let $offset: Tensor3D|Tensor1D;\n if (offset != null) {\n $offset = convertToTensor(offset, 'offset', 'batchNorm');\n }\n util.assert(\n $x.rank === 3,\n   () => `Error
 in batchNorm3D: x must be rank 3 but got rank ` +\n          `${$x.rank}.`);\n  util.assert(\n      $mean.rank === 3 || $mean.rank === 1,\n      () => `Error in batchNorm3D: mean must be rank 3 or rank 1 but ` +\n          `got rank ${$mean.rank}.`);\n  util.assert(\n      $variance.rank === 3 || $variance.rank === 1,\n      () => `Error in batchNorm3D: variance must be rank 3 or rank 1 ` +\n          `but got rank ${$variance.rank}.`);\n  if ($scale != null) {\n    util.assert(\n        $scale.rank === 3 || $scale.rank === 1,\n        () => `Error in batchNorm3D: scale must be rank 3 or rank 1 ` +\n            `but got rank ${$scale.rank}.`);\n  }\n  if ($offset != null) {\n    util.assert(\n        $offset.rank === 3 || $offset.rank === 1,\n        () => `Error in batchNorm3D: offset must be rank 3 or rank 1 ` +\n            `but got rank ${$offset.rank}.`);\n }\n\n return batchNorm($x, $mean, $variance, $offset, $scale, varianceEpsilon);\n}\n\nexport const batchNorm3d = op({batchNorm3d_});\n","/**\n
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WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\nimport {Tensor1D, Tensor4D} from '../tensor';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\nimport * as util from '../util';\n\nimport {batchNorm} from './batchnorm';\nimport {op} from './operation';\n\n/**\n * Batch
 normalization, strictly for 4D. For the more relaxed version, see\n * `tf.batchNorm`.\n *\n * @param x The input Tensor.\n * @param mean A mean Tensor.\n * @param variance A variance Tensor.\n * @param offset An offset Tensor.\n * @param scale A scale Tensor.\n * @param varianceEpsilon A small float number to avoid dividing by 0.\n */\nfunction batchNorm4d_(\n    x: Tensor4D|TensorLike, mean: Tensor4D|Tensor1D|TensorLike,\n    variance: Tensor4D|Tensor1D|TensorLike,\n    offset?: Tensor4D|Tensor1D|TensorLike, scale?: Tensor4D|Tensor1D|TensorLike,\n    varianceEpsilon?: number): Tensor4D {\n  const $x = convertToTensor(x, 'x', 'batchNorm');\n  const $mean = convertToTensor(mean, 'mean', 'batchNorm');\n  const $variance = convertToTensor(variance, 'variance', 'batchNorm');\n  let $scale: Tensor4D|Tensor1D;\n  if (scale != null) {\n    $scale = convertToTensor(scale, 'scale', 'batchNorm');\n  }\n  let $offset: Tensor4D|Tensor1D;\n  if (offset != null) {\n    $offset = convertToTensor(offset,
 'offset', 'batchNorm');\n  }\n  util.assert(\n      $x.rank === 4,\n      () => `Error in batchNorm4D: x must be rank 4 but got rank ` +\n          `${$x.rank}.`);\n  util.assert(\n      $mean.rank === 4 || $mean.rank === 1,\n      () => `Error in batchNorm4D: mean must be rank 4 or rank 1 but ` +\n          `got rank ${$mean.rank}.`);\n  util.assert(\n      $variance.rank === 4 || $variance.rank === 1,\n      () => `Error in batchNorm4D: variance must be rank 4 or rank 1 ` +\n          `but got rank ${$variance.rank}.`);\n  if ($scale != null) {\n    util.assert(\n        $scale.rank === 4 || $scale.rank === 1,\n        () => `Error in batchNorm4D: scale must be rank 4 or rank 1 ` +\n            `but got rank ${$scale.rank}.`);\n  }\n  if ($offset != null) {\n    util.assert(\n        $offset.rank === 4 || $offset.rank === 1,\n        () => `Error in batchNorm4D: offset must be rank 4 or rank 1 ` +\n            `but got rank ${$offset.rank}.`);\n  }\n  return batchNorm($x, $mean,
 $variance, $offset, $scale, varianceEpsilon);\n}\n\nexport const batchNorm4d = op({batchNorm4d_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {ENGINE} from '../engine';\nimport {Bincount, BincountAttrs, BincountInputs} from '../kernel_names';\nimport {NamedAttrMap} from '../kernel_registry';\nimport {Tensor1D}
 from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\nimport * as util from '../util';\n\nimport {op} from './operation';\n\n/**\n * Outputs a vector with length `size` and the same dtype as `weights`.\n *\n * If `weights` are empty, then index `i` stores the number of times the value\n * `i` is counted in `x`. If `weights` are non-empty, then index `i` stores the\n * sum of the value in `weights` at each index where the corresponding value in\n * `x` is `i`.\n *\n * Values in `x` outside of the range [0, size) are ignored.\n *\n * @param x The input int tensor, rank 1.\n * @param weights The weights tensor, must have the same shape as x, or a\n *     length-0 Tensor, in which case it acts as all weights equal to 1.\n * @param size Non-negative integer.\n *\n * @doc {heading: 'Operations', subheading: 'Reduction'}\n */\nfunction bincount_<T extends Tensor1D>(\n    x: T|TensorLike,
 weights: T|TensorLike, size: number): T {\n  const $x = convertToTensor(x, 'x', 'bincount');\n  const $weights = convertToTensor(weights, 'weights', 'bincount');\n\n  util.assert(\n      $x.dtype === 'int32',\n      () => `Error in bincount: input ` +\n          `dtype must be int32, but got ${$x.dtype}`);\n  util.assert(size >= 0, () => `size must be non-negative, but got ${size}.`);\n  util.assert(\n      $weights.size === $x.size || $weights.size === 0,\n      () =>
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`Error in bincount: weights must have the same size as input or` +\n `0-length, but got input shape: ${$x.shape}, weights shape: ` +\n `${$weights.shape}.`);\n\n const inputs: BincountInputs = {x: $x, weights: $weights};\n const attrs: BincountAttrs = {size};\n\n return ENGINE.runKernel(\n Bincount, inputs as {} as NamedTensorMap, attrs as {} as NamedAttrMap);\n}\n\nexport const bincount = op({bincount_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ===\n */\n\nimport {ENGINE} from '../engine';\nimport {Tile, TileAttrs, TileInputs} from '../kernel_names';\nimport {NamedAttrMap} from '../kernel_registry';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {Rank, ShapeMap, TensorLike} from '../types';\n\nimport {clone} from './clone';\nimport {op} from './operation';\nimport {reshape} from './reshape';\n\n/**\n * Broadcast an array to a compatible shape NumPy-style.\n *\n * The tensor's shape is compared to the broadcast shape from end to beginning.\n * Ones are prepended to the tensor's shape until is has the same length as\n * the broadcast shape. If input.shape[i]==shape[i], the (i+1)-th axis is\n * already broadcast-compatible. If input.shape[i]==1 and shape[i]==N, then\n * the input tensor is tiled N times along that axis (using tf.tile).\n *\n * @param input The tensor that is to be broadcasted.\n * @param shape The input is to be broadcast to this shape.\n *\n * @doc {heading: 'Tensors', subheading: 'Transformations'}\n */\nfunction broadcastTo_<R extends Rank>(\n x: Tensor|TensorLike, shape: ShapeMap[R]): Tensor<R> {\n let input = convertToTensor(x, 'broadcastTo', 'x');\n const xShape = input.shape;\n\n if (shape.some(d => !(d > 0) || d % 1 !== 0)) {\n throw new Error(`broadcastTo(): Invalid broadcast shape [${shape}].`);\n }\n\n if (shape.length < input.rank) {\n throw new Error(`broadcastTo(): shape.length=${shape.length} < input.rank=${\n input.rank}.`);\n }\n\n if (shape.length > input.rank) {\n const newShape = input.shape.slice();\n while (newShape.length < shape.length) {\n newShape.unshift(1);\n }\n input = reshape(input, newShape);\n }\n\n const inputShape = input.shape;\n const reps: number[] = Array.from(shape);\n for (let i = shape.length - 1; i >= 0; i--) {\n if (inputShape[i] === shape[i]) {\n reps[i] = 1;\n } else if (input.shape[i] !== 1) {\n throw new Error(\n `broadcastTo(): [${xShape}] cannot be broadcast to [${shape}].`);\n }\n }\n const axes = reps.map((n, i) => n > 1 ? i : -1).filter(i => i >= 0);\n\n if (axes.length === 0) {\n return clone(input) as Tensor<R>;\n }\n\n // TODO call broadcastTo kernel directly once backends implement broadcstTo\n const inputs: TileInputs = {x: input};\n const attrs: TileAttrs = {reps};\n return ENGINE.runKernel(\n Tile, inputs as {} as NamedTensorMap, attrs as unknown as NamedAttrMap);\n}\n\nexport const broadcastTo = op({broadcastTo_});\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ===\n */\n\nimport {ENGINE} from '../engine';\nimport {Ceil, CeilInputs} from '../kernel_names';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\n\nimport {op} from

'./operation';\n\n/**\n * Computes ceiling of input `tf.Tensor` element-wise: `ceil(x)`\n *\n * ```js\n * const x = tf.tensor1d([.6, 1.1, -3.3]);\n *\n * x.ceil().print(); // or tf.ceil(x)\n * ```\n * @param x The input Tensor.\n *\n * @doc {heading: 'Operations', subheading: 'Basic math'}\n */\nfunction ceil_<T extends Tensor>(x: T|TensorLike): T {\n const $x = convertToTensor(x, 'x', 'ceil');\n\n const inputs: CeilInputs = {x: $x};\n return ENGINE.runKernel(Ceil, inputs as {} as NamedTensorMap);\n}\nexport const ceil = op({ceil_});\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of
the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
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*/\nimport {ENGINE} from '../engine';\nimport {ClipByValue, ClipByValueAttrs, ClipByValueInputs} from '../kernel_names';\nimport {NamedAttrMap} from '../kernel_registry';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\nimport * as util from '../util';\n\nimport {op} from './operation';\n\n/**\n * Clips values element-wise. `max(min(x, clipValueMax), clipValueMin)`\n *\n * ```js\n * const
x = tf.tensor1d([-1, 2, -3, 4]);\n *\n * x.clipByValue(-2, 3).print(); // or tf.clipByValue(x, -2, 3)\n * ```\n * @param x The input tensor.\n * @param clipValueMin Lower-bound of range to be clipped to.\n * @param clipValueMax Upper-bound of range to be clipped to.\n *\n * @doc {heading: 'Operations', subheading: 'Basic math'}\n */\nfunction clipByValue_<T extends Tensor>(\n   x: T|TensorLike, clipValueMin: number, clipValueMax: number): T {\n const $x = convertToTensor(x, 'x', 'clipByValue');\n util.assert(\n   (clipValueMin <= clipValueMax),\n   () => `Error in clip: min (${clipValueMin}) must be ` +\n   `less than or equal to max (${clipValueMax}).`);\n\n const inputs: ClipByValueInputs = {x: $x};\n const attrs: ClipByValueAttrs = {clipValueMin, clipValueMax};\n\n return ENGINE.runKernel(\n   ClipByValue, inputs as {} as NamedTensorMap, attrs as {} as NamedAttrMap);\n}\n\nexport const clipByValue = op({clipByValue_});\n","/**\n * @license\n * Copyright 2020
Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
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*/\nimport {Tensor1D} from '../tensor';\nimport {TensorLike} from '../types';\n\nimport {concat} from './concat';\nimport {op} from './operation';\n\n/**\n * Concatenates a list of`tf.Tensor1D`s along an axis. See `concat` for details.\n *\n * For example, if:\n * A: shape(3) = |r1, g1, b1|\n * B: shape(2) = |r2,
g2|\n * C = tf.concat1d([A, B]) == |r1, g1, b1, r2, g2|\n *\n * @param tensors A list of`tf.Tensor`s to concatenate.\n * @return The concatenated array.\n */\nfunction concat1d_(tensors: Array<Tensor1D|TensorLike>): Tensor1D {\n return concat(tensors, 0 /* axis */);\n}\n\nexport const concat1d = op({concat1d_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
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*/\nimport {Tensor2D} from '../tensor';\nimport {TensorLike} from '../types';\n\nimport {concat} from './concat';\nimport {op} from './operation';\n\n/**\n * Concatenates a list of`tf.Tensor2D`s along an axis. See `concat` for details.\n *\n * For example, if:\n * A: shape(2, 3) = | r1, g1, b1 |\n * | r2, g2, b2 |\n *\n * B: shape(2, 3) = | r3, g3, b3 |\n * | r4, g4, b4 |\n *\n * C = tf.concat2d([A, B], axis)\n *\n * if axis = 0:\n * C: shape(4, 3) = | r1, g1, b1 |\n * | r2, g2, b2 |\n * | r3, g3, b3 |\n * | r4, g4, b4 |\n *\n * if axis = 1:\n * C = shape(2, 6) = | r1, g1, b1, r3, g3, b3 |\n * | r2, g2, b2, r4, g4, b4 |\n *\n *\n * @param tensors A list of `tf.Tensor`s to concatenate.\n * @param axis The axis to concatenate along.\n * @return The concatenated array.\n */\nfunction concat2d_(\n tensors: Array<Tensor2D|TensorLike>, axis: number): Tensor2D {\n return concat(tensors, axis);\n}\n\nexport const concat2d = op({concat2d_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n * ==\n */\nimport {Tensor3D} from '../tensor';\nimport {TensorLike} from '../types';\n\nimport {concat} from './concat';\nimport {op} from './operation';\n\n/**\n * Concatenates a list of `tf.Tensor3D`s along an axis.\n * See `concat` for details.\n *\n * For example, if:\n * A: shape(2, 1, 3) = | r1, g1, b1 |\n * | r2, g2, b2 |\n *\n * B: shape(2, 1, 3) = | r3, g3, b3 |\n * | r4, g4, b4 |\n *\n * C = tf.concat3d([A, B], axis)\n *\n * if axis = 0:\n * C: shape(4, 1, 3) = | r1, g1, b1 |\n * | r2, g2, b2 |\n * | r3, g3, b3 |\n * | r4, g4, b4 |\n *\n * if axis = 1:\n * C: shape(2, 2, 3) = | r1, g1, b1, r3, g3, b3 |\n * | r2, g2, b2, r4, g4, b4 |\n *\n * if axis = 2:\n * C = shape(2, 1, 6) = | r1, g1, b1, r3, g3, b3 |\n * | r2, g2, b2, r4, g4, b4 |\n *\n * @param tensors A list of`tf.Tensor`s to concatenate.\n * @param axis The axis to concate along.\n * @return The concatenated array.\n */\nfunction concat3d_(\n tensors: Array<Tensor3D|TensorLike>, axis: number): Tensor3D {\n return concat(tensors, axis);\n}\n\nexport const concat3d = op({concat3d_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n * ==\n */\nimport {Tensor4D} from '../tensor';\nimport {TensorLike} from '../types';\n\nimport {concat} from './concat';\nimport {op} from './operation';\n\n/**\n * Concatenates a list of `tf.Tensor4D`s along an axis.\n * See `concat` for details.\n *\n * @param tensors
A list of `tf.Tensor`s to concatenate.\n * @param axis The axis to concate along.\n * @return The concatenated array.\n */\nfunction concat4d_(\n tensors: Array<Tensor4D|TensorLike>, axis: number): Tensor4D {\n return concat(tensors, axis);\n}\n\nexport const concat4d = op({concat4d_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n * ==\n */

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*/\nimport {ENGINE} from '../engine';\nimport {Conv2D, Conv2DAttrs, Conv2DInputs} from '../kernel_names';\nimport {NamedAttrMap} from '../kernel_registry';\nimport {Tensor3D, Tensor4D} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\nimport * as util from '../util';\n\nimport * as conv_util from './conv_util';\nimport {op} from './operation';\nimport {reshape} from './reshape';\n\n/**\n * Computes a 2D convolution over the input x.\n *\n * @param x The input tensor, of rank 4 or rank 3, of shape\n *     `[batch, height, width, inChannels]`. If rank 3, batch of 1 is\n * assumed.\n * @param filter The filter, rank 4, of shape\n *     `[filterHeight, filterWidth, inDepth, outDepth]`.\n * @param strides The strides of the convolution: `[strideHeight,\n * strideWidth]`.\n * @param pad The type of padding algorithm.\n *    - `same` and stride 1: output will be of same size as input,\n *       regardless of filter size.\n *    - `valid`: output will be smaller than input if filter is larger\n *       than 1x1.\n *    - For more info, see this guide:\n *     [https://www.tensorflow.org/api_guides/python/nn#Convolution](\n *     https://www.tensorflow.org/api_guides/python/nn#Convolution)\n * @param dataFormat: An optional string from: \"NHWC\", \"NCHW\". Defaults to\n *     \"NHWC\". Specify the data format of the input and output data. With the\n *     default format \"NHWC\", the data is stored in the order of: [batch,\n *     height, width, channels].\n * @param dilations The dilation rates: `[dilationHeight, dilationWidth]`\n *     in which we sample input values across the height and width dimensions\n *     in atrous convolution. Defaults to `[1, 1]`. If `dilations` is a single\n *     number, then `dilationHeight == dilationWidth`. If it is greater than\n *     1, then all values of `strides` must be 1.\n * @param dimRoundingMode A string
 from: 'ceil', 'round', 'floor'. If none is\n *     provided, it will default to truncate.\n *\n * @doc {heading: 'Operations', subheading: 'Convolution'}\n */\nfunction conv2d_<T extends Tensor3D|Tensor4D>(\n    x: T|TensorLike, filter: Tensor4D|TensorLike,\n    strides: [number, number]|number,\n    pad: 'valid'|'same'|number|conv_util.ExplicitPadding,\n    dataFormat: 'NHWC'|'NCHW' = 'NHWC',\n    dilations: [number, number]|number = [1, 1],\n    dimRoundingMode?: 'floor'|'round'|'ceil'): T {\n  const $x = convertToTensor(x, 'x', 'conv2d');\n  const $filter = convertToTensor(filter, 'filter', 'conv2d');\n\n  let x4D = $x as Tensor4D;\n  let reshapedTo4D = false;\n\n  if ($x.rank === 3) {\n    reshapedTo4D = true;\n    x4D = reshape($x, [1, $x.shape[0], $x.shape[1], $x.shape[2]]);\n  }\n\n  util.assert(\n      x4D.rank === 4,\n      () => `Error in conv2d: input must be rank 4, but got rank ${x4D.rank}.`);\n  util.assert(\n      $filter.rank === 4,\n      () => `Error in conv2d: filter
 must be rank 4, but got rank ` +\n          `${$filter.rank}.`);\n  if (dimRoundingMode != null) {\n    util.assert(\n        util.isInt(pad as number),\n        () => `Error in conv2d: pad must be an integer when using, ` +\n            `dimRoundingMode ${dimRoundingMode} but got pad ${pad}.`);\n  }\n\n  const inDepth = dataFormat === 'NHWC' ? x4D.shape[3] : x4D.shape[1];\n  util.assert(\n      inDepth === $filter.shape[2],\n      () => `Error in conv2d: depth of input (${inDepth}) must match ` +\n          `input depth for filter ${$filter.shape[2]}.`);\n  util.assert(\n      conv_util.eitherStridesOrDilationsAreOne(strides, dilations),\n      () => 'Error in conv2D: Either strides or dilations must be 1. ' +\n          `Got strides ${strides} and dilations '${dilations}'`);\n\n  const inputs: Conv2DInputs = {x: x4D, filter: $filter};\n  const attrs:\n      Conv2DAttrs = {strides, pad, dataFormat, dilations, dimRoundingMode};\n\n  // tslint:disable-next-line: no-unnecessary-type-assertion\n
  const res = ENGINE.runKernel(\n                Conv2D, inputs as {} as NamedTensorMap,\n                attrs as {} as NamedAttrMap) as T;\n\n  if (reshapedTo4D) {\n    return reshape(res, [res.shape[1], res.shape[2], res.shape[3]]) as T;\n  }\n  return res;\n}\n\nexport const conv2d = op({conv2d_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
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*/\nimport {Tensor2D, Tensor3D, Tensor4D} from '../tensor';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\nimport * as util from '../util';\n\nimport {conv2d} from './conv2d';\nimport * as conv_util from './conv_util';\nimport {op} from './operation';\nimport {reshape} from './reshape';\n\n/**\n * Computes a 1D convolution over the input x.\n *\n * @param x The input tensor, of rank 3 or rank 2, of shape\n *   `[batch, width, inChannels]`. If rank 2, batch of 1 is assumed.\n * @param filter The filter, rank 3, of shape\n *   `[filterWidth, inDepth, outDepth]`.\n * @param stride The number of entries by which the filter is moved right at\n *   each step.\n * @param pad The type of padding algorithm.\n *   - `same` and stride 1: output will be of same size as input,\n *   regardless of filter size.\n *   - `valid`: output will be smaller than input if filter is larger\n *   than 1x1.\n
 *   - For more info, see this guide:\n *   [https://www.tensorflow.org/api_guides/python/nn#Convolution](\n * https://www.tensorflow.org/api_guides/python/nn#Convolution)\n * @param dataFormat An optional string from \"NWC\", \"NCW\". Defaults to \"NWC\",\n *   the data is stored in the order of [batch, in_width, in_channels]. Only\n *   \"NWC\" is currently supported.\n * @param dilation The dilation rate in which we sample input values in\n *   atrous convolution. Defaults to `1`. If it is greater than 1, then\n *   stride must be `1`.\n * @param dimRoundingMode A string from: 'ceil', 'round', 'floor'. If none is\n *   provided, it will default to truncate.\n *\n * @doc {heading: 'Operations', subheading: 'Convolution'}\n */\nfunction conv1d_<T extends Tensor2D|Tensor3D>(\n   x: T|TensorLike, filter: Tensor3D|TensorLike, stride: number,\n   pad: 'valid'|'same'|number|conv_util.ExplicitPadding,\n   dataFormat: 'NWC'|'NCW' = 'NWC', dilation = 1,\n dimRoundingMode?:
 'floor'|'round'|'ceil'): T {\n const $x = convertToTensor(x, 'x', 'conv1d');\n const $filter = convertToTensor(filter, 'filter', 'conv1d');\n\n let x3D = $x as Tensor3D;\n let reshapedTo3D = false;\n if ($x.rank === 2) {\n reshapedTo3D = true;\n   x3D = reshape($x, [1, $x.shape[0], $x.shape[1]]);\n }\n\n util.assert(\n   x3D.rank === 3,\n   () => `Error in conv1d: input must be rank 3, but got rank ${x3D.rank}.`);\n util.assert(\n $filter.rank === 3,\n   () => `Error in conv1d: filter must be rank 3, but got rank ` +\n   `${$filter.rank}.`);\n if (dimRoundingMode != null) {\n   util.assert(\n   util.isInt(pad as number),\n   () => `Error in conv1d: pad must be an integer when using, ` +\n   `dimRoundingMode ${dimRoundingMode} but got pad ${pad}.`);\n }\n\n util.assert(\n   x3D.shape[2] === $filter.shape[1],\n   () => `Error in conv1d: depth of input (${x3D.shape[2]}) must match ` +\n   `input depth for filter
 ${$filter.shape[1]}.`);\n  util.assert(\n      conv_util.eitherStridesOrDilationsAreOne(stride, dilation),\n      () => 'Error in conv1D: Either stride or dilation must be 1. ' +\n          `Got stride ${stride} and dilation '${dilation}'`);\n  util.assert(\n      dataFormat === 'NWC',\n      () => `Error in conv1d: got dataFormat of ${\n   dataFormat} but only NWC is currently supported.`);\n\n const filter4D = reshape(\n $filter, [1, $filter.shape[0], $filter.shape[1], $filter.shape[2]]);\n const input4D = reshape(x3D, [x3D.shape[0], 1, x3D.shape[1], x3D.shape[2]]);\n const strides: [number, number] = [1, stride];\n const dilations: [number, number] = [1, dilation];\n\n const conv2dDataFormat = 'NHWC';\n\n const res = conv2d(\n   (input4D as Tensor4D), (filter4D as Tensor4D), strides, pad,\n conv2dDataFormat, dilations, dimRoundingMode);\n\n if (reshapedTo3D) {\n   return reshape(res, [res.shape[2], res.shape[3]]) as T;\n }\n\n return reshape(res, [res.shape[0],
 res.shape[2], res.shape[3]]) as T;\n}\n\nexport const conv1d = op({conv1d_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ===\n*/\nimport {ENGINE} from '../engine';\nimport {Conv2DBackpropInput, Conv2DBackpropInputAttrs, Conv2DBackpropInputInputs} from '../kernel_names';\nimport {NamedAttrMap} from '../kernel_registry';\nimport

{Tensor3D, Tensor4D} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport * as util from '../util';\n\nimport * as conv_util from './conv_util';\nimport {op} from './operation';\nimport {reshape} from './reshape';\n\n/**\n * Computes the derivative of the input of a 2D convolution.\n *\n * @param xShape The shape of the input: [batch, height, width, inDepth].\n * If length of 3, batch of 1 is assumed.\n * @param dy The derivative of the output, of rank 4 or rank 3 of shape\n *   `[batch, outHeight, outWidth, outDepth]`. If rank 3, batch of 1 is\n * assumed.\n * @param filter The filter, rank 4, of shape\n *   `[filterHeight, filterWidth, inDepth, outDepth]`.\n * @param strides The strides of the convolution: `[strideHeight,\n * strideWidth]`.\n * @param pad The type of padding algorithm used:\n *   - `same` and stride 1: output will be of same size as input,\n *   regardless of filter size.\n *   - `valid`: output will be smaller than input if
filter is larger\n *   than 1x1.\n * @param dataFormat: An optional string from: \"NHWC\", \"NCHW\". Defaults to\n *   \"NHWC\". Specify the data format of the input and output data. With the\n *   default format \"NHWC\", the data is stored in the order of: [batch,\n *   height, width, channels].\n * @param dimRoundingMode A string from: 'ceil', 'round', 'floor'. If none is\n *   provided, it will default to truncate.\n */\nfunction conv2DBackpropInput_<T extends Tensor3D|Tensor4D>(\n   xShape: [number, number, number, number]|[number, number, number], dy: T,\n   filter: Tensor4D, strides: [number, number]|number,\n   pad: 'valid'|'same'|number|conv_util.ExplicitPadding,\n   dataFormat: 'NHWC'|'NCHW' = 'NHWC',\n   dimRoundingMode?: 'floor'|'round'|'ceil'): T {\n util.assert(\n   xShape.length === dy.rank,\n   () => `Length of inShape ` +\n   `(${xShape.length}) and rank of dy (${dy.rank}) must match`);\n\n let xShape4D = xShape as [number, number, number,
number];\n let dy4D = dy as Tensor4D;\n let reshapedTo4D = false;\n if (dy.rank === 3) {\n   reshapedTo4D = true;\n   dy4D = reshape(dy, [1, dy.shape[0], dy.shape[1], dy.shape[2]]);\n   xShape4D = [1, xShape[0], xShape[1], xShape[2]];\n }\n\n util.assert(\n   xShape4D.length === 4,\n   () =>\n   `Error in conv2dDerInput: inShape must be length 4, but got length ` +\n   `${xShape4D.length}.`);\n util.assert(\n   dy4D.rank === 4,\n   () => `Error in conv2dDerInput: dy must be rank 4, but got ` +\n   `rank ${dy4D.rank}`);\n util.assert(\n   filter.rank === 4,\n   () => `Error in conv2dDerInput: filter must be rank 4, but got ` +\n   `rank ${filter.rank}`);\n const inDepth = dataFormat === 'NHWC' ? xShape4D[3] : xShape4D[1];\n const outDepth = dataFormat === 'NHWC' ? dy4D.shape[3] : dy4D.shape[1];\n util.assert(\n   inDepth === filter.shape[2],\n   () => `Error in conv2dDerInput: depth of input (${inDepth}) must ` +\n
      `match input depth for filter ${filter.shape[2]}.`);\n util.assert(\n   outDepth === filter.shape[3],\n   () => `Error in conv2dDerInput: depth of output (${outDepth}) must ` +\n   `match output depth for filter ${filter.shape[3]}.`);\n if (dimRoundingMode != null) {\n   util.assert(\n   util.isInt(pad as number),\n   () => `Error in conv2dDerInput: pad must be an integer when using, ` +\n   `dimRoundingMode ${dimRoundingMode} but got pad ${pad}.`);\n }\n\n const inputs: Conv2DBackpropInputInputs = {dy: dy4D, filter};\n\n const attrs: Conv2DBackpropInputAttrs =\n   {strides, pad, dataFormat, dimRoundingMode, inputShape: xShape4D};\n\n // tslint:disable-next-line: no-unnecessary-type-assertion\n const res =\n   ENGINE.runKernel(\n   Conv2DBackpropInput, inputs as {} as NamedTensorMap,\n   attrs as {} as NamedAttrMap) as T;\n\n if (reshapedTo4D) {\n   return reshape(res, [res.shape[1], res.shape[2], res.shape[3]]) as T;\n }\n return res;\n}\n\nexport const conv2DBackpropInput = op({conv2DBackpropInput_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
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*/\nimport {Tensor3D, Tensor4D} from '../tensor';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\n\nimport {conv2DBackpropInput} from './conv2d_backprop_input';\nimport

{op} from './operation';\n\n/**\n * Computes the transposed 2D convolution of an image, also known as a\n * deconvolution.\n *\n * @param x The input image, of rank 4 or rank 3, of shape\n * `[batch, height, width, inDepth]`. If rank 3, batch of 1 is assumed.\n * @param filter The filter, rank 4, of shape\n * `[filterHeight, filterWidth, outDepth, inDepth]`.\n * `inDepth` must match `inDepth` in `x`.\n * @param outputShape Output shape, of rank 4 or rank 3:\n * `[batch, height, width, outDepth]`. If rank 3, batch of 1 is assumed.\n * @param strides The strides of the original convolution:\n * `[strideHeight, strideWidth]`.\n * @param pad The type of padding algorithm used in the non-transpose version\n * of the op.\n * @param dimRoundingMode A string from: 'ceil', 'round', 'floor'. If none is\n * provided, it will default to truncate.\n *\n * @doc {heading: 'Operations', subheading: 'Convolution'}\n */\nfunction conv2dTranspose_<T extends Tensor3D|Tensor4D>(\n x: T|TensorLike, filter: Tensor4D|TensorLike,\n outputShape: [number, number, number, number]|[number, number, number],\n strides: [number, number]|number, pad: 'valid'|'same'|number,\n dimRoundingMode?: 'floor'|'round'|'ceil'): T {\n const $x = convertToTensor(x, 'x', 'conv2dTranspose');\n const $filter = convertToTensor(filter, 'filter', 'conv2dTranspose');\n\n return conv2DBackpropInput(\n outputShape, $x, $filter, strides, pad, 'NHWC', dimRoundingMode);\n}\n\nexport const conv2dTranspose = op({conv2dTranspose_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n * ==\n */\nimport {ENGINE} from '../engine';\nimport {Conv3D, Conv3DAttrs, Conv3DInputs} from '../kernel_names';\nimport {NamedAttrMap} from '../kernel_registry';\nimport {Tensor4D, Tensor5D} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\nimport * as util from '../util';\n\nimport {eitherStridesOrDilationsAreOne} from './conv_util';\nimport {op} from './operation';\nimport {reshape} from './reshape';\n\n/**\n * Computes a 3D convolution over the input x.\n *\n * @param x The input tensor, of rank 5 or rank 4, of shape\n * `[batch, depth, height, width, channels]`. If rank 4,\n * batch of 1 is assumed.\n * @param filter The filter, rank 5, of shape\n * `[filterDepth, filterHeight, filterWidth, inChannels, outChannels]`.\n * inChannels must match between input and filter.\n * @param strides The strides of the convolution: `[strideDepth, strideHeight,\n * strideWidth]`.\n * @param pad The type of padding algorithm.\n * - `same` and stride 1: output will be of same size as input,\n * regardless of filter size.\n * - `valid`: output will be smaller than input if filter is larger\n * than 1x1.\n * - For more info, see this guide:\n * [https://www.tensorflow.org/api_guides/python/nn#Convolution](\n * https://www.tensorflow.org/api_guides/python/nn#Convolution)\n * @param dataFormat: An optional string from: \"NDHWC\", \"NCDHW\". Defaults to\n * \"NDHWC\". Specify the data format of the input and output data. With the\n * default format \"NDHWC\", the data is stored in the order of: [batch,\n * depth, height, width, channels].\n * Only \"NDHWC\" is currently supported.\n * @param dilations The dilation rates: `[dilationDepth, dilationHeight,\n * dilationWidth]` in which we sample input values across the height\n * and width dimensions in atrous convolution. Defaults to `[1, 1, 1]`.\n * If `dilations` is a single number, then\n * `dilationDepth == dilationHeight == dilationWidth`. If it is greater\n * than 1, then all values of `strides` must be 1.\n *\n * @doc {heading: 'Operations', subheading: 'Convolution'}\n */\nfunction conv3d_<T extends Tensor4D|Tensor5D>(\n x: T|TensorLike, filter: Tensor5D|TensorLike,\n strides: [number, number, number]|number, pad: 'valid'|'same',\n dataFormat: 'NDHWC'|'NCDHW' = 'NDHWC',\n dilations: [number, number, number]|number = [1, 1, 1]): T {\n const $x = convertToTensor(x, 'x', 'conv3d');\n const $filter =

convertToTensor(filter, 'filter', 'conv3d');\n\n let x5D = $x as Tensor5D;\n let reshapedTo5D = false;\n\n if ($x.rank === 4) {\n
    reshapedTo5D = true;\n   x5D = reshape($x, [1, $x.shape[0], $x.shape[1], $x.shape[2], $x.shape[3]]);\n }\n util.assert(\n   x5D.rank === 5,\n   () => `Error in conv3d: input must be rank 5, but got rank ${x5D.rank}.`);\n util.assert(\n $filter.rank === 5,\n   () => `Error in conv3d: filter must be rank 5, but got rank ` +\n   `${$filter.rank}.`);\n util.assert(\n   x5D.shape[4] === $filter.shape[3],\n   () => `Error in conv3d: depth of input (${x5D.shape[4]}) must match ` +\n   `input depth for filter ${$filter.shape[3]}.`);\n util.assert(\n   eitherStridesOrDilationsAreOne(strides, dilations),\n   () => 'Error in conv3D: Either strides or dilations must be 1. ' +\n   `Got strides ${strides} and dilations '${dilations}'`);\n util.assert(\n   dataFormat === 'NDHWC',\n   () => `Error in conv3d: got dataFormat of ${\n          dataFormat} but only NDHWC is currently supported.`);\n\n const inputs: Conv3DInputs = {x: x5D, filter:
  $filter};\n\n const attrs: Conv3DAttrs = {strides, pad, dataFormat, dilations};\n\n // tslint:disable-next-line: no-unnecessary-type-assertion\n const res = ENGINE.runKernel(\n   Conv3D, inputs as {} as NamedTensorMap,\n   attrs as {} as NamedAttrMap) as T;\n\n if (reshapedTo5D) {\n   return reshape(\n   res, [res.shape[1], res.shape[2], res.shape[3], res.shape[4]]) as\n   T;\n }\n return res;\n}\n\nexport const conv3d = op({conv3d_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND,
  either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n */\nimport {ENGINE} from '../engine';\nimport {Conv3DBackpropInputV2, Conv3DBackpropInputV2Attrs, Conv3DBackpropInputV2Inputs} from '../kernel_names';\nimport {NamedAttrMap} from '../kernel_registry';\nimport {Tensor4D, Tensor5D} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport * as util from '../util';\n\nimport {op} from './operation';\nimport {reshape} from './reshape';\n\n/**\n * Computes the derivative of the input of a 3D convolution.\n *\n * @param xShape The shape of the input: [batch, depth, height, width,\n * in_channels]. If length of 4, batch of 1 is assumed.\n * @param dy The derivative of the output, of rank 5 or rank 4 of shape\n *   `[batch, outDepth, outHeight, outWidth, in_channels]`.\n * If rank 4, batch of 1 is assumed.\n
 * @param filter The filter, rank 5, of shape\n *   `[filterDepth, filterHeight, filterWidth, inDepth, outDepth]`.\n * @param strides The strides of the convolution: `[strideDepth, strideHeight,\n * strideWidth]`.\n * @param pad The type of padding algorithm used:\n *   - `same` and stride 1: output will be of same size as input,\n *   regardless of filter size.\n *   - `valid`: output will be smaller than input if filter is larger\n *   than 1x1.\n */\nfunction conv3DBackpropInput_<T extends Tensor4D|Tensor5D>(\n   xShape:\n   [number, number, number, number,\n   number]|[number, number, number, number],\n   dy: T, filter: Tensor5D, strides: [number, number, number]|number,\n   pad: 'valid'|'same'): T {\n util.assert(\n   xShape.length === dy.rank,\n   () => `Length of inShape ` +\n   `(${xShape.length}) and rank of dy (${dy.rank}) must match`);\n\n let xShape5D = xShape as [number, number, number, number, number];\n let dy5D = dy as Tensor5D;\n
  let reshapedTo5D = false;\n if (dy.rank === 4) {\n   reshapedTo5D = true;\n   dy5D = reshape(dy, [1, dy.shape[0], dy.shape[1], dy.shape[2], dy.shape[3]]);\n   xShape5D = [1, xShape[0], xShape[1], xShape[2], xShape[3]];\n }\n\n const inDepth = xShape5D[4];\n const outDepth = dy5D.shape[4];\n util.assert(\n   xShape5D.length === 5,\n   () =>\n   `Error in conv3dDerInput: inShape must be length 5, but got length ` +\n   `${xShape5D.length}.`);\n util.assert(\n   dy5D.rank === 5,\n   () => `Error in conv3dDerInput: dy must be rank 5, but got ` +\n   `rank ${dy5D.rank}`);\n util.assert(\n   filter.rank === 5,\n   () => `Error in conv3dDerInput: filter must be rank 5, but got ` +\n   `rank ${filter.rank}`);\n util.assert(\n   inDepth === filter.shape[3],\n   () => `Error in conv3dDerInput: depth of input (${inDepth}) must ` +\n   `match input

depth for filter ${filter.shape[3]}.`);\n util.assert(\n   outDepth === filter.shape[4],\n
    () => `Error in conv3dDerInput: depth of output (${outDepth}) must ` +\n   `match output depth for filter ${filter.shape[4]}.`);\n\n const inputs: Conv3DBackpropInputV2Inputs = {dy: dy5D, filter};\n\n const attrs:\n Conv3DBackpropInputV2Attrs = {pad, strides, inputShape: xShape5D};\n\n // tslint:disable-next-line: no-unnecessary-type-assertion\n const res = ENGINE.runKernel(\n   Conv3DBackpropInputV2, inputs as {} as NamedTensorMap,\n   attrs as {} as NamedAttrMap) as T;\n\n if (reshapedTo5D) {\n   return reshape(\n   res, [res.shape[1], res.shape[2], res.shape[3], res.shape[4]]) as\n   T;\n }\n return res;\n}\n\nexport const conv3DBackpropInput = op({conv3DBackpropInput_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain
 a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
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*/\nimport {Tensor4D, Tensor5D} from '../tensor';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\n\nimport {conv3DBackpropInput} from './conv3d_backprop_input';\nimport {op} from './operation';\n\n/**\n * Computes the transposed 3D convolution of a volume, also known as a\n * deconvolution.\n *\n * @param x The input image, of rank 5 or rank 4, of shape\n *   `[batch, depth, height, width, inDepth]`. If rank 4, batch of 1 is assumed.\n * @param filter The
 filter, rank 4, of shape\n *   `[depth, filterHeight, filterWidth, outDepth, inDepth]`.\n *   `inDepth` must match `inDepth` in `x`.\n * @param outputShape Output shape, of rank 5 or rank 4:\n *   `[batch, depth, height, width, outDepth]`. If rank 3, batch of 1 is\n *   assumed.\n * @param strides The strides of the original convolution:\n *   `[strideDepth, strideHeight, strideWidth]`.\n * @param pad The type of padding algorithm used in the non-transpose version\n *   of the op.\n *\n * @doc {heading: 'Operations', subheading: 'Convolution'}\n */\nfunction conv3dTranspose_<T extends Tensor4D|Tensor5D>(\n   x: T|TensorLike, filter: Tensor5D|TensorLike,\n outputShape:\n   [number, number, number, number,\n   number]|[number, number, number, number],\n strides: [number, number, number]|number, pad: 'valid'|'same'): T {\n const $x = convertToTensor(x, 'x', 'conv3dTranspose');\n const $filter = convertToTensor(filter, 'filter', 'conv3dTranspose');\n\n return
 conv3DBackpropInput(outputShape, $x, $filter, strides, pad);\n}\n\nexport const conv3dTranspose = op({conv3dTranspose_});\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
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*/\n\nimport {ENGINE} from '../engine';\nimport {Cos, CosInputs} from '../kernel_names';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from
 '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\n\nimport {op} from './operation';\n\n/**\n * Computes cos of the input `tf.Tensor` element-wise: `cos(x)`\n *\n * ```js\n * const x = tf.tensor1d([0, Math.PI / 2, Math.PI * 3 / 4]);\n *\n * x.cos().print(); // or tf.cos(x)\n * ```\n * @param x The input tensor.\n *\n * @doc {heading: 'Operations', subheading: 'Basic math'}\n */\nfunction cos_<T extends Tensor>(x: T|TensorLike): T {\n const $x = convertToTensor(x, 'x', 'cos');\n\n const inputs: CosInputs = {x: $x};\n\n return ENGINE.runKernel(Cos, inputs as {} as NamedTensorMap);\n}\nexport const cos = op({cos_});\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the

License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n==========\n*/\n\nimport {ENGINE} from '../engine';\nimport {Cosh, CoshInputs} from '../kernel_names';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\n\nimport {op} from './operation';\n\n/**\n * Computes hyperbolic cos of the input `tf.Tensor` element-wise: `cosh(x)`\n *\n * ```js\n * const x = tf.tensor1d([0, 1, -1, .7]);\n *\n * x.cosh().print(); // or tf.cosh(x)\n * ```\n * @param x The input tensor.\n *\n * @doc {heading: 'Operations', subheading: 'Basic math'}\n */\nfunction cosh_<T extends Tensor>(x: T|TensorLike): T {\n const $x = convertToTensor(x, 'x', 'cosh');\n const inputs: CoshInputs = {x: $x};\n\n return ENGINE.runKernel(Cosh, inputs as {} as NamedTensorMap);\n}\nexport const cosh = op({cosh_});\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n==========\n*/\n\nimport {ENGINE} from '../engine';\nimport {Cumsum, CumsumAttrs, CumsumInputs} from '../kernel_names';\nimport {NamedAttrMap} from '../kernel_registry';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\n\nimport {op} from './operation';\n\n/**\n * Computes the cumulative sum of a `tf.Tensor` along `axis`.\n *\n * ```js\n * const x = tf.tensor([1, 2, 3, 4]);\n * x.cumsum().print();\n * ```\n * ```js\n * const x = tf.tensor([[1, 2], [3, 4]]);\n * x.cumsum().print();\n * ```\n *\n * @param x The input tensor to be summed.\n * @param axis The axis along which to sum. Optional. Defaults to 0.\n * @param exclusive Whether to perform exclusive cumulative sum. Optional.\n *   Defaults to false. If set to true then the sum of each tensor entry\n *   does not include its own value, but only the values previous to it\n *   along the specified axis.\n * @param reverse Whether to sum in the opposite direction. Optional.\n *   Defaults to false.\n *\n * @doc {heading: 'Operations', subheading: 'Scan'}\n */\nfunction cumsum_<T extends Tensor>(\n   x: Tensor|TensorLike, axis = 0, exclusive = false, reverse = false): T {\n const $x = convertToTensor(x, 'x', 'cumsum');\n\n const inputs: CumsumInputs = {x: $x};\n const attrs: CumsumAttrs = {axis, exclusive, reverse};\n\n return ENGINE.runKernel(\n   Cumsum, inputs as {} as NamedTensorMap, attrs as {} as NamedAttrMap);\n}\n\nexport const cumsum = op({cumsum_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT
WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n==========\n*/\n\nimport {ENGINE} from '../engine';\nimport {DenseBincount, DenseBincountAttrs, DenseBincountInputs} from '../kernel_names';\nimport {NamedAttrMap} from '../kernel_registry';\nimport {Tensor1D, Tensor2D} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from

'../tensor_util_env';\nimport {TensorLike} from '../types';\nimport * as util from '../util';\n\nimport {op} from './operation';\n\n/**\n * Outputs a vector with length `size` and the same dtype as `weights`.\n *\n * If `weights` are empty, then index `i` stores the number of times the value\n * `i` is counted in `x`. If `weights` are non-empty, then index `i` stores the\n * sum of the value in `weights` at each index where the corresponding value in\n * `x` is `i`.\n *\n * Values in `x` outside of the range [0, size) are ignored.\n *\n * @param x The input int tensor, rank 1 or rank 2.\n * @param weights The weights tensor, must have the same shape as x, or a\n * length-0 Tensor, in which case it acts as all weights equal to 1.\n * @param size Non-negative integer.\n * @param binaryOutput Optional. Whether the kernel should count the appearance\n * or number of occurrences. Defaults to False.\n *\n * @doc {heading: 'Operations', subheading: 'Reduction'}\n */\nfunction denseBincount_<T extends Tensor1D|Tensor2D>(\n x: T|TensorLike, weights: T|TensorLike, size: number,\n binaryOutput = false): T {\n const $x = convertToTensor(x, 'x', 'denseBincount');\n const $weights = convertToTensor(weights, 'weights', 'denseBincount');\n\n util.assert(\n $x.dtype === 'int32',\n () => `Error in denseBincount: input ` +\n `dtype must be int32, but got ${$x.dtype}`);\n util.assert($x.rank <= 2,\n () => `Error in denseBincount: input must be at most rank 2, but got ` +\n `rank ${$x.rank}.`);\n util.assert(size >= 0, () => `size must be non-negative, but got ${size}.`);\n util.assert(\n $weights.size === $x.size || $weights.size === 0,\n () =>\n `Error in denseBincount: weights must have the same shape as x or ` +\n `0-length, but got x shape: ${$x.shape}, weights shape: ` +\n `${$weights.shape}.`);\n\n const inputs: DenseBincountInputs = {x: $x, weights: $weights};\n const attrs: DenseBincountAttrs = {size, binaryOutput};\n\n return ENGINE.runKernel(\n DenseBincount, inputs as {} as NamedTensorMap,\n attrs as {} as NamedAttrMap);\n}\n\nexport const denseBincount = op({denseBincount_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ===\n */\n\nimport {ENGINE} from '../engine';\nimport {DepthToSpace, DepthToSpaceAttrs, DepthToSpaceInputs} from '../kernel_names';\nimport {NamedAttrMap} from '../kernel_registry';\nimport {Tensor4D} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike4D} from '../types';\nimport * as util from '../util';\n\nimport {op} from './operation';\n\n/**\n * Rearranges data from depth into blocks of spatial data. More specifically,\n * this op outputs a copy of the input tensor where values from the `depth`\n * dimension are moved in spatial blocks to the `height` and `width` dimensions.\n * The attr `blockSize` indicates the input block size and how the data is\n * moved.\n *\n * - Chunks of data of size `blockSize * blockSize` from depth are rearranged\n * into non-overlapping blocks of size `blockSize x blockSize`\n *\n * - The width the output tensor is `inputWidth * blockSize`, whereas the\n * height is `inputHeight * blockSize`\n *\n * - The Y, X coordinates within each block of the output image are determined\n * by the high order component of the input channel index\n *\n * - The depth of the input tensor must be divisible by `blockSize *\n * blockSize`\n *\n * The `dataFormat` attr specifies the layout of the input and output tensors\n * with the following options: \"NHWC\": [`batch, height, width, channels`]\n * \"NCHW\": [`batch, channels, height, width`]\n *\n * ```js\n * const x = tf.tensor4d([1, 2, 3, 4], [1, 1, 1, 4]);\n * const blockSize = 2;\n * const dataFormat = \"NHWC\";\n *\n * tf.depthToSpace(x, blockSize, dataFormat).print();\n * ```\n *\n * @param x The input tensor of rank 4\n * @param blockSIze An `int` that is `>= 2`. The size of the spatial block\n * @param dataFormat An optional string from: \"NHWC\", \"NCHW\". Defaults to \"NHWC\"\n *\n * @doc {heading: 'Tensors', subheading: 'Transformations'}\n */\nfunction depthToSpace_(\n x: Tensor4D|TensorLike4D, blockSize: number,\n dataFormat: 'NHWC'|'NCHW' = 'NHWC'): Tensor4D {\n const $x = convertToTensor(x, 'x', 'depthToSpace') as Tensor4D;\n\n const inputHeight = (dataFormat === 'NHWC') ? $x.shape[1] : $x.shape[2];\n const inputWidth = (dataFormat === 'NHWC') ?

$x.shape[2] : $x.shape[3];\n const inputDepth = (dataFormat === 'NHWC') ? $x.shape[3] : $x.shape[1];\n\n util.assert(\n   inputHeight * blockSize >= 0,\n   () => `Negative dimension size caused by overflow when multiplying\n    ${inputHeight} and ${blockSize}  for depthToSpace with input shape\n    ${$x.shape}`);\n\n util.assert(\n inputWidth * blockSize >= 0,\n   () => `Negative dimension size caused by overflow when multiplying\n ${inputWidth} and ${blockSize} for depthToSpace with input shape\n        ${$x.shape}`);\n\n util.assert(\n (inputDepth % (blockSize * blockSize) === 0),\n   () => `Dimension size must be evenly divisible by ${\n blockSize * blockSize} but is ${\n           inputDepth} for depthToSpace with input shape ${$x.shape}`);\n\n const inputs: DepthToSpaceInputs = {x: $x};\n const attrs: DepthToSpaceAttrs = {blockSize, dataFormat};\n\n return ENGINE.runKernel(\n   DepthToSpace, inputs as {} as NamedTensorMap,\n   attrs as {} as NamedAttrMap);\n}\n\nexport const depthToSpace = op({depthToSpace_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not
 use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n
*/\nimport {ENGINE} from '../engine';\nimport {DepthwiseConv2dNative, DepthwiseConv2dNativeAttrs, DepthwiseConv2dNativeInputs} from '../kernel_names';\nimport {NamedAttrMap} from '../kernel_registry';\nimport {Tensor3D, Tensor4D} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\nimport * as util from '../util';\n\nimport {op}
 from './operation';\nimport {reshape} from './reshape';\n\n/**\n * Depthwise 2D convolution.\n *\n * Given a 4D `input` array and a `filter` array of shape\n * `[filterHeight, filterWidth, inChannels, channelMultiplier]` containing\n * `inChannels` convolutional filters of depth 1, this op applies a\n * different filter to each input channel (expanding from 1 channel to\n * `channelMultiplier` channels for each), then concatenates the results\n * together. The output has `inChannels * channelMultiplier` channels.\n *\n * See\n * [https://www.tensorflow.org/api_docs/python/tf/nn/depthwise_conv2d](\n * https://www.tensorflow.org/api_docs/python/tf/nn/depthwise_conv2d)\n * for more details.\n *\n * @param x The input tensor, of rank 4 or rank 3, of shape\n *   `[batch, height, width, inChannels]`. If rank 3, batch of 1 is\n * assumed.\n * @param filter The filter tensor, rank 4, of shape\n *   `[filterHeight, filterWidth, inChannels, channelMultiplier]`.\n * @param strides The
 strides of the convolution: `[strideHeight,\n * strideWidth]`. If strides is a single number, then `strideHeight ==\n * strideWidth`.\n * @param pad The type of padding algorithm.\n *   - `same` and stride 1: output will be of same size as input,\n *   regardless of filter size.\n *   - `valid`: output will be smaller than input if filter is larger\n *   than 1x1.\n *   - For more info, see this guide:\n *   [https://www.tensorflow.org/api_guides/python/nn#Convolution](\n *   https://www.tensorflow.org/api_guides/python/nn#Convolution)\n * @param dilations The dilation rates: `[dilationHeight, dilationWidth]`\n *   in which we sample input values across the height and width dimensions\n *   in atrous convolution. Defaults to `[1, 1]`. If `rate` is a single\n *   number, then `dilationHeight == dilationWidth`. If it is greater than\n *   1, then all values of `strides` must be 1.\n * @param dataFormat: An optional string from: \"NHWC\", \"NCHW\". Defaults to\n
 *   \"NHWC\". Specify the data format of the input and output data. With the\n *   default format \"NHWC\", the data is stored in the order of: [batch,\n *   height, width, channels]. Only \"NHWC\" is currently supported.\n * @param dimRoundingMode A string from: 'ceil', 'round', 'floor'. If none is\n *   provided, it will default to truncate.\n *\n * @doc {heading: 'Operations', subheading: 'Convolution'}\n */\nfunction depthwiseConv2d_<T extends Tensor3D|Tensor4D>(\n   x: T|TensorLike, filter: Tensor4D|TensorLike,\n   strides: [number,

number]|number, pad: 'valid'|'same'|number,\n dataFormat: 'NHWC'|'NCHW' = 'NHWC',\n dilations: [number, number]|number = [1, 1],\n dimRoundingMode?: 'floor'|'round'|'ceil'): T {\n const $x = convertToTensor(x, 'x', 'depthwiseConv2d');\n const $filter = convertToTensor(filter, 'filter', 'depthwiseConv2d');\n\n let x4D = $x as Tensor4D;\n let reshapedTo4D = false;\n if ($x.rank === 3) {\n   reshapedTo4D = true;\n   x4D = reshape($x, [1, $x.shape[0], $x.shape[1], $x.shape[2]]);\n }\n util.assert(\n   x4D.rank === 4,\n   () => `Error in depthwiseConv2d: input must be rank 4, but got ` +\n   `rank ${x4D.rank}.`);\n util.assert(\n $filter.rank === 4,\n   () => `Error in depthwiseConv2d: filter must be rank 4, but got rank ` +\n   `${$filter.rank}.`);\n util.assert(\n   x4D.shape[3] === $filter.shape[2],\n   () => `Error in depthwiseConv2d: number of input channels ` +\n   `(${x4D.shape[3]}) must match the inChannels dimension in ` +\n   `filter ${$filter.shape[2]}.`);\n\n if (dimRoundingMode != null) {\n   util.assert(\n   util.isInt(pad as number),\n   () => `Error in depthwiseConv2d: pad must be an integer when using, ` +\n   `dimRoundingMode ${dimRoundingMode} but got pad ${pad}.`);\n }\n\n const inputs: DepthwiseConv2dNativeInputs = {x: x4D, filter: $filter};\n const attrs: DepthwiseConv2dNativeAttrs =\n   {strides, pad, dataFormat, dilations, dimRoundingMode};\n\n // tslint:disable-next-line: no-unnecessary-type-assertion\n const res = ENGINE.runKernel(\n   DepthwiseConv2dNative, inputs as {} as NamedTensorMap,\n   attrs as {} as NamedAttrMap) as T;\n\n if (reshapedTo4D) {\n   return reshape(res, [res.shape[1], res.shape[2], res.shape[3]]) as T;\n }\n return res;\n}\n\nexport const depthwiseConv2d = op({depthwiseConv2d_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {ENGINE} from '../engine';\nimport {Diag, DiagInputs} from '../kernel_names';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\n\nimport {op} from './operation';\n\n/**\n * Returns a diagonal tensor with a given diagonal values.\n *\n * Given a diagonal, this operation returns a tensor with the diagonal and\n * everything else padded with zeros.\n *\n * Assume the input has dimensions `[D1,..., Dk]`, then the output is a tensor\n * of rank 2k with dimensions `[D1,..., Dk, D1,..., Dk]`\n *\n * ```js\n * const x = tf.tensor1d([1, 2, 3, 4]);\n *\n * tf.diag(x).print()\n * ```\n * ```js\n * const x = tf.tensor1d([1, 2, 3, 4, 5, 6, 6, 8], [4, 2])\n *\n * tf.diag(x).print()\n * ```\n * @param x The input tensor.\n */\nfunction diag_(x: Tensor): Tensor {\n const $x = convertToTensor(x, 'x', 'diag');\n\n const inputs: DiagInputs = {x: $x};\n\n return ENGINE.runKernel(Diag, inputs as {} as NamedTensorMap);\n}\n\nexport const diag = op({diag_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {ENGINE} from '../engine';\nimport {Dilation2D, Dilation2DAttrs, Dilation2DInputs} from '../kernel_names';\nimport {NamedAttrMap} from '../kernel_registry';\nimport {Tensor3D, Tensor4D} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\nimport * as util from '../util';\n\nimport {op} from './operation';\nimport {reshape} from './reshape';\n\n/**\n * Computes the grayscale dilation over the input `x`.\n *\n * @param x The input tensor, rank 3 or rank 4 of shape\n *   `[batch, height, width, inChannels]`. If rank 3, batch

of 1 is assumed.\n * @param filter The filter tensor, rank 3, of shape\n * `[filterHeight, filterWidth, depth]`.\n * @param strides The strides of the sliding window for each dimension of the\n * input tensor: `[strideHeight, strideWidth]`.\n * If `strides` is a single number,\n * then `strideHeight == strideWidth`.\n * @param pad The type of padding algorithm.\n * - `same` and stride 1: output
will be of same size as input,\n * regardless of filter size.\n * - `valid`: output will be smaller than input if filter is larger\n * than 1*1x1.\n * - For more info, see this guide:\n * [https://www.tensorflow.org/api_guides/python/nn#Convolution](\n * https://www.tensorflow.org/api_guides/python/nn#Convolution)\n * @param dataFormat Specify the data format of the input and output data.\n * Defaults to 'NHWC'. Only 'NHWC' is currently supported. With the\n * default format \"NHWC\", the data is stored in the order of: [batch,\n * height, width, channels].\n * @param dilations The dilation rates: `[dilationHeight, dilationWidth]`\n * in which we sample input values across the height and width dimensions\n * for atrous morphological dilation. Defaults to `[1, 1]`. If `dilations`\n * is a single number, then `dilationHeight == dilationWidth`. If it is\n * greater than 1, then all values of `strides` must be 1.\n *\n * @doc
{heading: 'Operations', subheading: 'Convolution'}\n */\nfunction dilation2d_<T extends Tensor3D|Tensor4D>(\n x: T|TensorLike, filter: Tensor3D|TensorLike,\n strides: [number, number]|number, pad: 'valid'|'same',\n dilations: [number, number]|number = [1, 1],\n dataFormat: 'NHWC' = 'NHWC'): T {\n const $x = convertToTensor(x, 'x', 'dilation2d');\n const $filter = convertToTensor(filter, 'filter', 'dilation2d');\n\n util.assert(\n $x.rank === 3 || $x.rank === 4,\n () => `Error in dilation2d: input must be rank 3 or 4, but got rank ` +\n `${$x.rank}.`);\n util.assert(\n $filter.rank === 3,\n () => `Error in dilation2d: filter must be rank 3, but got rank ` +\n `${$filter.rank}.`);\n util.assert(\n dataFormat === 'NHWC',\n () => `Error in dilation2d: Only NHWC is currently supported, ` +\n `but got dataFormat of ${dataFormat}`);\n\n let x4D = $x as Tensor4D;\n let reshapedTo4D = false;\n\n if ($x.rank === 3) {\n x4D = reshape($x, [1, $x.shape[0], $x.shape[1], $x.shape[2]]);\n reshapedTo4D = true;\n }\n\n const inputs: Dilation2DInputs = {x: x4D, filter: $filter};\n const attrs: Dilation2DAttrs = {strides, pad, dilations};\n\n // tslint:disable-next-line: no-unnecessary-type-assertion\n const res = ENGINE.runKernel(\n Dilation2D, inputs as {} as NamedTensorMap,\n attrs as {} as NamedAttrMap) as T;\n\n if (reshapedTo4D) {\n return reshape(res, [res.shape[1], res.shape[2], res.shape[3]]) as T;\n }\n\n return res;\n}\n\nexport const dilation2d = op({dilation2d_});\n","/**\n * @license\n * Copyright 2017 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed
under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n */\n\n/**\n * Returns the dimensions in the input shape that are broadcasted to\n * produce the provided output shape.\n *\n * The returned dimensions are 0-indexed and sorted. An example:\n * inShape = [4, 1, 3]\n * outShape = [5, 4, 3, 3]\n * result = [1]. Dimension 1 (2nd dimension of input) gets broadcasted 1 => 3.\n */\nexport function getBroadcastDims(\n inShape: number[], outShape: number[]): number[] {\n const inRank = inShape.length;\n const dims: number[] = [];\n for (let i = 0; i < inRank; i++) {\n const dim = inRank - 1 - i;\n const a = inShape[dim] || 1;\n const b = outShape[outShape.length - 1 - i] || 1;\n if (b > 1 && a === 1)
{\n dims.unshift(dim);\n }\n }\n return dims;\n}\n\n/**\n * Returns the axes in the output space that should be reduced to produce\n * the input space.\n */\nexport function getReductionAxes(\n inShape: number[], outShape: number[]): number[] {\n const result: number[] = [];\n for (let i = 0; i < outShape.length; i++) {\n const inDim = inShape[inShape.length - i - 1];\n const outAxis = outShape.length - i - 1;\n const outDim = outShape[outAxis];\n if (inDim == null || (inDim === 1 && outDim > 1)) {\n result.unshift(outAxis);\n }\n }\n return result;\n}\n\nexport function assertAndGetBroadcastShape(\n shapeA: number[], shapeB: number[]):

number[] {\n const result: number[] = [];\n const l = Math.max(shapeA.length, shapeB.length);\n\n for (let i = 0; i < l; i++) {\n   let a = shapeA[shapeA.length - i - 1];\n   if (a == null) {\n   a = 1;\n   }\n   let b = shapeB[shapeB.length - i - 1];\n   if (b == null) {\n   b = 1;\n   }\n   if (a === 1) {\n   result.unshift(b);\n   } else if (b === 1) {\n   result.unshift(a);\n   } else if (a !== b) {\n   const errMsg = `Operands could not be broadcast together with shapes ` +\n   `${shapeA} and ${shapeB}.`;\n   throw Error(errMsg);\n   } else {\n   result.unshift(a);\n   }\n }\n return result;\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==\n */\nimport {ENGINE} from '../engine';\nimport {Equal, EqualInputs} from '../kernel_names';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {makeTypesMatch} from '../tensor_util';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\n\nimport {assertAndGetBroadcastShape} from './broadcast_util';\nimport {op} from './operation';\n\n/**\n * Returns the truth value of (a == b) element-wise. Supports broadcasting.\n *\n * ```js\n * const a = tf.tensor1d([1, 2, 3]);\n * const b = tf.tensor1d([2, 2, 2]);\n *\n * a.equal(b).print();\n * ```\n *\n * @param a The first input tensor.\n * @param b The second input tensor. Must have the same dtype as `a`.\n *\n * @doc {heading: 'Operations', subheading: 'Logical'}\n */\nfunction equal_<T extends Tensor>(\n   a: Tensor|TensorLike, b: Tensor|TensorLike): T {\n let $a = convertToTensor(a, 'a', 'equal');\n let $b = convertToTensor(b, 'b', 'equal');\n [$a, $b] = makeTypesMatch($a, $b);\n\n assertAndGetBroadcastShape($a.shape, $b.shape);\n\n const inputs: EqualInputs = {a: $a, b: $b};\n\n return ENGINE.runKernel(Equal, inputs as {} as NamedTensorMap);\n}\n\nexport const equal = op({equal_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==\n */\n\nimport {ENGINE} from '../engine';\nimport {Select, SelectInputs} from '../kernel_names';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\nimport {assert, assertShapesMatch} from '../util';\n\nimport {broadcastTo} from './broadcast_to';\nimport {assertAndGetBroadcastShape} from './broadcast_util';\nimport {op} from './operation';\n\n/**\n * Returns the elements, either `a` or `b` depending on the `condition`.\n *\n * If the condition is true, select from `a`, otherwise select from `b`.\n *\n * ```js\n * const cond = tf.tensor1d([false, false, true], 'bool');\n * const a = tf.tensor1d([1 , 2, 3]);\n * const b = tf.tensor1d([-1, -2, -3]);\n *\n * a.where(cond, b).print();\n * ```\n *\n * @param condition The input condition. Must be of dtype bool.\n * @param a If `condition` is rank 1, `a` may have a higher rank but\n *   its first dimension must match the size of `condition`.\n * @param b A tensor with the same dtype as `a` and with shape that is\n * compatible with `a`.\n * @return A tensor with same dtype as `a` and `b`, and shape that is\n *   broadcastable from `a` and `b`.\n *\n * @doc {heading: 'Operations', subheading: 'Logical'}\n */\nfunction where_<T extends Tensor>(\n   condition: Tensor|TensorLike, a: T|TensorLike, b: T|TensorLike): T {\n const $a = convertToTensor(a, 'a', 'where');\n const $b = convertToTensor(b, 'b', 'where');\n const $condition = convertToTensor(condition, 'condition', 'where', 'bool');\n // TODO: move this logic to forward function when the broadcastTo op is\n // implemented in WASM.\n // Find the broadcastable shape for $a and $b.\n const

broadcastShape = assertAndGetBroadcastShape($a.shape, $b.shape);\n const $broadcastedA = broadcastTo($a, broadcastShape);\n const $broadcastedB = broadcastTo($b, broadcastShape);\n if ($condition.rank === 1) {\n   // If condition rank is
1, then the first dimension must match the size of\n   // condition.\n   assert(\n $condition.shape[0] === $a.shape[0],\n   () => 'The first dimension of `a` must match the size of `condition`.');\n }\n\n if ($condition.rank !== 1) {\n   // A must have the same shape as condition.\n   assertShapesMatch(\n $condition.shape, $broadcastedB.shape, 'Error in where: ');\n }\n\n const inputs: SelectInputs = {\n   condition: $condition,\n   t: $broadcastedA,\n   e: $broadcastedB\n };\n return ENGINE.runKernel(Select, inputs as unknown as NamedTensorMap);\n}\n\nexport const where = op({where_});\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing,
software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {ENGINE} from '../engine';\nimport {ZerosLike, ZerosLikeInputs} from '../kernel_names';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\n\nimport {op} from './operation';\n\n/**\n * Creates a `tf.Tensor` with all elements set to 0 with the same shape as the\n * given tensor.\n *\n * ```js\n * const x = tf.tensor([1, 2]);\n * tf.zerosLike(x).print();\n * ```\n *\n * @param x The tensor of required shape.\n *\n * @doc {heading: 'Tensors', subheading: 'Creation'}\n */\nfunction zerosLike_<T extends Tensor>(x:
T|TensorLike): T {\n const $x = convertToTensor(x, 'x', 'zerosLike');\n const inputs: ZerosLikeInputs = {x: $x};\n return ENGINE.runKernel(ZerosLike, inputs as {} as NamedTensorMap);\n}\nexport const zerosLike = op({zerosLike_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {Tensor} from '../tensor';\nimport
{makeTypesMatch} from '../tensor_util';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\n\nimport {div} from './div';\nimport {equal} from './equal';\nimport {op} from './operation';\nimport {where} from './where';\nimport {zerosLike} from './zeros_like';\n\n/**\n * Divides two `tf.Tensor`s element-wise, A / B. Supports broadcasting. Return 0\n * if denominator is 0.\n *\n *\n * ```js\n * const a = tf.tensor1d([1, 4, 9, 16]);\n * const b = tf.tensor1d([1, 2, 3, 4]);\n * const c = tf.tensor1d([0, 0, 0, 0]);\n *\n * a.divNoNan(b).print(); // or tf.divNoNan(a, b)\n * a.divNoNan(c).print(); // or tf.divNoNan(a, c)\n * ```\n *\n * ```js\n * // Broadcast div a with b.\n * const a = tf.tensor1d([2, 4, 6, 8]);\n * const b = tf.scalar(2);\n * const c = tf.scalar(0);\n *\n * a.divNoNan(b).print(); // or tf.divNoNan(a, b)\n * a.divNoNan(c).print(); // or tf.divNoNan(a, c)\n * ```\n *\n * @param a The first tensor as the numerator.\n * @param b
The second tensor as the denominator. Must have the same dtype as\n * `a`.\n *\n * @doc {heading: 'Operations', subheading: 'Arithmetic'}\n */\nfunction divNoNan_<T extends Tensor>(\n   a: Tensor|TensorLike, b:
Tensor|TensorLike): T {\n // TODO: Make this into its own kernel.\n let $a = convertToTensor(a, 'a', 'div');\n let $b = convertToTensor(b, 'b', 'div');\n [$a, $b] = makeTypesMatch($a, $b);\n\n const divResult = div($a, $b);\n const zeros = zerosLike(divResult);\n const bEqualsZero = equal($b, zeros);\n return where(bEqualsZero, zeros, divResult) as T;\n}\n\nexport const divNoNan = op({divNoNan_});\n","/**\n * @license\n * Copyright 2020

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 * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n
*/\n\nimport {Tensor,} from '../tensor';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\nimport * as util from '../util';\n\nimport {matMul} from './mat_mul';\nimport {op} from './operation';\nimport {reshape} from './reshape';\n\n/**\n * Computes the dot product of two matrices and/or vectors, `t1` and `t2`.\n *\n * ```js\n * const a = tf.tensor1d([1, 2]);\n * const b = tf.tensor2d([[1, 2], [3, 4]]);\n * const c = tf.tensor2d([[1, 2, 3], [4, 5, 6]]);\n *\n * a.dot(b).print(); // or tf.dot(a, b)\n * b.dot(a).print();\n * b.dot(c).print();\n * ```\n * @param t1 The first tensor in the dot operation.\n *
 @param t2 The second tensor in the dot operation.\n *\n * @doc {heading: 'Operations', subheading: 'Matrices'}\n */\nfunction dot_(t1: Tensor|TensorLike, t2: Tensor|TensorLike): Tensor {\n const $t1 = convertToTensor(t1, 't1', 'dot');\n const $t2 = convertToTensor(t2, 't2', 'dot');\n\n util.assert(\n   ($t1.rank === 1 || $t1.rank === 2) && ($t2.rank === 1 || $t2.rank === 2),\n   () => `Error in dot: inputs must all be rank 1 or 2, but got ranks ` +\n `${$t1.rank} and ${$t2.rank}.`);\n\n const t1Inner = ($t1.rank === 1 ? $t1.size : $t1.shape[1]);\n const t2Inner = ($t2.rank === 1 ? $t2.size : $t2.shape[0]);\n\n util.assert(\n   t1Inner === t2Inner,\n   () => `Error in dot: inner dimensions of inputs must match, but got ` +\n   `${t1Inner} and ${t2Inner}.`);\n\n if ($t1.rank === 1 && $t2.rank === 1) {\n   const t12D = reshape($t1, [1, -1]);\n   const t22D = reshape($t2, [-1, 1]);\n   const t1t2 = matMul(t12D, t22D);\n   return reshape(t1t2, []);\n
 } else if ($t1.rank === 1 && $t2.rank === 2) {\n   const t12D = reshape($t1, [1, -1]);\n   const t22D = reshape($t2, [$t2.shape[0], $t2.shape[1]]);\n   const t1t2 = matMul(t12D, t22D);\n   return reshape(t1t2, [t1t2.size]);\n } else if ($t1.rank === 2 && $t2.rank === 1) {\n   const t22D = reshape($t2, [-1, 1]);\n   const t1t2 = matMul($t1, t22D);\n
 return reshape(t1t2, [t1t2.size]);\n } else {\n   const t22D = reshape($t2, [$t2.shape[0], $t2.shape[1]]);\n   const t1t2 = matMul($t1, t22D);\n   return t1t2;\n }\n}\n\nexport const dot = op({dot_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on
 an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n
*/\n\nimport {ENGINE} from '../engine';\nimport {Elu, EluInputs} from '../kernel_names';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\n\nimport {op} from './operation';\n\n/**\n * Computes exponential linear element-wise: `x > 0 ? e ^ x - 1 : 0`.\n *\n * ```js\n * const x = tf.tensor1d([-1, 1, -3, 2]);\n *\n * x.elu().print(); // or tf.elu(x)\n * ```\n * @param x The input tensor.\n *\n * @doc {heading: 'Operations', subheading: 'Basic math'}\n */\nfunction elu_<T extends Tensor>(x: T|TensorLike): T {\n const $x = convertToTensor(x, 'x', 'elu');\n\n const inputs: EluInputs
 = {x: $x};\n\n return ENGINE.runKernel(Elu, inputs as {} as NamedTensorMap);\n}\n\nexport const elu = op({elu_});\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed

on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {ENGINE} from '../engine';\nimport {Erf, ErfInputs} from '../kernel_names';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\nimport * as util from '../util';\n\nimport {cast} from './cast';\nimport {op} from './operation';\n\n/**\n * Computes gause error function of the input `tf.Tensor` element-wise:\n * `erf(x)`\n *\n * ```js\n * const x = tf.tensor1d([0, .1, -.1, .7]);\n *\n * x.erf().print(); // or tf.erf(x);\n * ```\n * @param x The input tensor.\n *\n * @doc {heading: 'Operations', subheading: 'Basic math'}\n */\nfunction erf_<T extends Tensor>(x: T|TensorLike): T {\n let $x = convertToTensor(x, 'x', 'erf');\n util.assert(\n $x.dtype === 'int32' || $x.dtype === 'float32',\n   () => 'Input dtype must be `int32` or `float32`.');\n\n if ($x.dtype === 'int32') {\n $x = cast($x, 'float32');\n }\n\n const inputs: ErfInputs = {x: $x};\n return ENGINE.runKernel(Erf, inputs as {} as NamedTensorMap);\n}\nexport const erf = op({erf_});\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {ENGINE} from '../engine';\nimport {Exp, ExpInputs} from '../kernel_names';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\n\nimport {op} from './operation';\n\n/**\n * Computes exponential of the input `tf.Tensor` element-wise. `e ^ x`\n *\n * ```js\n * const x = tf.tensor1d([1, 2, -3]);\n *\n * x.exp().print(); // or tf.exp(x)\n * ```\n * @param x The input tensor.\n *\n * @doc {heading: 'Operations', subheading: 'Basic math'}\n */\nfunction exp_<T extends Tensor>(x: T|TensorLike): T {\n const $x = convertToTensor(x, 'x', 'exp');\n\n const inputs: ExpInputs = {x: $x};\n return ENGINE.runKernel(Exp, inputs as {} as NamedTensorMap);\n}\nexport const exp = op({exp_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {ENGINE} from '../engine';\nimport {ExpandDims, ExpandDimsAttrs, ExpandDimsInputs} from '../kernel_names';\nimport {NamedAttrMap} from '../kernel_registry';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\nimport * as util from '../util';\n\nimport {op} from './operation';\n\n/**\n * Returns a `tf.Tensor` that has expanded rank, by inserting a dimension\n * into the tensor's shape.\n *\n * ```js\n * const x = tf.tensor1d([1, 2, 3, 4]);\n * const axis = 1;\n * x.expandDims(axis).print();\n * ```\n *\n * @param x The input tensor whose dimensions to be expanded.\n * @param axis The dimension index at which to insert shape of `1`. Defaults\n *

to 0 (the first dimension).\n *\n * @doc {heading: 'Tensors', subheading: 'Transformations'}\n */\nfunction expandDims_<T extends Tensor>(x: Tensor|TensorLike, axis = 0): T {\n const $x = convertToTensor(x, 'x', 'expandDims', 'string_or_numeric');\n\n util.assert(axis <= $x.rank, () => 'Axis must be <= rank of the tensor');\n\n const inputs: ExpandDimsInputs = {input: $x};\n const attrs: ExpandDimsAttrs = {dim: axis};\n\n return ENGINE.runKernel(\n   ExpandDims, inputs as {} as NamedTensorMap, attrs as {} as NamedAttrMap);\n}\n\nexport const expandDims = op({expandDims_});\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the
License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {ENGINE} from '../engine';\nimport {Expm1, Expm1Inputs} from '../kernel_names';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\n\nimport {op} from './operation';\n\n/**\n * Computes exponential of the input `tf.Tensor` minus one element-wise.\n * `e ^ x - 1`\n *\n * ```js\n * const x = tf.tensor1d([1, 2, -3]);\n *\n * x.expm1().print(); // or tf.expm1(x)\n * ```\n * @param x The input tensor.\n *\n * @doc {heading: 'Operations', subheading: 'Basic math'}\n */\nfunction expm1_<T extends Tensor>(x: T|TensorLike): T {\n const $x = convertToTensor(x,
'x', 'expm1');\n\n const inputs: Expm1Inputs = {x: $x};\n return ENGINE.runKernel(Expm1, inputs as {} as NamedTensorMap);\n}\nexport const expm1 = op({expm1_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {ENGINE} from '../engine';\nimport {Tile, TileAttrs, TileInputs} from '../kernel_names';\nimport
{NamedAttrMap} from '../kernel_registry';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\nimport * as util from '../util';\n\nimport {op} from './operation';\n\n/**\n * Construct a tensor by repeating it the number of times given by reps.\n *\n * This operation creates a new tensor by replicating `input` `reps`\n * times. The output tensor's i'th dimension has `input.shape[i] *\n * reps[i]` elements, and the values of `input` are replicated\n * `reps[i]` times along the i'th dimension. For example, tiling\n * `[a, b, c, d]` by `[2]` produces `[a, b, c, d, a, b, c, d]`.\n *\n * ```js\n * const a = tf.tensor1d([1, 2]);\n *\n * a.tile([2]).print();   // or a.tile([2])\n * ```\n *\n * ```js\n * const a = tf.tensor2d([1, 2, 3, 4], [2, 2]);\n *\n * a.tile([1, 2]).print(); // or a.tile([1, 2])\n * ```\n * @param x The tensor to tile.\n * @param reps Determines
the number of replications per dimension.\n *\n * @doc {heading: 'Tensors', subheading: 'Slicing and Joining'}\n */\nfunction tile_<T extends Tensor>(x: T|TensorLike, reps: number[]): T {\n const $x = convertToTensor(x, 'x', 'tile', 'string_or_numeric');\n util.assert(\n $x.rank === reps.length,\n   () => `Error in transpose: rank of input ${$x.rank} ` +\n   `must match length of reps ${reps}.`);\n\n const inputs: TileInputs = {x: $x};\n const attrs: TileAttrs = {reps};\n\n return ENGINE.runKernel(\n   Tile, inputs as unknown as NamedTensorMap,\n   attrs as unknown as NamedAttrMap);\n}\n\nexport const tile = op({tile_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n *

http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {Tensor2D} from '../tensor';\nimport {DataType} from '../types';\n\nimport {buffer} from './buffer';\nimport {expandDims} from './expand_dims';\nimport {op} from './operation';\nimport {reshape} from './reshape';\nimport {tile} from './tile';\n\n/**\n * Create an identity matrix.\n *\n * @param numRows Number of rows.\n * @param numColumns Number of columns. Defaults to `numRows`.\n * @param batchShape If provided, will add the batch shape to the beginning\n * of the shape of the returned `tf.Tensor` by repeating the identity\n * matrix.\n * @param dtype Data type.\n * @returns Identity matrix of the specified size and data type, possibly\n * with batch repetition if `batchShape` is specified.\n *\n * @doc {heading: 'Tensors', subheading: 'Creation'}\n */\nfunction eye_(\n numRows: number, numColumns?: number,\n batchShape?:\n [\n number\n]|[number,\n number]|[number, number, number]|[number, number, number, number],\n dtype: DataType = 'float32'): Tensor2D {\n if (numColumns == null) {\n numColumns = numRows;\n }\n const buff = buffer([numRows, numColumns], dtype);\n const n = numRows <= numColumns ? numRows : numColumns;\n for (let i = 0; i < n; ++i) {\n buff.set(1, i, i);\n }\n const out: Tensor2D = reshape(buff.toTensor(), [numRows, numColumns]);\n if (batchShape == null) {\n return out;\n } else {\n if (batchShape.length === 1) {\n return tile(expandDims(out, 0), [batchShape[0], 1, 1]) as Tensor2D;\n } else if (batchShape.length === 2) {\n // tslint:disable-next-line:no-unnecessary-type-assertion\n return tile(\n expandDims(expandDims(out, 0), 0),\n [batchShape[0], batchShape[1], 1, 1]) as Tensor2D;\n } else if (batchShape.length === 3) {\n // tslint:disable-next-line:no-unnecessary-type-assertion\n return tile(expandDims(expandDims(expandDims(out, 0), 0), 0), [\n batchShape[0], batchShape[1], batchShape[2], 1, 1\n]) as Tensor2D;\n } else {\n throw new Error(\n `eye() currently supports only 1D and 2D ` +\n // tslint:disable-next-line:no-any\n `batchShapes, but received ${(batchShape as any).length}D.`);\n }\n }\n}\n\nexport const eye = op({eye_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {ENGINE} from '../engine';\nimport {Fill, FillAttrs} from '../kernel_names';\nimport {NamedAttrMap} from '../kernel_registry';\nimport {Tensor} from '../tensor';\nimport {DataType, Rank, ShapeMap} from '../types';\n\n/**\n * Creates a `tf.Tensor` filled with a scalar value.\n *\n * ```js\n * tf.fill([2, 2], 4).print();\n * ```\n *\n * @param shape An array of integers defining the output tensor shape.\n * @param value The scalar value to fill the tensor with.\n * @param dtype The type of an element in the resulting tensor. Defaults to\n * 'float'.\n *\n * @doc {heading: 'Tensors', subheading: 'Creation'}\n */\nfunction fill<R extends Rank>(\n shape: ShapeMap[R], value: number|string, dtype?: DataType): Tensor<R> {\n const attrs: FillAttrs = {shape, value, dtype};\n\n return ENGINE.runKernel(Fill, {}, attrs as {} as NamedAttrMap);\n}\n\nexport {fill};\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *

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 */\nimport {ENGINE} from '../engine';\nimport {Floor, FloorInputs} from '../kernel_names';\nimport {Tensor}
from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from
'../tensor_util_env';\nimport {TensorLike} from '../types';\n\nimport {op} from './operation';\n\n/**\n * Computes
floor of input `tf.Tensor` element-wise: `floor(x)`.\n *\n * ```js\n * const x = tf.tensor1d([.6, 1.1, -3.3]);\n *\n *
x.floor().print();  // or tf.floor(x)\n * ```\n * @param x The input tensor.\n *\n * @doc {heading: 'Operations',
subheading: 'Basic math'}\n */\nfunction floor_<T extends Tensor>(x: T|TensorLike): T {\n  const $x =
convertToTensor(x, 'x', 'floor');\n\n  const inputs: FloorInputs = {x: $x};\n  return ENGINE.runKernel(Floor, inputs
as {} as NamedTensorMap);\n}\nexport const floor = op({floor_});\n","/**\n * @license\n * Copyright 2018
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http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing,
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OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language
governing permissions and\n * limitations under the License.\n *
=============================================================================\n
*/\n\nimport {ENGINE} from '../engine';\nimport {GatherV2, GatherV2Attrs, GatherV2Inputs} from
'../kernel_names';\nimport {NamedAttrMap} from '../kernel_registry';\nimport {Tensor} from '../tensor';\nimport
{NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport
{TensorLike} from '../types';\n\nimport {op} from './operation';\n\n/**\n * Gather slices from tensor `x`'s axis `axis`
according
 to `indices`.\n *\n * ```js\n * const x = tf.tensor1d([1, 2, 3, 4]);\n * const indices = tf.tensor1d([1, 3, 3], 'int32');\n *\n
* x.gather(indices).print();\n * ```\n *\n * ```js\n * const x = tf.tensor2d([1, 2, 3, 4], [2, 2]);\n * const indices =
tf.tensor1d([1, 1, 0], 'int32');\n *\n * x.gather(indices).print();\n * ```\n * @param x The input tensor whose slices to
be gathered.\n * @param indices The indices of the values to extract.\n * @param axis The axis over which to select
values. Defaults to 0.\n * @param batchDims Optional. The number of batch dimensions. It must be less\n *     than
or equal to rank(indices). Defaults to 0.\n *     The output tensor will have shape of\n *     `x.shape[:axis] +
indices.shape[batchDims:] + x.shape[axis + 1:]`\n *\n * @doc {heading: 'Tensors', subheading: 'Slicing and
Joining'}\n */\nfunction gather_<T extends Tensor>(\n    x: T|TensorLike, indices: Tensor|TensorLike, axis = 0,
batchDims = 0): T {\n  const $x = convertToTensor(x, 'x',
 'gather');\n  const $indices = convertToTensor(indices, 'indices', 'gather', 'int32');\n\n  const inputs: GatherV2Inputs
= {x: $x, indices: $indices};\n  const attrs: GatherV2Attrs = {axis, batchDims};\n\n  return ENGINE.runKernel(\n
GatherV2, inputs as {} as NamedTensorMap, attrs as {} as NamedAttrMap);\n}\n\nexport const gather =
op({gather_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the
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on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or
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License.\n *
=============================================================================\n
 */\nimport {ENGINE} from '../engine';\nimport {Greater, GreaterInputs} from '../kernel_names';\nimport {Tensor}
from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {makeTypesMatch} from
'../tensor_util';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\n\nimport
{assertAndGetBroadcastShape} from './broadcast_util';\nimport {op} from './operation';\n\n/**\n * Returns the truth
value of (a > b) element-wise. Supports broadcasting.\n *\n * ```js\n * const a = tf.tensor1d([1, 2, 3]);\n * const b =
tf.tensor1d([2, 2, 2]);\n *\n * a.greater(b).print();\n * ```\n *\n * @param a The first input tensor.\n * @param b The
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second input tensor. Must have the same dtype as `a`.\n *\n * @doc {heading: 'Operations', subheading: 'Logical'}\n */\nfunction greater_<T extends Tensor>(\n a: Tensor|TensorLike, b: Tensor|TensorLike): T {\n let $a = convertToTensor(a,
'a', 'greater');\n let $b = convertToTensor(b, 'b', 'greater');\n [$a, $b] = makeTypesMatch($a, $b);\n\n assertAndGetBroadcastShape($a.shape, $b.shape);\n\n const inputs: GreaterInputs = {a: $a, b: $b};\n\n return ENGINE.runKernel(Greater, inputs as {} as NamedTensorMap);\n}\n\nexport const greater = op({greater_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\nimport {ENGINE} from '../engine';\nimport {GreaterEqual, GreaterEqualInputs} from '../kernel_names';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {makeTypesMatch} from '../tensor_util';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\n\nimport {assertAndGetBroadcastShape} from './broadcast_util';\nimport {op} from './operation';\n\n/**\n * Returns the truth value of (a >= b) element-wise. Supports broadcasting.\n *\n * ```js\n * const a = tf.tensor1d([1, 2, 3]);\n * const b = tf.tensor1d([2, 2, 2]);\n *\n * a.greaterEqual(b).print();\n * ```\n *\n * @param a The first input tensor.\n * @param b The second input tensor. Must have the same dtype as `a`.\n *\n * @doc {heading: 'Operations', subheading: 'Logical'}\n */\nfunction greaterEqual_<T extends Tensor>(\n a: Tensor|TensorLike, b: Tensor|TensorLike): T {\n let $a = convertToTensor(a, 'a',
'greaterEqual');\n let $b = convertToTensor(b, 'b', 'greaterEqual');\n [$a, $b] = makeTypesMatch($a, $b);\n\n assertAndGetBroadcastShape($a.shape, $b.shape);\n\n const inputs: GreaterEqualInputs = {a: $a, b: $b};\n\n return ENGINE.runKernel(GreaterEqual, inputs as {} as NamedTensorMap);\n}\n\nexport const greaterEqual = op({greaterEqual_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {ENGINE} from '../engine';\nimport {Imag, ImagInputs} from '../kernel_names';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\nimport {op} from './operation';\n\n/**\n * Returns the imaginary part of a complex (or real) tensor.\n *\n * Given a tensor input, this operation returns a tensor of type float that is\n * the imaginary part of each element in input considered as a complex number.\n * If input is real, a tensor of all zeros is returned.\n *\n * ```js\n * const x = tf.complex([-2.25, 3.25], [4.75, 5.75]);\n * tf.imag(x).print();\n * ```\n *\n * @doc {heading: 'Tensors', subheading: 'Creation'}\n */\nfunction imag_<T extends Tensor>(input: T|TensorLike): T {\n const $input = convertToTensor(input, 'input', 'imag');\n\n const inputs: ImagInputs = {input: $input};\n return
ENGINE.runKernel(Imag, inputs as {} as NamedTensorMap);\n}\n\nexport const imag = op({imag_});\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n *

WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {ENGINE} from '../engine';\nimport {IsFinite, IsFiniteInputs} from '../kernel_names';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\n\nimport {op} from './operation';\n\n/**\n * Returns which elements of x are finite.\n *\n * ```js\n * const x = tf.tensor1d([NaN, Infinity, -Infinity, 0, 1]);\n *\n * x.isFinite().print(); // or tf.isNaN(x)\n * ```\n * @param x The input Tensor.\n *\n * @doc {heading: 'Operations', subheading: 'Basic math'}\n */\nfunction isFinite_<T extends Tensor>(x: T|TensorLike): T {\n const $x = convertToTensor(x, 'x', 'isFinite');\n\n const inputs: IsFiniteInputs = {x: $x};\n\n return ENGINE.runKernel(IsFinite, inputs as {} as NamedTensorMap);\n}\nexport const isFinite = op({isFinite_});\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {ENGINE} from '../engine';\nimport {IsInf, IsInfInputs} from '../kernel_names';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\n\nimport {op} from './operation';\n\n/**\n * Returns which elements of x are Infinity or -Infinity.\n *\n * ```js\n * const x = tf.tensor1d([NaN, Infinity, -Infinity, 0, 1]);\n *\n * x.isInf().print(); // or tf.isNaN(x)\n * ```\n * @param x The input Tensor.\n *\n * @doc {heading: 'Operations', subheading: 'Basic math'}\n */\nfunction isInf_<T extends Tensor>(x: T|TensorLike): T {\n const $x = convertToTensor(x, 'x', 'isInf');\n\n const inputs: IsInfInputs = {x: $x};\n\n return ENGINE.runKernel(IsInf, inputs as {} as NamedTensorMap);\n}\nexport const isInf = op({isInf_});\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {ENGINE} from '../engine';\nimport {IsNan, IsNanInputs} from '../kernel_names';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\n\nimport {op} from './operation';\n\n/**\n * RReturns which elements of x are NaN.\n *\n * ```js\n * const x = tf.tensor1d([NaN, Infinity, -Infinity, 0, 1]);\n *\n * x.isNaN().print(); // or tf.isNaN(x)\n * ```\n * @param x The input Tensor.\n *\n * @doc {heading: 'Operations', subheading: 'Basic math'}\n */\nfunction isNaN_<T extends Tensor>(x: T|TensorLike): T {\n const $x = convertToTensor(x, 'x', 'isNaN');\n const inputs: IsNanInputs = {x: $x};\n\n return ENGINE.runKernel(IsNan, inputs as {} as NamedTensorMap);\n}\nexport const isNaN = op({isNaN_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either

express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {ENGINE} from '../engine';\nimport {LeakyRelu, LeakyReluAttrs, LeakyReluInputs} from '../kernel_names';\nimport {NamedAttrMap} from '../kernel_registry';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\n\nimport {op} from './operation';\n\n/**\n * Computes leaky rectified linear element-wise.\n *\n * See\n * [http://web.stanford.edu/~awni/papers/relu_hybrid_icml2013_final.pdf](\n * http://web.stanford.edu/~awni/papers/relu_hybrid_icml2013_final.pdf)\n *\n * ```js\n * const x = tf.tensor1d([-1, 2, -3, 4]);\n *\n * x.leakyRelu(0.1).print(); // or tf.leakyRelu(x, 0.1)\n * ```\n * @param x The input tensor.\n * @param alpha The scaling factor for negative values, defaults to 0.2.\n *\n * @doc {heading: 'Operations', subheading: 'Basic math'}\n */\nfunction leakyRelu_<T extends Tensor>(x: T|TensorLike, alpha = 0.2): T {\n const $x = convertToTensor(x, 'x', 'leakyRelu');\n\n const inputs: LeakyReluInputs = {x: $x};\n const attrs: LeakyReluAttrs = {alpha};\n\n return ENGINE.runKernel(\n   LeakyRelu, inputs as {} as NamedTensorMap, attrs as {} as NamedAttrMap);\n}\n\nexport const leakyRelu = op({leakyRelu_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\nimport {ENGINE} from '../engine';\nimport {Less, LessInputs} from '../kernel_names';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {makeTypesMatch} from '../tensor_util';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\n\nimport {assertAndGetBroadcastShape} from './broadcast_util';\nimport {op} from './operation';\n\n/**\n * Returns the truth value of (a < b) element-wise.
Supports broadcasting.\n *\n * ```js\n * const a = tf.tensor1d([1, 2, 3]);\n * const b = tf.tensor1d([2, 2, 2]);\n *\n * a.less(b).print();\n * ```\n * @param a The first input tensor.\n * @param b The second input tensor. Must have the same dtype as `a`.\n *\n * @doc {heading: 'Operations', subheading: 'Logical'}\n */\nfunction less_<T extends Tensor>(\n   a: Tensor|TensorLike, b: Tensor|TensorLike): T {\n let $a = convertToTensor(a, 'a', 'less');\n let $b = convertToTensor(b, 'b', 'less');\n [$a, $b] = makeTypesMatch($a, $b);\n\n assertAndGetBroadcastShape($a.shape, $b.shape);\n\n const inputs: LessInputs = {a: $a, b: $b};\n\n return ENGINE.runKernel(Less, inputs as {} as NamedTensorMap);\n}\n\nexport const less = op({less_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\nimport {ENGINE} from '../engine';\nimport {LessEqual, LessEqualInputs} from '../kernel_names';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {makeTypesMatch} from '../tensor_util';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\n\nimport {assertAndGetBroadcastShape} from './broadcast_util';\nimport {op} from './operation';\n\n/**\n * Returns the truth value of (a <= b) element-wise. Supports broadcasting.\n *\n * ```js\n * const a =

tf.tensor1d([1, 2, 3]);\n * const b = tf.tensor1d([2, 2, 2]);\n *\n * a.lessEqual(b).print();\n * ```\n *\n * @param a The first input tensor.\n * @param b The second input tensor. Must have the same dtype as `a`.\n *\n * @doc {heading: 'Operations', subheading: 'Logical'}\n */\nfunction lessEqual_<T extends Tensor>(\n a: Tensor|TensorLike, b: Tensor|TensorLike): T {\n let $a = convertToTensor(a, 'a', 'lessEqual');\n let $b = convertToTensor(b, 'b', 'lessEqual');\n [$a, $b] = makeTypesMatch($a, $b);\n\n assertAndGetBroadcastShape($a.shape, $b.shape);\n\n const inputs: LessEqualInputs = {a: $a, b: $b};\n\n return ENGINE.runKernel(LessEqual, inputs as {} as NamedTensorMap);\n}\n\nexport const lessEqual = op({lessEqual_});\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {ENGINE} from '../engine';\nimport {LinSpace, LinSpaceAttrs} from '../kernel_names';\nimport {NamedAttrMap} from '../kernel_registry';\nimport {Tensor1D} from '../tensor';\n\n/**\n * Return an evenly spaced sequence of numbers over the given interval.\n *\n * ```js\n * tf.linspace(0, 9, 10).print();\n * ```\n * @param start The start value of the sequence.\n * @param stop The end value of the sequence.\n * @param num The number of values to generate.\n *\n * @doc {heading: 'Tensors', subheading: 'Creation'}\n */\nexport function linspace(start: number, stop: number, num: number): Tensor1D {\n if (num <= 0) {\n throw new Error('The number of values should be positive.');\n }\n\n const attrs: LinSpaceAttrs = {start, stop, num};\n return ENGINE.runKernel(LinSpace, {}, attrs as {} as NamedAttrMap);\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {ENGINE} from '../engine';\nimport {LRN, LRNAttrs, LRNInputs} from '../kernel_names';\nimport {NamedAttrMap} from '../kernel_registry';\nimport {Tensor3D, Tensor4D} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\nimport * as util from '../util';\n\nimport {op} from './operation';\nimport {reshape} from './reshape';\n\n/**\n * Normalizes the activation of a local neighborhood across or within\n * channels.\n *\n * @param x The input tensor. The 4-D input tensor is treated as a 3-D array\n * of 1D vectors (along the last dimension), and each vector is\n * normalized independently.\n * @param depthRadius The number of adjacent channels in the 1D normalization\n * window.\n * @param bias A constant bias term for the basis.\n * @param alpha A scale factor, usually positive.\n * @param beta An exponent.\n *\n * @doc {heading: 'Operations', subheading:\n 'Normalization'}\n */\nfunction localResponseNormalization_<T extends Tensor3D|Tensor4D>(\n x: T|TensorLike, depthRadius = 5, bias = 1, alpha = 1, beta = 0.5): T {\n const $x = convertToTensor(x, 'x', 'localResponseNormalization');\n util.assert(\n $x.rank === 4 || $x.rank === 3,\n () => `Error in localResponseNormalization: x must be rank 3 or 4 but got\n rank ${$x.rank}.`);\n util.assert(\n util.isInt(depthRadius),\n () => `Error in localResponseNormalization: depthRadius must be an ` +\n `integer but got depthRadius ${depthRadius}.`);\n\n let x4D = $x as Tensor4D;\n let reshapedTo4D = false;\n if ($x.rank === 3) {\n reshapedTo4D = true;\n x4D = reshape($x, [1, $x.shape[0], $x.shape[1], $x.shape[2]]);\n }\n\n const inputs: LRNInputs = {x: x4D};\n\n const attrs: LRNAttrs = {depthRadius, bias, alpha, beta};\n\n //

tslint:disable-next-line: no-unnecessary-type-assertion\n const res = ENGINE.runKernel(\n
    LRN, inputs as {} as NamedTensorMap,\n   attrs as {} as NamedAttrMap) as T;\n\n if (reshapedTo4D) {\n   return reshape(res, [res.shape[1], res.shape[2], res.shape[3]]) as T;\n } else {\n   return res;\n }\n}\n\nexport const localResponseNormalization = op({localResponseNormalization_});\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n
 */\n\nimport {ENGINE} from '../engine';\nimport {Log, LogInputs} from '../kernel_names';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\n\nimport {op} from './operation';\n\n/**\n * Computes natural logarithm of the input `tf.Tensor` element-wise: `ln(x)`\n *\n * ```js\n * const x = tf.tensor1d([1, 2, Math.E]);\n *\n * x.log().print(); // or tf.log(x)\n * ```\n * @param x The input tensor.\n *\n * @doc {heading: 'Operations', subheading: 'Basic math'}\n */\nfunction log_<T extends Tensor>(x: T|TensorLike): T {\n const $x = convertToTensor(x, 'x', 'log');\n\n const inputs: LogInputs = {x: $x};\n return ENGINE.runKernel(Log, inputs as {} as NamedTensorMap);\n}\nexport const log = op({log_});\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n
 * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n
*/\n\nimport {ENGINE} from '../engine';\nimport {Log1p, Log1pInputs} from '../kernel_names';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\n\nimport {op} from './operation';\n\n/**\n * Computes natural logarithm of the input `tf.Tensor` plus one\n * element-wise: `ln(1 + x)`\n *\n
 * ```js\n * const x = tf.tensor1d([1, 2, Math.E - 1]);\n *\n * x.log1p().print(); // or tf.log1p(x)\n * ```\n * @param x The input tensor.\n *\n * @doc {heading: 'Operations', subheading: 'Basic math'}\n */\nfunction log1p_<T extends Tensor>(x: T|TensorLike): T {\n const $x = convertToTensor(x, 'x', 'log1p');\n\n const inputs: Log1pInputs = {x: $x};\n return ENGINE.runKernel(Log1p, inputs as {} as NamedTensorMap);\n}\nexport const log1p = op({log1p_});\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See
 the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n
*/\n\nimport {CustomGradientFunc, ENGINE} from './engine';\nimport {Scalar, Tensor, Variable} from './tensor';\nimport {NamedTensorMap} from './tensor_types';\nimport {convertToTensor, convertToTensorArray} from './tensor_util_env';\nimport {TensorLike} from './types';\nimport * as util from './util';\n\n/**\n * Provided `f(x)`, returns another function `g(x, dy?)`, which gives the\n * gradient of `f(x)` with respect to `x`.\n *\n * If `dy` is provided, the gradient of `f(x).mul(dy).sum()` with respect to\n * `x` is computed instead. `f(x)` must take a single tensor `x` and return a\n * single tensor `y`. If `f()` takes multiple inputs, use `tf.grads` instead.\n *\n * ```js\n * //

f(x) = x ^ 2\n * const f = x => x.square();\n * // f'(x) = 2x\n * const g = tf.grad(f);\n *\n * const x = tf.tensor1d([2, 3]);\n
 * g(x).print();\n * ```\n *\n * ```js\n * // f(x) = x ^ 3\n * const f = x => x.pow(tf.scalar(3, 'int32'));\n * // f'(x) = 3x ^ 2\n * const g = tf.grad(f);\n * // f''(x) = 6x\n * const gg = tf.grad(g);\n *\n * const x = tf.tensor1d([2, 3]);\n * gg(x).print();\n * ```\n *\n * @param f The function f(x), to compute gradient for.\n *\n * @doc {heading: 'Training', subheading: 'Gradients'}\n */\nfunction grad(f: (x: Tensor) => Tensor): (\n x: TensorLike|Tensor, dy?: TensorLike|Tensor) => Tensor {\n util.assert(\n util.isFunction(f), () => 'The f passed in grad(f) must be a function');\n return (x: TensorLike|Tensor, dy?: TensorLike|Tensor): Tensor => {\n // x can be of any dtype, thus null as the last argument.\n const $x = convertToTensor(x, 'x', 'tf.grad', 'string_or_numeric');\n const $dy: Tensor =\n (dy != null) ? convertToTensor(dy, 'dy', 'tf.grad') : null;\n return ENGINE.tidy(() => {\n const {value, grads} = ENGINE.gradients(() => f($x), [$x], $dy);\n
 if ($dy != null) {\n util.assertShapesMatch(\n value.shape, $dy.shape,\n 'The shape of dy passed in grad(f)(x, dy) must match the shape ' +\n 'returned by f(x)');\n }\n checkGrads(grads);\n return grads[0];\n });\n };\n}\n\n/**\n * Provided `f(x1, x2,...)`, returns another function `g([x1, x2,...], dy?)`,\n * which gives an array of gradients of `f()` with respect to each input\n * [`x1`,`x2`,...].\n *\n * If `dy` is passed when calling `g()`, the gradient of\n * `f(x1,...).mul(dy).sum()` with respect to each input is computed instead.\n * The provided `f` must take one or more tensors and return a single tensor\n * `y`. If `f()` takes a single input, we recommend using `tf.grad` instead.\n *\n * ```js\n * // f(a, b) = a * b\n * const f = (a, b) => a.mul(b);\n * // df / da = b, df / db = a\n * const g = tf.grads(f);\n *\n * const a = tf.tensor1d([2, 3]);\n * const b = tf.tensor1d([-2, -3]);\n * const [da, db] = g([a,
 b]);\n * console.log('da');\n * da.print();\n * console.log('db');\n * db.print();\n * ```\n *\n * @param f The function `f(x1, x2,...)` to compute gradients for.\n *\n * @doc {heading: 'Training', subheading: 'Gradients'}\n */\nfunction grads(f: (...args: Tensor[]) => Tensor): (\n args: Array<Tensor|TensorLike>, dy?: Tensor|TensorLike) => Tensor[] {\n util.assert(\n util.isFunction(f), () => 'The f passed in grads(f) must be a function');\n return (args: Array<Tensor|TensorLike>, dy?: Tensor|TensorLike): Tensor[] => {\n util.assert(\n Array.isArray(args),\n () => 'The args passed in grads(f)(args) must be an array ' +\n 'of `Tensor`s or `TensorLike`s');\n // args can be of any dtype, thus null as the last argument.\n const $args =\n convertToTensorArray(args, 'args', 'tf.grads', 'string_or_numeric');\n const $dy: Tensor =\n (dy != null) ? convertToTensor(dy, 'dy', 'tf.grads') : null;\n return ENGINE.tidy(() => {\n
 const {value, grads} = ENGINE.gradients(() => f(...$args), $args, $dy);\n if ($dy != null) {\n util.assertShapesMatch(\n value.shape, $dy.shape,\n 'The shape of dy passed in grads(f)([x1,...], dy) must ' +\n 'match the shape returned by f([x1,...])');\n }\n checkGrads(grads);\n return grads;\n });\n };\n}\n\n/**\n * Like `tf.grad`, but also returns the value of `f()`. Useful when `f()`\n * returns a metric you want to show.\n *\n * The result is a rich object with the following properties:\n * - grad: The gradient of `f(x)` w.r.t `x` (result of `tf.grad`).\n * - value: The value returned by `f(x)`.\n *\n * ```js\n * // f(x) = x ^ 2\n * const f = x => x.square();\n * // f'(x) = 2x\n * const g = tf.valueAndGrad(f);\n *\n * const x = tf.tensor1d([2, 3]);\n * const {value, grad} = g(x);\n *\n * console.log('value');\n * value.print();\n * console.log('grad');\n * grad.print();\n * ```\n *\n * @doc {heading: 'Training', subheading:
 'Gradients'}\n */\nfunction valueAndGrad<I extends Tensor, O extends Tensor>(f: (x: I) => O): (\n x: I, dy?: O) => {\n value: O;\n grad: I;\n} {\n util.assert(\n util.isFunction(f),\n () => 'The f passed in valueAndGrad(f) must be a function');\n return (x: I, dy?: O) => {\n util.assert(\n x instanceof Tensor,\n () => 'The x passed in valueAndGrad(f)(x) must be a tensor');\n util.assert(\n dy == null || dy instanceof Tensor,\n () => 'The dy passed in valueAndGrad(f)(x, dy) must be a tensor');\n const {grads, value} = ENGINE.gradients(() => f(x), [x], dy);\n checkGrads(grads);\n return {grad: grads[0] as I, value};\n };\n}\n\n/**\n * Like `tf.grads`, but returns also the value of `f()`. Useful when `f()`\n * returns a metric you want to show.\n *\n * The result is a rich object with the following properties:\n * - grads: The gradients of `f()` w.r.t each input (result of `tf.grads`).\n * - value: The value returned

by `f(x)`.\n *\n * ```js\n * // f(a, b) = a * b\n * const f = (a, b) => a.mul(b);\n * // df/da = b, df/db = a\n * const g = tf.valueAndGrads(f);\n *\n * const a = tf.tensor1d([2, 3]);\n * const b = tf.tensor1d([-2, -3]);\n * const {value, grads} = g([a, b]);\n *\n * const [da, db] = grads;\n *\n * console.log('value');\n * value.print();\n *\n * console.log('da');\n * da.print();\n * console.log('db');\n * db.print();\n * ```\n *\n * @doc {heading: 'Training', subheading: 'Gradients'}\n */\nfunction valueAndGrads<O extends Tensor>(f: (...args: Tensor[]) => O): (\n args: Tensor[], dy?: O) => {\n grads: Tensor[];\n value: O;\n} {\n util.assert(\n util.isFunction(f),\n () => 'The f passed in valueAndGrads(f) must be a function');\n return (args: Tensor[], dy?: O) => {\n util.assert(\n Array.isArray(args) && args.every(arg => arg instanceof Tensor),\n () => 'The args passed in valueAndGrads(f)(args) must be array of ' +\n 'tensors');\n util.assert(\n dy == null || dy instanceof Tensor,\n () => 'The dy passed in valueAndGrads(f)(args, dy) must be a tensor');\n const res = ENGINE.gradients(() => f(...args), args, dy);\n if (dy != null) {\n util.assertShapesMatch(\n res.value.shape, dy.shape,\n 'The shape of dy passed in valueAndGrads(f)([x1,...], dy) must ' +\n 'match the shape returned by f([x1,...])');\n }\n checkGrads(res.grads);\n return res;\n };\n}\n\n/**\n * Computes and returns the gradient of f(x) with respect to the list of\n * trainable variables provided by `varList`. If no list is provided, it\n * defaults to all trainable variables.\n *\n * ```js\n * const a = tf.variable(tf.tensor1d([3, 4]));\n * const b = tf.variable(tf.tensor1d([5, 6]));\n * const x = tf.tensor1d([1, 2]);\n *\n * // f(a, b) = a * x ^ 2 + b * x\n * const f = () => a.mul(x.square()).add(b.mul(x)).sum();\n * // df/da = x ^ 2, df/db = x\n * const {value, grads} = tf.variableGrads(f);\n *\n * Object.keys(grads).forEach(varName => grads[varName].print());\n * ```\n *\n * @param f The function to execute. f() should return a scalar.\n * @param varList The list of variables to compute the gradients with respect\n * to. Defaults to all trainable variables.\n * @returns An object with the following keys and values:\n * - `value`: The value of the function `f`.\n * - `grads`: A map from the names of the variables to the gradients.\n * If the `varList` argument is provided explicitly and contains a subset of\n * non-trainable variables, this map in the return value will contain keys\n * that map the names of the non-trainable variables to `null`.\n *\n * @doc {heading: 'Training', subheading: 'Gradients'}\n */\nfunction variableGrads(f: () => Scalar, varList?: Variable[]):\n {value: Scalar, grads: NamedTensorMap} {\n util.assert(\n util.isFunction(f),\n () => 'The f passed in variableGrads(f) must be a function');\n util.assert(\n varList == null ||\n Array.isArray(varList) && varList.every(v => v instanceof Variable),\n () =>\n 'The varList passed in variableGrads(f, varList) must be an array ' +\n 'of variables');\n\n const specifiedVarList = varList != null;\n if (!specifiedVarList) {\n // Get all of the trainable variables.\n varList = [];\n for (const varName in ENGINE.registeredVariables) {\n varList.push(ENGINE.registeredVariables[varName]);\n }\n }\n\n const specifiedNonTrainable: Variable[] =\n specifiedVarList ? varList.filter(variable => !variable.trainable) : null;\n\n // Prune non-trainable variables.\n const originalVarCount = varList.length;\n varList = varList.filter(variable => variable.trainable);\n util.assert(\n varList.length > 0,\n () => `variableGrads() expects at least one of the input variables to ` +\n `be trainable, but none of the ${originalVarCount} variables is ` +\n `trainable.`);\n\n const allowNoGradients = true;\n const {value, grads} = ENGINE.gradients(f, varList, null, allowNoGradients);\n\n util.assert(\n grads.some(g => g != null),\n () => 'Cannot find a connection between any variable and the result of ' +\n 'the loss function y=f(x). Please make sure the operations that ' +\n 'use variables are inside the function f passed to minimize().');\n util.assert(\n value.rank === 0,\n () => `The f passed in variableGrads(f) must return a scalar, but it ` +\n `returned a rank-${value.rank} tensor`);\n\n const namedGrads: NamedTensorMap = {};\n varList.forEach((v, i) => {\n if (grads[i] != null) {\n namedGrads[v.name] = grads[i];\n }\n });\n if (specifiedNonTrainable != null) {\n // If varList is explicitly provided and contains non-trainable values,\n // add them to the returned gradients with `null` values.\n specifiedNonTrainable.forEach(v => namedGrads[v.name] = null);\n }\n return {value, grads: namedGrads};\n}\n\n/**\n * Overrides the gradient computation of a function `f`.\n *\n * Takes a function\n * `f(...inputs, save) => {value: Tensor, gradFunc: (dy, saved) => Tensor[]}`\n * and returns another function

`g(...inputs)` which takes the same inputs as\n * `f`. When called, `g` returns `f().value`. In backward mode, custom gradients\n * with respect to each input of `f` are computed using `f().gradFunc`.\n *\n * The `save` function passsed to `f` should be used for saving tensors needed\n * in the gradient. And the `saved` passed to the `gradFunc` is a\n * `NamedTensorMap`, which contains those saved tensor.\n *\n * ```js\n * const customOp = tf.customGrad((x, save) => {\n * // Save x to make sure it's available later for the gradient.\n * save([x]);\n * // Override gradient of our custom x ^ 2 op to be dy * abs(x);\n * return {\n * value: x.square(),\n * // Note `saved.x` which points to the `x` we saved earlier.\n * gradFunc: (dy, saved) => [dy.mul(saved[0].abs())]\n * };\n * });\n *\n * const x = tf.tensor1d([-1, -2, 3]);\n * const dx = tf.grad(x => customOp(x));\n *\n * console.log(`f(x):`);\n * customOp(x).print();\n * console.log(`f'(x):`);\n * dx(x).print();\n * ```\n *\n * @param f The function to evaluate in forward mode, which should return\n * `{value: Tensor, gradFunc: (dy, saved) => Tensor[]}`, where `gradFunc`\n * returns the custom gradients of `f` with respect to its inputs.\n *\n * @doc {heading: 'Training', subheading: 'Gradients'}\n */\nfunction customGrad<T extends Tensor>(f: CustomGradientFunc<T>):\n (...args: Tensor[]) => T {\n return ENGINE.customGrad(f);\n}\n\nfunction checkGrads(grads: Tensor[]) {\n const numNullGradients = grads.filter(g => g == null).length;\n if (numNullGradients > 0) {\n throw new Error(\n `Cannot compute gradient of y=f(x) with respect to x. Make sure that\n  the f you passed encloses all operations that lead from x to y.`);\n }\n}\n\nexport {\n customGrad,\n variableGrads,\n valueAndGrad,\n valueAndGrads,\n grad,\n grads,\n};\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {ENGINE} from '../engine';\nimport {Neg, NegInputs} from '../kernel_names';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\n\nimport {op} from './operation';\n\n/**\n * Computes `-1 * x` element-wise.\n *\n * ```js\n * const x = tf.tensor2d([1, 2, -2, 0], [2, 2]);\n *\n * x.neg().print(); // or tf.neg(x)\n * ```\n *\n * @param x The input tensor.\n *\n * @doc {heading: 'Operations', subheading: 'Basic math'}\n */\nfunction neg_<T extends Tensor>(x: T|TensorLike): T {\n const $x = convertToTensor(x, 'x', 'neg');\n\n const inputs: NegInputs = {x: $x};\n return ENGINE.runKernel(Neg, inputs as {} as NamedTensorMap);\n}\nexport const neg = op({neg_});\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed
 under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {ENGINE} from '../engine';\nimport {Softplus, SoftplusInputs} from '../kernel_names';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\n\nimport {op} from './operation';\n\n/**\n * Computes softplus of the input `tf.Tensor` element-wise: `log(exp(x) + 1)`\n *\n * ```js\n * const x = tf.tensor1d([0, 1, -1, .7]);\n *\n * x.softplus().print(); // or tf.softplus(x)\n * ```\n *\n * @param x The input tensor.\n *\n * @doc {heading: 'Operations', subheading: 'Basic math'}\n */\nfunction softplus_<T extends Tensor>(x: T|TensorLike): T {\n const $x = convertToTensor(x, 'x', 'softplus');\n\n const inputs: SoftplusInputs = {x: $x};\n return ENGINE.runKernel(Softplus, inputs as {} as NamedTensorMap);\n}\nexport const softplus =

op({softplus_});\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {customGrad} from '../gradients';\nimport {Tensor} from '../tensor';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\n\nimport {mul} from './mul';\nimport {neg} from './neg';\nimport {op} from './operation';\nimport {sigmoid} from './sigmoid';\nimport {softplus} from './softplus';\n\n/**\n * Computes log sigmoid of the input `tf.Tensor` element-wise:\n * `logSigmoid(x)`. For numerical stability, we use `-tf.softplus(-x)`.\n *\n * ```js\n * const x = tf.tensor1d([0, 1, -1, .7]);\n *\n * x.logSigmoid().print(); // or tf.logSigmoid(x)\n * ```\n * @param x The input tensor.\n *\n * @doc {heading: 'Operations', subheading: 'Basic math'}\n */\nfunction logSigmoid_<T extends Tensor>(x: T|TensorLike): T {\n const $x = convertToTensor(x, 'x', 'logSigmoid');\n\n // Use a custom gradient to maintain previous implementation.\n // There is no LogSigmoid kernel in TF so we can't use engine.runKernel\n // directly\n const customOp = customGrad((x: Tensor) => {\n   // TODO(yassogba) we can remove the chained softplus call here only\n   // after backends have modualrized softplus at which point we can call\n   // engine runKernel(..., Sotfplus, ...) directly.\n   const value = neg(softplus(neg(x)));\n\n   const gradFunc = (dy: T) => {\n   const derX = mul(dy, sigmoid(neg(x)));\n   return derX;\n   };\n   return {value, gradFunc};\n });\n\n return customOp($x) as T;\n}\nexport const logSigmoid = op({logSigmoid_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {ENGINE} from '../engine';\nimport {Max, MaxAttrs, MaxInputs} from '../kernel_names';\nimport {NamedAttrMap} from '../kernel_registry';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\n\nimport {op} from './operation';\n\n/**\n * Computes the maximum of elements across dimensions of a `tf.Tensor`.\n *\n * Reduces the input along the dimensions given in `axes`. Unless `keepDims`\n * is true, the rank of the `tf.Tensor` is reduced by 1 for each entry in\n * `axes`. If `keepDims` is true, the reduced dimensions are retained with\n * length 1. If `axes` has no entries, all dimensions are reduced, and an\n * `tf.Tensor` with a single element is returned.\n *\n * ```js\n * const x = tf.tensor1d([1, 2, 3]);\n *\n * x.max().print(); // or tf.max(x)\n * ```\n *\n * ```js\n * const x = tf.tensor2d([1, 2, 3, 4], [2, 2]);\n *\n * const axis = 1;\n * x.max(axis).print(); // or tf.max(x, axis)\n * ```\n *\n * @param x The input tensor.\n * @param axis The dimension(s) to reduce. By default it reduces\n *   all dimensions.\n * @param keepDims If true, retains reduced dimensions with size 1.\n *\n * @doc {heading: 'Operations', subheading: 'Reduction'}\n */\nfunction max_<T extends Tensor>(\n   x: Tensor|TensorLike, axis: number|number[] = null, keepDims = false): T {\n const $x = convertToTensor(x, 'x', 'max');\n\n const inputs: MaxInputs = {x: $x};\n const attrs: MaxAttrs = {reductionIndices: axis, keepDims};\n\n return ENGINE.runKernel(\n   Max, inputs as {} as NamedTensorMap, attrs as {} as NamedAttrMap);\n}\n\nexport const max = op({max_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in

writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\nimport {ENGINE} from '../engine';\nimport {Sub, SubInputs} from '../kernel_names';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {makeTypesMatch} from '../tensor_util';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\n\nimport {op} from './operation';\n\n/**\n * Subtracts two `tf.Tensor`s element-wise, A - B. Supports broadcasting.\n *\n * ```js\n * const a = tf.tensor1d([10, 20, 30, 40]);\n * const b = tf.tensor1d([1, 2, 3, 4]);\n *\n * a.sub(b).print(); // or tf.sub(a, b)\n * ```\n *\n * ```js\n * // Broadcast subtract a with b.\n * const a = tf.tensor1d([10, 20, 30, 40]);\n * const b = tf.scalar(5);\n *\n * a.sub(b).print(); // or tf.sub(a, b)\n * ```\n * @param a The first `tf.Tensor` to subtract from.\n * @param b The second `tf.Tensor` to be subtracted. Must have the same dtype as\n * `a`.\n *\n * @doc {heading: 'Operations', subheading: 'Arithmetic'}\n */\nfunction sub_<T extends Tensor>(a: Tensor|TensorLike, b: Tensor|TensorLike): T {\n let $a = convertToTensor(a, 'a', 'sub');\n let $b = convertToTensor(b, 'b', 'sub');\n [$a, $b] = makeTypesMatch($a, $b);\n\n const inputs: SubInputs = {a: $a, b: $b};\n\n return ENGINE.runKernel(Sub, inputs as {} as NamedTensorMap);\n}\n\nexport const sub = op({sub_});\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under
the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\nimport {ENGINE} from '../engine';\nimport {Sum, SumAttrs, SumInputs} from '../kernel_names';\nimport {NamedAttrMap} from '../kernel_registry';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\n\nimport {cast} from './cast';\nimport {op} from
'./operation';\n\n/**\n * Computes the sum of elements across dimensions of a `tf.Tensor`.\n *\n * Reduces the input along the dimensions given in `axes`. Unless `keepDims`\n * is true, the rank of the `tf.Tensor` is reduced by 1 for each entry in\n * `axes`. If `keepDims` is true, the reduced dimensions are retained with\n * length 1. If axes has no entries, all dimensions are reduced, and a\n * `tf.Tensor` with a single element is returned.\n *\n * ```js\n * const x = tf.tensor1d([1, 2, 3]);\n *\n * x.sum().print(); // or tf.sum(x)\n * ```\n *\n * ```js\n * const x = tf.tensor2d([1, 2, 3, 4], [2, 2]);\n *\n * const axis = 1;\n * x.sum(axis).print(); // or tf.sum(x, axis)\n * ```\n *\n * @param x The input tensor to compute the sum over. If the dtype is `bool`\n *   it will be converted to `int32` and the output dtype will be `int32`.\n * @param axis The dimension(s) to reduce. By default it reduces\n *   all dimensions.\n * @param keepDims If true, retains reduced dimensions
with size 1.\n *\n * @doc {heading: 'Operations', subheading: 'Reduction'}\n */\nfunction sum_<T extends Tensor>(\n   x: Tensor|TensorLike, axis: number|number[] = null, keepDims = false): T {\n let $x = convertToTensor(x, 'x', 'sum');\n if ($x.dtype === 'bool') {\n $x = cast($x, 'int32');\n }\n\n const inputs: SumInputs = {x: $x};\n const attrs: SumAttrs = {axis, keepDims};\n\n return ENGINE.runKernel(\n   Sum, inputs as {} as NamedTensorMap, attrs as {} as NamedAttrMap);\n}\n\nexport const sum = op({sum_});\n","/**\n * @license\n * Copyright 2020 Google Inc. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES

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==========================================================================\n
*/\n\nimport {customGrad} from '../gradients';\n\nimport {Tensor} from '../tensor';\nimport {GradSaveFunc} from '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\n\nimport {cast} from './cast';\nimport {exp} from './exp';\nimport {log} from './log';\nimport {max} from './max';\nimport {mul} from './mul';\nimport {op} from './operation';\nimport {sub} from './sub';\nimport {sum} from './sum';\n\n/**\n * Computes the log softmax.\n *\n * ```js\n * const a = tf.tensor1d([1, 2, 3]);\n *\n * a.logSoftmax().print();  // or tf.logSoftmax(a)\n * ```\n *\n * ```js\n * const a = tf.tensor2d([2, 4, 6, 1, 2, 3], [2, 3]);\n *\n * a.logSoftmax().print();  // or tf.logSoftmax(a)\n * ```\n *\n *
 @param logits The logits array.\n * @param axis The dimension softmax would be performed on. Defaults to `-1`\n *     which indicates the last dimension.\n *\n * @doc {heading: 'Operations', subheading: 'Normalization'}\n */\nfunction logSoftmax_<T extends Tensor>(logits: T|TensorLike, axis = -1): T {\n  const $logits = convertToTensor(logits, 'logits', 'logSoftmax');\n\n  if (axis === -1) {\n    axis = $logits.rank - 1;\n  }\n  if (axis !== $logits.rank - 1) {\n    throw Error(\n        'Log Softmax along a non-last dimension is not yet supported. ' +\n        `Logits was rank ${$logits.rank} and axis was ${axis}`);\n  }\n\n  // const forward: ForwardFunc<Tensor> = (backend, save) => {\n  //   const keepDims = true;\n  //   const xMax = max(logits, axis, true);\n  //   const shifted = sub(logits, xMax);\n  //   const value =\n  //       sub(cast(shifted, 'float32'), log(sum(exp(shifted), axis,\n  // keepDims)));\n  //   save([value]);\n  //   return value;\n  // };\n\n  // Use a
 custom gradient for numerical stability.\n  const customOp = customGrad((logits: Tensor, save: GradSaveFunc) => {\n    const keepDims = true;\n    const xMax = max(logits, axis, true);\n    const shifted = sub(logits, xMax);\n    const value =\n        sub(cast(shifted, 'float32'), log(sum(exp(shifted), axis, keepDims)));\n    save([value]);\n\n    const gradFunc = (dy: Tensor, saved: Tensor[]) => {\n      const [value] = saved;\n      const keepDims = true;\n      const softmax = exp(value);\n      return sub(dy, mul(sum(dy, axis, keepDims), softmax));\n    };\n    return {value, gradFunc};\n  });\n\n  return customOp($logits) as T;\n\n  // TODO Use Engine.runKernel when CPU/WebGL/WASM backends implement this.\n  // const inputs: LogSoftmaxInputs = {logits: $logits};\n  // const attrs: LogSoftmaxAttrs = {axis};\n  // return ENGINE.runKernel(\n  //           LogSoftmax, inputs as {} as NamedTensorMap,\n  //           attrs as {} as NamedAttrMap);\n}\n\nexport const logSoftmax = op({logSoftmax_});\n","/**\n
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==========================================================================\n
*/\n\nimport * as util from '../util';\n\n/**\n * Returns true if the axis specifies the inner most dimensions of the\n * array.\n */\nexport function axesAreInnerMostDims(axes: number[], rank: number): boolean {\n  for (let i = 0; i < axes.length; ++i) {\n    if
 (axes[axes.length - i - 1] !== rank - 1 - i) {\n      return false;\n    }\n  }\n  return true;\n}\n\nexport function combineLocations(\n    outputLoc: number[], reduceLoc: number[], axes: number[]): number[] {\n  const rank = outputLoc.length + reduceLoc.length;\n  const loc = [];\n  let outIdx = 0;\n  let reduceIdx = 0;\n    for (let dim = 0; dim < rank; dim++) {\n    if (axes.indexOf(dim) === -1) {\n      loc.push(outputLoc[outIdx++]);\n    } else {\n      loc.push(reduceLoc[reduceIdx++]);\n    }\n  }\n  return loc;\n}\n\nexport function computeOutAndReduceShapes(\n  aShape: number[], axes: number[]): [number[], number[]] {\n  const outShape = [];\n  const rank = aShape.length;\n  for (let dim = 0; dim < rank; dim++) {\n    if (axes.indexOf(dim) === -1) {\n      outShape.push(aShape[dim]);\n    }\n  }\n  const reduceShape = axes.map(dim => aShape[dim]);\n  return [outShape, reduceShape];\n}\n\nexport function expandShapeToKeepDim(\n    shape: number[], axes: number[]):
```

number[]
{\n const reduceSubShape = axes.map(x => 1);\n return combineLocations(shape, reduceSubShape, axes);\n}\n\nexport function assertAxesAreInnerMostDims(\n   msg: string, axes: number[], rank: number): void {\n util.assert(\n   axesAreInnerMostDims(axes, rank),\n   () => `${msg} supports only inner-most axes for now. ` +\n   `Got axes ${axes} and rank-${rank} input.`);\n}\n\n/**\n * Returns the axes permutation to be used with `tf.transpose`, if such\n * permutation is necessary. Otherwise it returns null. This method is used by\n * operations that operate only on inner-most axes.\n */\nexport function getAxesPermutation(axes: number[], rank: number): number[]|\n   null {\n if (axesAreInnerMostDims(axes, rank)) {\n   return null;\n }\n const result: number[] = [];\n for (let i = 0; i < rank; ++i) {\n   if (axes.indexOf(i) === -1) {\n   result.push(i);\n   }\n }\n axes.forEach(axis => result.push(axis));\n return result;\n}\n\n/** Returns the axes permutation
that undoes the original permutation. */\nexport function getUndoAxesPermutation(axes: number[]): number[] {\n return axes.map((axis, i) => [i, axis])\n   .sort((a, b) => a[1] - b[1])\n   .map(x => x[0]);\n}\n\nexport function getInnerMostAxes(numAxes: number, rank: number): number[] {\n const res: number[] = [];\n for (let i = rank - numAxes; i < rank; ++i) {\n   res.push(i);\n }\n return res;\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing
permissions and\n * limitations under the License.\n *
==\n */\n\nimport {Tensor} from '../tensor';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\nimport {parseAxisParam} from '../util';\n\nimport {add} from './add';\nimport {expandShapeToKeepDim} from './axis_util';\nimport {exp} from './exp';\nimport {log} from './log';\nimport {max} from './max';\nimport {op} from './operation';\nimport {reshape} from './reshape';\nimport {sub} from './sub';\nimport {sum} from './sum';\n\n/**\n * Computes the log(sum(exp(elements across the reduction dimensions)).\n *\n * Reduces the input along the dimensions given in `axis`. Unless `keepDims`\n * is true, the rank of the array is reduced by 1 for each entry in `axis`.\n * If `keepDims` is true, the reduced dimensions are retained with length 1.\n * If `axis` has no entries, all dimensions are reduced, and an array with a\n * single element is returned.\n *\n * ```js\n * const x = tf.tensor1d([1, 2, 3]);\n *\n * x.logSumExp().print(); // or tf.logSumExp(x)\n * ```\n *\n * ```js\n * const x = tf.tensor2d([1, 2, 3, 4], [2, 2]);\n *\n * const axis = 1;\n * x.logSumExp(axis).print(); // or tf.logSumExp(a, axis)\n * ```\n * @param x The input tensor.\n * @param axis The dimension(s) to reduce. If null (the default),\n *   reduces all dimensions.\n * @param keepDims If true, retains reduced dimensions with length\n *   of 1. Defaults to false.\n *\n * @doc {heading: 'Operations', subheading: 'Reduction'}\n */\nfunction logSumExp_<T extends Tensor>(\n   x: Tensor|TensorLike, axis: number|number[] = null, keepDims = false): T {\n const $x = convertToTensor(x, 'x', 'logSumExp');\n\n const axes = parseAxisParam(axis, $x.shape);\n const xMax = max($x, axes, true /* keepDims */);\n const a = sub($x, xMax);\n const b = exp(a);\n const c = sum(b, axes);\n const d = log(c);\n const res = add(reshape(xMax, d.shape), d);\n\n if (keepDims) {\n   const newShape = expandShapeToKeepDim(res.shape, axes);\n   return reshape(res, newShape) as T;\n }\n return res as T;\n}\n\nexport const logSumExp = op({logSumExp_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
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*/\nimport {ENGINE} from '../engine';\nimport {LogicalAnd, LogicalAndInputs}
from '../kernel_names';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from
'../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from
'../types';\n\nimport {assertAndGetBroadcastShape} from './broadcast_util';\nimport {op} from './operation';\n\n/**\n
* Returns the truth value of `a AND b` element-wise. Supports broadcasting.\n *\n * ```js\n * const a =
tf.tensor1d([false, false, true, true], 'bool');\n * const b = tf.tensor1d([false, true, false, true], 'bool');\n *\n *
a.logicalAnd(b).print();\n * ```\n *\n * @param a The first input tensor. Must be of dtype bool.\n * @param b The
second input tensor. Must be of dtype bool.\n *\n * @doc {heading: 'Operations', subheading: 'Logical'}\n
*/\nfunction logicalAnd_<T extends Tensor>(\n   a: Tensor|TensorLike, b: Tensor|TensorLike): T {\n const $a =
convertToTensor(a, 'a', 'logicalAnd', 'bool');\n const $b = convertToTensor(b, 'b', 'logicalAnd', 'bool');\n
assertAndGetBroadcastShape($a.shape,
$b.shape);\n\n const inputs: LogicalAndInputs = {a: $a, b: $b};\n\n return ENGINE.runKernel(LogicalAnd, inputs
as {} as NamedTensorMap);\n}\n\nexport const logicalAnd = op({logicalAnd_});\n","/**\n * @license\n *
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\"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the
License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or
agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n *
WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for
the specific language governing permissions and\n * limitations under the License.\n *
==\n
*/\n\nimport {ENGINE} from '../engine';\nimport {LogicalNot, LogicalNotInputs}
from '../kernel_names';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from
'../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\nimport
{op} from './operation';\n\n/**\n * Returns the truth value of `NOT x` element-wise.\n *\n * ```js\n * const a =
tf.tensor1d([false, true], 'bool');\n *\n * a.logicalNot().print();\n * ```\n *\n * @param x The input tensor. Must be of
dtype 'bool'.\n *\n * @doc {heading: 'Operations', subheading: 'Logical'}\n */\nfunction logicalNot_<T extends
Tensor>(x: T|TensorLike): T {\n const $x = convertToTensor(x, 'x', 'logicalNot', 'bool');\n const inputs:
LogicalNotInputs = {x: $x};\n return ENGINE.runKernel(LogicalNot, inputs as {} as
NamedTensorMap);\n}\n\nexport const logicalNot = op({logicalNot_});\n","/**\n * @license\n * Copyright 2020
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http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing,
software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES
OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language
governing permissions and\n * limitations under the License.\n *
==\n
*/\n\nimport {ENGINE} from '../engine';\nimport {LogicalOr, LogicalOrInputs} from '../kernel_names';\nimport
{Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from
'../tensor_util_env';\nimport {TensorLike} from '../types';\nimport {assertAndGetBroadcastShape} from
'./broadcast_util';\nimport {op} from './operation';\n\n/**\n * Returns the truth value of `a OR b` element-wise.
Supports broadcasting.\n
*\n * ```js\n * const a = tf.tensor1d([false, false, true, true], 'bool');\n * const b = tf.tensor1d([false, true, false, true],
'bool');\n *\n * a.logicalOr(b).print();\n * ```\n * @param a The first input tensor. Must be of dtype bool.\n *
@param b The second input tensor. Must be of dtype bool.\n *\n * @doc {heading: 'Operations', subheading:
'Logical'}\n */\nfunction logicalOr_<T extends Tensor>(\n   a: Tensor|TensorLike, b: Tensor|TensorLike): T {\n
const $a = convertToTensor(a, 'a', 'logicalOr', 'bool');\n const $b = convertToTensor(b, 'b', 'logicalOr', 'bool');\n
assertAndGetBroadcastShape($a.shape, $b.shape);\n\n const inputs: LogicalOrInputs = {a: $a, b: $b};\n return

ENGINE.runKernel(LogicalOr, inputs as {} as NamedTensorMap);\n}\nexport const logicalOr = op({logicalOr_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n * ==========\n */\n\nimport {Tensor} from '../tensor';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\n\nimport {assertAndGetBroadcastShape} from './broadcast_util';\nimport {logicalAnd} from './logical_and';\nimport {logicalNot} from './logical_not';\nimport {logicalOr} from './logical_or';\nimport {op} from './operation';\n\n/**\n * Returns the truth value of `a XOR b` element-wise. Supports broadcasting.\n *\n * ```js\n * const a = tf.tensor1d([false, false, true, true], 'bool');\n * const b = tf.tensor1d([false, true, false, true], 'bool');\n *\n * a.logicalXor(b).print();\n * ```\n *\n * @param a The first input tensor. Must be of dtype bool.\n * @param b The second input tensor. Must be of dtype bool.\n *\n * @doc {heading: 'Operations', subheading: 'Logical'}\n */\nfunction logicalXor_<T extends Tensor>(\n   a: Tensor|TensorLike, b: Tensor|TensorLike): T {\n const $a = convertToTensor(a, 'a', 'logicalXor', 'bool');\n const $b = convertToTensor(b, 'b', 'logicalXor', 'bool');\n assertAndGetBroadcastShape($a.shape, $b.shape);\n\n // x ^ y = (x | y) & ~(x & y)\n return logicalAnd(logicalOr(a, b), logicalNot(logicalAnd(a, b)));\n}\n\nexport const logicalXor = op({logicalXor_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n * ==========\n */\n\nimport {ENGINE} from '../engine';\nimport {MaxPool, MaxPoolAttrs, MaxPoolInputs} from '../kernel_names';\nimport {NamedAttrMap} from '../kernel_registry';\nimport {Tensor3D, Tensor4D} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\nimport * as util from '../util';\n\nimport * as conv_util from './conv_util';\nimport {op} from './operation';\nimport {reshape} from './reshape';\n\n/**\n * Computes the 2D max pooling of an image.\n *\n * @param x The input tensor, of rank 4 or rank 3 of shape\n *   `[batch, height, width, inChannels]`. If rank 3, batch of 1 is assumed.\n * @param filterSize The filter size: `[filterHeight, filterWidth]`. If\n *   `filterSize` is a single number, then `filterHeight == filterWidth`.\n * @param strides The strides of the pooling: `[strideHeight, strideWidth]`. If\n *   `strides` is a single number, then `strideHeight == strideWidth`.\n * @param dilations The dilation rates: `[dilationHeight, dilationWidth]`\n *   in which we sample input values across the height and width dimensions\n *   in dilated pooling. Defaults to `[1, 1]`. If `dilations` is a single\n *   number, then `dilationHeight == dilationWidth`. If it is greater than\n *   1, then all values of `strides` must be 1.\n * @param pad The type of padding algorithm.\n *   - `same` and stride 1: output will be of same size as input,\n *   regardless of filter size.\n *   - `valid`:
output will be smaller than input if filter is larger\n *   than 1x1.\n *   - For more info, see this guide:\n *
[https://www.tensorflow.org/api_guides/python/nn#Convolution](\n *
https://www.tensorflow.org/api_guides/python/nn#Convolution)\n * @param dimRoundingMode A string from:
'ceil', 'round', 'floor'. If none is\n *   provided, it will default to truncate.\n */\nfunction maxPool_<T extends Tensor3D|Tensor4D>(\n   x: T|TensorLike, filterSize: [number, number]|number,\n   strides: [number, number]|number, pad: 'valid'|'same'|number,\n   dimRoundingMode?: 'floor'|'round'|'ceil'): T {\n const $x =

convertToTensor(x, 'x', 'maxPool');\n const dilations = 1;\n\n let x4D = $x as Tensor4D;\n let reshapedTo4D = false;\n if ($x.rank === 3) {\n   reshapedTo4D = true;\n   x4D = reshape($x, [1, $x.shape[0], $x.shape[1], $x.shape[2]]);\n }\n\n util.assert(\n   x4D.rank === 4,\n   () => `Error in maxPool: input must be rank 4 but got rank ${x4D.rank}.`);\n
  util.assert(\n   conv_util.eitherStridesOrDilationsAreOne(strides, dilations),\n   () => 'Error in maxPool: Either strides or dilations must be 1. ' +\n   `Got strides ${strides} and dilations '${dilations}'`);\n if (dimRoundingMode != null) {\n   util.assert(\n   util.isInt(pad as number),\n   () => `Error in maxPool: pad must be an integer when using, ` +\n   `dimRoundingMode ${dimRoundingMode} but got pad ${pad}.`);\n }\n\n const inputs: MaxPoolInputs = {x: x4D};\n\n const attrs: MaxPoolAttrs = {filterSize, strides, pad, dimRoundingMode};\n\n // tslint:disable-next-line: no-unnecessary-type-assertion\n const res = ENGINE.runKernel(\n   MaxPool, inputs as {} as NamedTensorMap,\n   attrs as {} as NamedAttrMap) as T;\n\n if (reshapedTo4D) {\n   return reshape(res, [res.shape[1], res.shape[2], res.shape[3]]) as T;\n }\n return res;\n}\n\nexport const maxPool = op({maxPool_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {ENGINE} from '../engine';\nimport {MaxPool3D, MaxPool3DAttrs, MaxPool3DInputs} from '../kernel_names';\nimport {NamedAttrMap} from '../kernel_registry';\nimport {Tensor4D, Tensor5D} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\nimport * as util from '../util';\n\nimport {op} from './operation';\nimport {reshape} from './reshape';\n\n/**\n * Computes the 3D max pooling.\n *\n * ```js\n * const x = tf.tensor5d([1, 2, 3, 4, 5, 6, 7, 8], [1, 2, 2, 2, 1]);\n * const result = tf.maxPool3d(x, 2, 1, 'valid');\n * result.print();\n * ```\n *\n * @param x The input tensor, of rank 5 or rank 4 of shape\n *   `[batch, depth, height, width, inChannels]`.\n * @param filterSize The filter size:\n *   `[filterDepth, filterHeight, filterWidth]`.\n *   If `filterSize` is a single number,\n *   then `filterDepth == filterHeight == filterWidth`.\n * @param strides The strides of the pooling:\n *   `[strideDepth, strideHeight, strideWidth]`.\n *   If `strides` is a single number,\n *   then `strideDepth == strideHeight == strideWidth`.\n * @param pad The type of padding algorithm.\n *   - `same` and stride 1: output will be of same size as input,\n *   regardless of filter size.\n *   - `valid`: output will be smaller than input if filter is larger\n *   than 1*1x1.\n *   - For more info, see this guide:\n *   [https://www.tensorflow.org/api_guides/python/nn#Convolution](\n *   https://www.tensorflow.org/api_guides/python/nn#Convolution)\n * @param dimRoundingMode A string from: 'ceil', 'round', 'floor'. If none is\n *   provided, it will default to truncate.\n * @param dataFormat An optional string from: \"NDHWC\", \"NCDHW\". Defaults to\n *   \"NDHWC\". Specify the data format of the input and output data. With the\n *   default format \"NDHWC\", the data is stored in the order of: [batch,\n *   depth, height, width, channels]. Only \"NDHWC\" is currently supported.\n * @doc {heading: 'Operations', subheading: 'Convolution'}\n */\nfunction maxPool3d_<T extends Tensor4D|Tensor5D>(\n   x: T|TensorLike, filterSize: [number, number, number]|number = [1, 1, 1],\n   strides: [number, number, number]|number, pad: 'valid'|'same'|number,\n   dimRoundingMode?: 'floor'|'round'|'ceil',\n   dataFormat: 'NDHWC'|'NCDHW' = 'NDHWC'): T {\n const $x = convertToTensor(x, 'x', 'maxPool3d');\n\n let x5D = $x as Tensor5D;\n let reshapedTo5D = false;\n if ($x.rank === 4) {\n   reshapedTo5D = true;\n   x5D = reshape($x, [1, $x.shape[0], $x.shape[1], $x.shape[2], $x.shape[3]]);\n }\n\n util.assert(\n   x5D.rank === 5,\n   () => `Error in maxPool3d: x must be rank 5 but got rank ${x5D.rank}.`);\n util.assert(\n   dataFormat === 'NDHWC',\n   () => `Error in maxPool3d: Only NDHWC

is currently supported, ` +\n `but got dataFormat of ${dataFormat}`);\n if (dimRoundingMode != null) {\n util.assert(\n util.isInt(pad as number),\n () => `Error in maxPool3d: pad must be an integer when using, ` +\n `dimRoundingMode ${dimRoundingMode} but got pad ${pad}.`);\n }\n\n const inputs: MaxPool3DInputs = {x: x5D};\n\n const attrs:\n MaxPool3DAttrs = {filterSize, strides, pad, dimRoundingMode, dataFormat};\n\n // tslint:disable-next-line: no-unnecessary-type-assertion\n const res = ENGINE.runKernel(\n MaxPool3D, inputs as {} as NamedTensorMap,\n attrs as {} as NamedAttrMap) as T;\n\n if (reshapedTo5D) {\n return reshape(\n res, [res.shape[1], res.shape[2], res.shape[3], res.shape[4]]) as\n T;\n }\n\n return res;\n}\n\nexport const maxPool3d = op({maxPool3d_});\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the
License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {ENGINE} from '../engine';\nimport {MaxPoolWithArgmax, MaxPoolWithArgmaxAttrs, MaxPoolWithArgmaxInputs} from '../kernel_names';\nimport {NamedAttrMap} from '../kernel_registry';\nimport {Tensor, Tensor4D} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\n\nimport {op} from './operation';\n\n/**\n * Computes the 2D max pooling of an image with Argmax index.\n * The indices in argmax are flattened, so that a maximum value at position `[b,\n * y, x, c]` becomes flattened index: `(y * width + x) * channels + c` if\n * include_batch_in_index is False; `((b * height + y) * width + x) * channels\n * +c` if include_batch_in_index is True.\n *\n * The indices returned are always in `[0, height) x [0, width)` before\n * flattening.\n *\n * @param x The input tensor, of rank 4 or rank 3 of shape\n * `[batch, height, width, inChannels]`. If rank 3, batch of 1 is assumed.\n * @param filterSize The filter size: `[filterHeight, filterWidth]`. If\n * `filterSize` is a single number, then `filterHeight == filterWidth`.\n * @param strides The strides of the pooling: `[strideHeight, strideWidth]`. If\n * `strides` is a single number, then `strideHeight == strideWidth`.\n * @param dataFormat An optional string from: \"NDHWC\", \"NCDHW\". Defaults to\n * \"NDHWC\". Specify the data format of the input and output data. With the\n * default format \"NDHWC\", the data is stored in the order of: [batch,\n * depth, height, width, channels]. Only \"NDHWC\" is currently supported.\n * @param pad The type of padding algorithm.\n * - `same` and stride 1: output will be of same size as input,\n * regardless of filter size.\n * - `valid`: output will be smaller than input if filter is larger\n * than 1x1.\n * - For more info, see this guide:\n * [https://www.tensorflow.org/api_guides/python/nn#Convolution](\n * https://www.tensorflow.org/api_guides/python/nn#Convolution)\n * @param includeBatchIndex Defaults to False. Whether to include batch\n * dimension in flattened index of argmax.\n *\n * @doc {heading: 'Operations', subheading: 'Convolution'}\n */\nfunction maxPoolWithArgmax_<T extends Tensor4D>(\n x: T|TensorLike, filterSize: [number, number]|number,\n strides: [number, number]|number, pad: 'valid'|'same'|number,\n includeBatchInIndex = false): NamedTensorMap {\n const $x = convertToTensor(x, 'x', 'maxPoolWithArgmax');\n\n const inputs: MaxPoolWithArgmaxInputs = {x: $x};\n const attrs:\n MaxPoolWithArgmaxAttrs = {filterSize, strides, pad, includeBatchInIndex};\n\n // tslint:disable-next-line: no-unnecessary-type-assertion\n const result = ENGINE.runKernel(\n MaxPoolWithArgmax, inputs as {} as NamedTensorMap,\n attrs as {} as NamedAttrMap) as Tensor[];\n\n return {result: result[0], indexes: result[1]};\n}\n\nexport const maxPoolWithArgmax = op({maxPoolWithArgmax_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable

law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {ENGINE} from '../engine';\nimport {Maximum, MaximumInputs} from '../kernel_names';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {makeTypesMatch} from '../tensor_util';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\n\nimport {assertAndGetBroadcastShape} from './broadcast_util';\nimport {cast} from './cast';\nimport {op} from './operation';\n\n/**\n * Returns the max of a and b (`a > b ? a : b`) element-wise.\n * Supports broadcasting.\n *\n * We also expose `tf.maximumStrict` which has the same signature as this op and\n * asserts that `a` and `b` are the same shape (does not broadcast).\n *\n * ```js\n * const a = tf.tensor1d([1, 4, 3, 16]);\n * const b = tf.tensor1d([1, 2, 9, 4]);\n *\n * a.maximum(b).print(); // or tf.maximum(a, b)\n * ```\n *\n * ```js\n * // Broadcast maximum a with b.\n * const a = tf.tensor1d([2, 4, 6, 8]);\n * const b = tf.scalar(5);\n *\n * a.maximum(b).print(); // or tf.maximum(a, b)\n * ```\n *\n * @param a The first tensor.\n * @param b The second tensor. Must have the same type as `a`.\n *\n * @doc {heading: 'Operations', subheading: 'Arithmetic'}\n */\nfunction maximum_<T extends Tensor>(\n   a: Tensor|TensorLike, b: Tensor|TensorLike): T {\n let $a = convertToTensor(a, 'a', 'maximum');\n let $b = convertToTensor(b, 'b', 'maximum');\n [$a, $b] = makeTypesMatch($a, $b);\n\n if ($a.dtype === 'bool') {\n $a = cast($a, 'int32');\n $b = cast($b, 'int32');\n }\n assertAndGetBroadcastShape($a.shape, $b.shape);\n\n const inputs: MaximumInputs = {a: $a, b: $b};\n\n return ENGINE.runKernel(Maximum, inputs as {} as NamedTensorMap);\n}\n\nexport const maximum = op({maximum_});\n","/**\n * @license\n * Copyright 2020 Google Inc. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {ENGINE} from '../engine';\nimport {Mean, MeanAttrs, MeanInputs} from '../kernel_names';\nimport {NamedAttrMap} from '../kernel_registry';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\n\nimport {op} from './operation';\n\n/**\n * Computes the mean of elements across dimensions of a `tf.Tensor`.\n *\n * Reduces `x` along the dimensions given in `axis`. Unless `keepDims` is\n * true, the rank of the `tf.Tensor` is reduced by 1 for each entry in `axis`.\n * If `keepDims` is true, the reduced dimensions are retained with length 1.\n * If `axis` has no entries, all dimensions are reduced, and a `tf.Tensor` with\n * a single element is returned.\n *\n * ```js\n * const x = tf.tensor1d([1, 2, 3]);\n *\n * x.mean().print(); // or tf.mean(a)\n * ```\n *\n * ```js\n * const x = tf.tensor2d([1, 2, 3, 4], [2, 2]);\n *\n * const axis = 1;\n * x.mean(axis).print(); // or tf.mean(x, axis)\n * ```\n *\n * @param x The input tensor.\n * @param axis The dimension(s) to reduce. By default it reduces\n *   all dimensions.\n * @param keepDims If true, retains reduced dimensions with size 1.\n *\n * @doc {heading: 'Operations', subheading: 'Reduction'}\n */\nfunction mean_<T extends Tensor>(\n   x: Tensor|TensorLike, axis: number|number[] = null, keepDims = false): T {\n const $x = convertToTensor(x, 'x', 'mean');\n\n const inputs: MeanInputs = {x: $x};\n const attrs: MeanAttrs = {axis, keepDims};\n\n return ENGINE.runKernel(\n   Mean, inputs as {} as NamedTensorMap, attrs as {} as NamedAttrMap);\n}\n\nexport const mean = op({mean_});\n","/**\n * @license\n * Copyright 2020 Google Inc. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n *

WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\nimport {ENGINE} from '../engine';\nimport {Min, MinAttrs, MinInputs} from '../kernel_names';\nimport {NamedAttrMap} from '../kernel_registry';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\n\nimport {op} from './operation';\n\n/**\n * Computes the minimum value from the input.\n *\n * Reduces the input along the dimensions given in `axes`. Unless `keepDims`\n * is true, the rank of the array is reduced by 1 for each entry in `axes`.\n * If `keepDims` is true, the reduced dimensions are retained with length 1.\n * If `axes` has no entries, all dimensions are reduced, and an array with a\n * single element is returned.\n *\n * ```js\n * const x = tf.tensor1d([1, 2, 3]);\n *\n * x.min().print(); // or tf.min(x)\n * ```\n *\n * ```js\n * const x = tf.tensor2d([1, 2, 3, 4], [2, 2]);\n *\n * const axis = 1;\n * x.min(axis).print(); // or tf.min(x, axis)\n * ```\n *\n * @param x The input Tensor.\n * @param axis The dimension(s) to reduce. By default it reduces\n *   all dimensions.\n * @param keepDims If true, retains reduced dimensions with size 1.\n *\n * @doc {heading: 'Operations', subheading: 'Reduction'}\n */\nfunction min_<T extends Tensor>(\n   x: Tensor|TensorLike, axis: number|number[] = null, keepDims = false): T {\n const $x = convertToTensor(x, 'x', 'min');\n\n const inputs: MinInputs = {x: $x};\n const attrs: MinAttrs = {axis, keepDims};\n\n // tslint:disable-next-line: no-unnecessary-type-assertion\n return ENGINE.runKernel(\n   Min, inputs as {} as NamedTensorMap,\n   attrs as {} as NamedAttrMap) as T;\n}\n\nexport const min = op({min_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {ENGINE} from '../engine';\nimport {Minimum, MinimumInputs} from '../kernel_names';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {makeTypesMatch} from '../tensor_util';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\n\nimport {assertAndGetBroadcastShape} from './broadcast_util';\nimport {cast} from './cast';\nimport {op} from './operation';\n\n/**\n * Returns the min of a and b (`a < b ? a : b`) element-wise.\n * Supports broadcasting.\n *\n * We also expose `minimumStrict` which has the same signature as this op and\n * asserts that `a` and `b` are the same shape (does not broadcast).\n *\n * ```js\n * const a = tf.tensor1d([1, 4, 3, 16]);\n * const b = tf.tensor1d([1, 2, 9, 4]);\n *\n * a.minimum(b).print(); // or tf.minimum(a, b)\n * ```\n *\n * ```js\n * // Broadcast minimum a with b.\n * const a = tf.tensor1d([2, 4, 6, 8]);\n * const b = tf.scalar(5);\n *\n * a.minimum(b).print(); // or tf.minimum(a, b)\n * ```\n *\n * @param a The first tensor.\n * @param b The second tensor. Must have the same type as `a`.\n *\n * @doc {heading: 'Operations', subheading: 'Arithmetic'}\n */\nfunction minimum_<T extends Tensor>(\n   a: Tensor|TensorLike, b: Tensor|TensorLike): T {\n let $a = convertToTensor(a, 'a', 'minimum');\n let $b = convertToTensor(b, 'b', 'minimum');\n [$a, $b] = makeTypesMatch($a, $b);\n\n if ($a.dtype === 'bool') {\n $a = cast($a, 'int32');\n $b = cast($b, 'int32');\n }\n\n assertAndGetBroadcastShape($a.shape, $b.shape);\n\n const inputs: MinimumInputs = {a: $a, b: $b};\n\n return ENGINE.runKernel(Minimum, inputs as {} as NamedTensorMap);\n}\n\nexport const minimum = op({minimum_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES

OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {ENGINE} from '../engine';\nimport {MirrorPad, MirrorPadAttrs, MirrorPadInputs} from '../kernel_names';\nimport {NamedAttrMap} from '../kernel_registry';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport
{convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\nimport * as util from '../util';\n\nimport {op} from './operation';\n\n/**\n * Pads a `tf.Tensor` using mirror padding.\n *\n * This operation implements the `REFLECT` and `SYMMETRIC` modes of pad.\n *\n * ```js\n * const x = tf.range(0, 9).reshape([1, 1, 3, 3]);\n * x.mirrorPad([[0, 0], [0, 0], [2, 2], [2, 2]], 'reflect').print();\n * ```\n * @param x The tensor to pad.\n * @param paddings An array of length `R` (the rank of the tensor), where\n * each element is a length-2 tuple of ints `[padBefore, padAfter]`,\n * specifying how much to pad along each dimension of the tensor.\n * In \"reflect\" mode, the padded regions do not include the borders,\n * while in \"symmetric\" mode the padded regions do include the borders.\n * For example, if the input is `[1, 2, 3]` and paddings is `[0, 2]`,\n * then the output is `[1, 2, 3, 2, 1]` in \"reflect\" mode, and\n * `[1, 2, 3, 3, 2]` in \"symmetric\"
mode.\n * If `mode` is \"reflect\" then both `paddings[D, 0]` and `paddings[D, 1]`\n * must be no greater than `x.shape[D] - 1`. If mode is \"symmetric\"\n * then both `paddings[D, 0]` and `paddings[D, 1]` must be no greater than\n * `x.shape[D]`\n * @param mode String to specify padding mode. Can be `'reflect' | 'symmetric'`\n */\n/** @doc {heading: 'Tensors', subheading: 'Transformations'} */\nfunction mirrorPad_<T extends Tensor>(\n x: T|TensorLike, paddings: Array<[number, number]>,\n mode: 'reflect'|'symmetric'): T {\n util.assert(\n mode === 'reflect' || mode === 'symmetric',\n () => `Invalid mode. Mode must be either reflect or symmetric. ` +\n `Got ${mode}.`);\n\n const $x = convertToTensor(x, 'x', 'mirrorPad');\n if ($x.rank === 0) {\n throw new Error(\n 'mirrorPad(scalar) is not defined. ' +\n 'Pass non-scalar to mirrorPad');\n }\n util.assert(\n paddings.length === $x.rank,\n () => `Padding doesn't match input. Must
be ${$x.rank}. ` +\n `Got ${paddings.length}.`);\n const shapeOffset = mode === 'reflect' ? 1 : 0;\n for (let i = 0; i < $x.rank; i++) {\n util.assert(\n paddings[i].length === 2,\n () => `Invalid number of paddings. Must be length of 2 each.`);\n util.assert(\n paddings[i][0] >= 0 && paddings[i][0] <= $x.shape[i] - shapeOffset &&\n paddings[i][1] >= 0 && paddings[i][1] <= $x.shape[i] - shapeOffset,\n () => `Padding in dimension ${i} cannot be greater than or equal ` +\n `to ${$x.shape[i] - shapeOffset} or less than 0 for input of ` +\n `shape ${$x.shape}`);\n }\n\n const attrs: MirrorPadAttrs = {paddings, mode};\n const inputs: MirrorPadInputs = {x: $x};\n return ENGINE.runKernel(\n MirrorPad, inputs as {} as NamedTensorMap, attrs as {} as NamedAttrMap);\n}\n\nexport const mirrorPad = op({mirrorPad_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache
License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {ENGINE} from '../engine';\nimport {Mod, ModInputs} from '../kernel_names';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {makeTypesMatch} from '../tensor_util';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\n\nimport {op} from './operation';\n\n/**\n * Returns the mod of
a and b element-wise.\n * `floor(x / y) * y + mod(x, y) = x`\n * Supports broadcasting.\n *\n * We also expose `tf.modStrict` which has the same signature as this op and\n * asserts that `a` and `b` are the same shape (does not broadcast).\n *\n * ```js\n * const a = tf.tensor1d([1, 4, 3, 16]);\n * const b = tf.tensor1d([1, 2, 9, 4]);\n *\n * a.mod(b).print(); // or tf.mod(a, b)\n * ```\n *\n * ```js\n * // Broadcast a mod b.\n * const a = tf.tensor1d([2, 4, 6, 8]);\n * const b = tf.scalar(5);\n *\n * a.mod(b).print(); // or tf.mod(a, b)\n * ```\n *\n * @param a The first tensor.\n

* @param b The second tensor. Must have the same type as `a`.\n *\n * @doc {heading: 'Operations', subheading: 'Arithmetic'}\n */\nfunction mod_<T extends Tensor>(a: Tensor|TensorLike, b: Tensor|TensorLike): T {\n let $a = convertToTensor(a, 'a', 'mod');\n let $b = convertToTensor(b, 'b', 'mod');\n [$a, $b] = makeTypesMatch($a, $b);\n\n const inputs: ModInputs = {a: $a, b: $b};\n\n return ENGINE.runKernel(Mod, inputs as {} as NamedTensorMap);\n}\n\nexport const mod = op({mod_});\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {ENGINE} from '../engine';\nimport {Tensor} from '../tensor';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\nimport {op} from './operation';\n\n/**\n * Computes square of `x` element-wise: `x ^ 2`\n *\n * ```js\n * const x = tf.tensor1d([1, 2, Math.sqrt(2), -1]);\n *\n * x.square().print(); // or tf.square(x)\n * ```\n * @param x The input Tensor.\n *\n * @doc {heading: 'Operations', subheading: 'Basic math'}\n */\nfunction square_<T extends Tensor>(x: T|TensorLike): T {\n const $x = convertToTensor(x, 'x', 'square');\n const attrs = {};\n return ENGINE.runKernel('Square', {x: $x}, attrs);\n}\n\nexport const square = op({square_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {Tensor} from '../tensor';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\nimport {parseAxisParam} from '../util';\n\nimport {expandShapeToKeepDim} from './axis_util';\nimport {cast} from './cast';\nimport {mean} from './mean';\nimport {op} from './operation';\nimport {reshape} from './reshape';\nimport {square} from './square';\nimport {sub} from './sub';\n\n/**\n * Calculates the mean and variance of `x`. The mean and variance are\n * calculated by aggregating the contents of `x` across `axes`. If `x` is\n * 1-D and `axes = [0]` this is just the mean and variance of a vector.\n *\n * @param x The input tensor.\n * @param axis The dimension(s) along with to compute mean and\n *   variance. By default it reduces all dimensions.\n * @param keepDims If true, the moments have the same dimensionality as the\n * input.\n * @return An object with two keys: `mean` and `variance`.\n *\n * @doc {heading: 'Operations', subheading: 'Normalization'}\n */\nfunction moments_(\n   x: Tensor|TensorLike, axis: number|number[] = null,\n keepDims = false): {mean: Tensor, variance: Tensor} {\n x = convertToTensor(x, 'x', 'moments');\n const axes = parseAxisParam(axis, x.shape);\n const xMean = mean(x, axes, keepDims);\n let keepDimsShape = xMean.shape;\n if (!keepDims) {\n   keepDimsShape = expandShapeToKeepDim(xMean.shape, axes);\n }\n const devSquared =\n   square(sub(cast(x, 'float32'), reshape(xMean, keepDimsShape)));\n const variance = mean(devSquared, axes, keepDims);\n return {mean: xMean, variance};\n}\n\nexport const moments = op({moments_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific

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language governing permissions and\n * limitations under the License.\n *
==========================================================================\n
*/\nimport {Tensor2D} from '../tensor';\nimport {convertToTensor, convertToTensorArray} from
'../tensor_util_env';\nimport {TensorLike} from '../types';\nimport {op} from './operation';\n\n/**\n * @docalias
(data: Tensor2D, c: Tensor2D, h: Tensor2D): [Tensor2D, Tensor2D]\n */\nexport type LSTMCellFunc = {\n  (data:
Tensor2D, c: Tensor2D, h: Tensor2D): [Tensor2D, Tensor2D];\n};\n\n/**\n * Computes the next
 states and outputs of a stack of LSTMCells.\n *\n * Each cell output is used as input to the next cell.\n *\n * Returns
`[cellState, cellOutput]`.\n *\n * Derived from tf.contrib.rn.MultiRNNCell.\n *\n * @param lstmCells Array of
LSTMCell functions.\n * @param data The input to the cell.\n * @param c Array of previous cell states.\n *
@param h Array of previous cell outputs.\n *\n * @doc {heading: 'Operations', subheading: 'RNN'}\n */\nfunction
multiRNNCell_(\n    lstmCells: LSTMCellFunc[], data: Tensor2D|TensorLike,\n    c:
Array<Tensor2D|TensorLike>,\n    h: Array<Tensor2D|TensorLike>): [Tensor2D[], Tensor2D[]] {\n  const $data =
convertToTensor(data, 'data', 'multiRNNCell');\n  const $c = convertToTensorArray(c, 'c', 'multiRNNCell');\n  const
$h = convertToTensorArray(h, 'h', 'multiRNNCell');\n\n  let input = $data;\n  const newStates = [];\n  for (let i = 0; i
< lstmCells.length; i++) {\n    const output = lstmCells[i](input, $c[i], $h[i]);\n    newStates.push(output[0]);\n
newStates.push(output[1]);\n
    input = output[1];\n  }\n  const newC: Tensor2D[] = [];\n  const newH: Tensor2D[] = [];\n  for (let i = 0; i <
newStates.length; i += 2) {\n    newC.push(newStates[i]);\n    newH.push(newStates[i + 1]);\n  }\n  return [newC,
newH];\n}\nexport const multiRNNCell = op({multiRNNCell_});\n","/**\n * @license\n * Copyright 2020 Google
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use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n *
http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing,
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OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language
governing permissions and\n * limitations under the License.\n *
==========================================================================\n
 */\n\nimport {ENGINE} from '../engine';\nimport {Multinomial, MultinomialAttrs, MultinomialInputs} from
'../kernel_names';\nimport {NamedAttrMap} from '../kernel_registry';\nimport {Tensor1D, Tensor2D} from
'../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from
'../tensor_util_env';\nimport {TensorLike} from '../types';\n\nimport {op} from './operation';\nimport {reshape} from
'./reshape';\n\n/**\n * Creates a `tf.Tensor` with values drawn from a multinomial distribution.\n *\n * ```js\n * const
probs = tf.tensor([.75, .25]);\n * tf.multinomial(probs, 3).print();\n * ```\n *\n * @param logits 1D array with
unnormalized log-probabilities, or\n *     2D array of shape `[batchSize, numOutcomes]`. See the `normalized`\n *
parameter.\n * @param numSamples Number of samples to draw for each row slice.\n * @param seed The seed
number.\n * @param normalized Whether the provided `logits` are normalized true\n *     probabilities
 (sum to 1). Defaults to false.\n * @return 1D array of shape `[numSamples]`, or 2D array of shape\n *
`[batchSize, numSamples]`, depending on the rank of the input.\n *\n * @doc {heading: 'Tensors', subheading:
'Random'}\n */\nfunction multinomial_(\n    logits: Tensor1D|Tensor2D|TensorLike, numSamples: number, seed?:
number,\n    normalized = false): Tensor1D|Tensor2D {\n  const $logits = convertToTensor(logits, 'logits',
'multinomial');\n  const numOutcomes = $logits.size;\n  const origRank = $logits.rank;\n  if (numOutcomes < 2) {\n
 throw new Error(\n      `Error in multinomial: you need at least 2 outcomes, but got ` +\n
`${numOutcomes}.`);\n  }\n  if (origRank > 2) {\n    throw new Error(`Rank of probabilities must be 1 or 2, but is
${origRank}`);\n  }\n  // TODO(lina128): Investigate correct seed behavior. The code seems not allow\n  // setting
see to 0.\n  seed = seed || Math.random();\n\n  // The kernel only accepts (and returns) rank 2 tensors.\n  const
 logits2D: Tensor2D =\n      origRank === 1 ? reshape($logits, [1, -1]) : $logits as Tensor2D;\n\n  const inputs:
MultinomialInputs = {logits: logits2D};\n  const attrs: MultinomialAttrs = {numSamples, seed, normalized};\n\n  //
tslint:disable-next-line: no-unnecessary-type-assertion\n  const res = ENGINE.runKernel(\n      Multinomial,
inputs as {} as NamedTensorMap,\n      attrs as {} as NamedAttrMap) as Tensor2D;\n\n  // tslint:disable-
```

next-line:no-unnecessary-type-assertion\n return origRank === 1 ? reshape(res, [res.size]) as Tensor1D : res;\n}\n\nexport const multinomial = op({multinomial_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ===\n */\nimport {ENGINE} from '../engine';\nimport {NotEqual, NotEqualInputs} from '../kernel_names';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {makeTypesMatch} from '../tensor_util';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\n\nimport {assertAndGetBroadcastShape} from './broadcast_util';\nimport {op} from './operation';\n\n/**\n * Returns the truth value of (a != b) element-wise. Supports broadcasting.\n *\n * ```js\n * const a = tf.tensor1d([1, 2, 3]);\n * const b = tf.tensor1d([0, 2, 3]);\n *\n * a.notEqual(b).print();\n * ```\n * @param a
 The first input tensor.\n * @param b The second input tensor. Must have the same dtype as `a`.\n *\n * @doc {heading: 'Operations', subheading: 'Logical'}\n */\nfunction notEqual_<T extends Tensor>(\n   a: Tensor|TensorLike, b: Tensor|TensorLike): T {\n let $a = convertToTensor(a, 'a', 'notEqual');\n let $b = convertToTensor(b, 'b', 'notEqual');\n [$a, $b] = makeTypesMatch($a, $b);\n\n assertAndGetBroadcastShape($a.shape, $b.shape);\n\n const inputs: NotEqualInputs = {a: $a, b: $b};\n\n return ENGINE.runKernel(NotEqual, inputs as {} as NamedTensorMap);\n}\n\nexport const notEqual = op({notEqual_});\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n *
 distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ===\n */\n\nimport {ENGINE} from '../engine';\nimport {Tensor} from '../tensor';\nimport {DataType, Rank, ShapeMap} from '../types';\nimport {makeZerosTypedArray, sizeFromShape} from '../util';\n\nimport {complex} from './complex';\n\n/**\n * Creates a `tf.Tensor` with all elements set to 0.\n *\n * ```js\n * tf.zeros([2, 2]).print();\n * ```\n *\n * @param shape An array of integers defining the output tensor shape.\n * @param dtype The type of an element in the resulting tensor. Can\n *   be 'float32', 'int32' or 'bool'. Defaults to 'float'.\n *\n * @doc {heading: 'Tensors', subheading: 'Creation'}\n */\nexport function zeros<R extends Rank>(\n   shape: ShapeMap[R],
 dtype: DataType = 'float32'): Tensor<R> {\n if (dtype === 'complex64') {\n   const real = zeros(shape, 'float32');\n   const imag = zeros(shape, 'float32');\n   return complex(real, imag);\n }\n const values = makeZerosTypedArray(sizeFromShape(shape), dtype);\n return ENGINE.makeTensor(values, shape, dtype) as Tensor<R>;\n}\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ===\n */\n\nimport {ENGINE} from '../engine';\nimport {Tensor} from '../tensor';\nimport {DataType, Rank, ShapeMap} from '../types';\nimport {makeOnesTypedArray, sizeFromShape} from '../util';\n\nimport {complex} from '../ops/complex';\n\n/**\n * Creates a `tf.Tensor` with all elements set to 1.\n *\n * ```js\n * tf.ones([2, 2]).print();\n * ```\n *\n * @param shape An array of integers defining the output tensor shape.\n * @param dtype The type of an element in the resulting tensor. Defaults to\n *   'float'.\n *\n * @doc {heading: 'Tensors', subheading: 'Creation'}\n */\nexport function ones<R extends Rank>(\n   shape: ShapeMap[R], dtype: DataType = 'float32'): Tensor<R> {\n if (dtype === 'complex64') {\n   const real = ones(shape, 'float32');\n   const imag = ones(shape, 'float32');\n   return complex(real, imag);\n }\n const values = makeOnesTypedArray(sizeFromShape(shape), dtype);\n return ENGINE.makeTensor(values, shape, dtype) as Tensor<R>;\n}\n","/**\n * @license\n * Copyright 2017 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ===\n */\n\nimport {ENGINE} from '../engine';\nimport {Tensor} from '../tensor';\nimport {DataType, Rank, ShapeMap} from '../types';\nimport {sizeFromShape} from '../util';\n\n/**\n * Creates a new variable with the provided initial value.\n * ```js\n * const x = tf.variable([1, 2, 3]);\n * x.assign([4, 5, 6]);\n *\n * x.print();\n * ```\n *\n * @param initialValue Initial value for the tensor.\n * @param trainable If true, optimizers are allowed to update it.\n * @param name Name of the variable. Defaults to a unique id.\n * @param dtype If set, initialValue will be converted to the given type.\n *\n * @doc {heading: 'Tensors', subheading: 'Creation'}\n */\nexport function variable<R extends Rank>(\n   initialValue: Tensor<R>, trainable = true, name?: string,\n   dtype?: DataType): Variable<R> {\n return ENGINE.makeVariable(initialValue, trainable, name, dtype) as Variable<R>;\n}\n\n/**\n * Creates a new variable with the same shape and dtype as the given tensor.\n *\n * ```js\n * const x = tf.variable([1, 2, 3]);\n * x.assign([4, 5, 6]);\n *\n * x.print();\n * ```\n *\n * @param x Tensor to clone.\n * @param trainable If true, optimizers are allowed to update it.\n * @param name Name of the variable. Defaults to a unique id.\n *\n * @doc {heading: 'Tensors', subheading: 'Creation'}\n */\nexport function variableLike<R extends Rank>(\n   x: Tensor<R>, trainable = true, name?: string): Variable<R> {\n const initialValue = zeros(x.shape, x.dtype);\n return ENGINE.makeVariable(initialValue, trainable, name, x.dtype) as Variable<R>;\n}\n\n/**\n * Creates a new variable with the same shape and dtype as the given tensor,\n * initialized to 1.\n *\n * ```js\n * const x = tf.variable([1, 2, 3]);\n * x.assign([4, 5, 6]);\n *\n * x.print();\n * ```\n *\n * @param x Tensor to clone.\n * @param trainable If true, optimizers are allowed to update it.\n * @param name Name of the variable. Defaults to a unique id.\n *\n * @doc {heading: 'Tensors', subheading: 'Creation'}\n */\nexport function onesLike<R extends Rank>(\n   x: Tensor<R>, trainable = true, name?: string): Variable<R> {\n const initialValue = ones(x.shape, x.dtype);\n return ENGINE.makeVariable(initialValue, trainable, name, x.dtype) as Variable<R>;\n}\n\n/**\n * Creates a new variable with the same shape and dtype as the given tensor,\n * initialized to 0.\n *\n * ```js\n * const x = tf.variable([1, 2, 3]);\n * x.assign([4, 5, 6]);\n *\n * x.print();\n * ```\n *\n * @param x Tensor to clone.\n * @param trainable If true, optimizers are allowed to update it.\n * @param name Name of the variable. Defaults to a unique id.\n *\n * @doc {heading: 'Tensors', subheading: 'Creation'}\n */\nexport function zerosLike<R extends Rank>(\n   x: Tensor<R>, trainable = true, name?: string): Variable<R> {\n const initialValue = zeros(x.shape, x.dtype);\n return ENGINE.makeVariable(initialValue, trainable, name, x.dtype) as Variable

'./complex';\nimport {zeros} from './zeros';\n\n/**\n * Creates a `tf.Tensor` with all elements set to 1.\n *\n * ```js\n * tf.ones([2, 2]).print();\n * ```\n *\n * @param shape An array of integers defining the output tensor shape.\n * @param dtype The type of an element in the resulting tensor. Defaults to\n * 'float'.\n *\n * @doc {heading: 'Tensors', subheading: 'Creation'}\n */\nexport function ones<R extends Rank>(\n shape: ShapeMap[R], dtype: DataType = 'float32'): Tensor<R> {\n if (dtype === 'complex64') {\n const real = ones(shape, 'float32');\n const imag = zeros(shape, 'float32');\n return complex(real, imag);\n }\n const values = makeOnesTypedArray(sizeFromShape(shape), dtype);\n return ENGINE.makeTensor(values, shape, dtype) as Tensor<R>;\n}\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {ENGINE} from '../engine';\nimport {OnesLike, OnesLikeInputs} from '../kernel_names';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\n\nimport {op} from './operation';\n\n/**\n * Creates a `tf.Tensor` with all elements set to 1 with the same shape as the\n * given tensor.\n *\n * ```js\n * const x = tf.tensor([1, 2]);\n * tf.onesLike(x).print();\n * ```\n * @param x A tensor.\n *\n * @doc {heading: 'Tensors', subheading: 'Creation'}\n */\nfunction onesLike_<T extends Tensor>(x: T|TensorLike): T {\n const $x = convertToTensor(x, 'x', 'onesLike');\n\n const inputs: OnesLikeInputs = {x: $x};\n return ENGINE.runKernel(OnesLike, inputs as {} as NamedTensorMap);\n}\n\nexport const onesLike = op({onesLike_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\nimport {Tensor1D, Tensor2D} from '../tensor';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\nimport * as util from '../util';\n\nimport {matMul} from './mat_mul';\nimport {op} from './operation';\nimport {reshape} from './reshape';\n\n/**\n * Computes the outer product of two vectors, `v1` and `v2`.\n *\n * ```js\n * const a = tf.tensor1d([1, 2, 3]);\n * const b = tf.tensor1d([3, 4, 5]);\n *\n * tf.outerProduct(a, b).print();\n * ```\n * @param v1 The first vector in the outer product operation.\n * @param v2 The second vector in the outer product operation.\n *\n * @doc {heading: 'Operations', subheading: 'Matrices'}\n */\nfunction outerProduct_(\n v1: Tensor1D|TensorLike, v2: Tensor1D|TensorLike): Tensor2D {\n const $v1 = convertToTensor(v1, 'v1', 'outerProduct');\n const $v2 = convertToTensor(v2, 'v2', 'outerProduct');\n\n util.assert(\n $v1.rank === 1 && $v2.rank === 1,\n () => `Error in outerProduct: inputs must be rank 1, but got ranks ` +\n `${$v1.rank} and ${$v2.rank}.`);\n\n const v12D = reshape($v1, [-1, 1]);\n const v22D = reshape($v2, [1, -1]);\n return matMul(v12D, v22D);\n}\n\nexport const outerProduct = op({outerProduct_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under

the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {ENGINE} from '../engine';\nimport {PadV2, PadV2Attrs, PadV2Inputs} from '../kernel_names';\nimport {NamedAttrMap} from '../kernel_registry';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\n\nimport {op} from './operation';\n\n/**\n * Pads a `tf.Tensor` with a given value and paddings.\n *\n * This operation implements `CONSTANT` mode. For `REFLECT` and `SYMMETRIC`,\n * refer to `tf.mirrorPad`\n *\n * Also available are stricter rank-specific methods with the same signature\n * as this method that assert that `paddings` is of given
length.\n * - `tf.pad1d`\n * - `tf.pad2d`\n * - `tf.pad3d`\n * - `tf.pad4d`\n *\n * ```js\n * const x = tf.tensor1d([1, 2, 3, 4]);\n * x.pad([[1, 2]]).print();\n * ```\n * @param x The tensor to pad.\n * @param paddings An array of length `R` (the rank of the tensor), where\n * each element is a length-2 tuple of ints `[padBefore, padAfter]`,\n * specifying how much to pad along each dimension of the tensor.\n * @param constantValue The pad value to use. Defaults to 0.\n *\n * @doc {heading: 'Tensors', subheading: 'Transformations'}\n */\nfunction pad_<T extends Tensor>(\n   x: T|TensorLike, paddings: Array<[number, number]>, constantValue = 0): T {\n const $x = convertToTensor(x, 'x', 'pad');\n if ($x.rank === 0) {\n   throw new Error('pad(scalar) is not defined. Pass non-scalar to pad');\n }\n\n const attrs: PadV2Attrs = {paddings, constantValue};\n const inputs: PadV2Inputs = {x: $x};\n return ENGINE.runKernel(\n   PadV2, inputs as unknown as NamedTensorMap,\n
attrs as unknown as NamedAttrMap);\n}\n\nexport const pad = op({pad_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\nimport {Tensor1D} from '../tensor';\nimport {TensorLike} from '../types';\nimport {assert} from '../util';\nimport {op} from './operation';\nimport {pad} from './pad';\n\n/**\n * Pads a `tf.Tensor1D`
with a given value and paddings. See `pad` for details.\n */\nfunction pad1d_(\n   x: Tensor1D|TensorLike, paddings: [number, number],\n   constantValue = 0): Tensor1D {\n assert(\n   paddings.length === 2,\n   () => 'Invalid number of paddings. Must be length of 2.');\n return pad(x, [paddings], constantValue);\n}\n\nexport const pad1d = op({pad1d_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n
* ==========\n */\nimport {Tensor2D} from '../tensor';\nimport {TensorLike} from '../types';\nimport {assert} from '../util';\nimport {op} from './operation';\nimport {pad} from './pad';\n\n/**\n * Pads a `tf.Tensor2D` with a given value and paddings. See `pad` for details.\n */\nfunction pad2d_(\n   x: Tensor2D|TensorLike, paddings: [[number, number], [number, number]],\n   constantValue = 0): Tensor2D {\n assert(\n   paddings.length === 2 && paddings[0].length === 2 &&\n   paddings[1].length === 2,\n   () => 'Invalid number of paddings. Must be length of 2 each.');\n return pad(x, paddings, constantValue);\n}\n\nexport const pad2d = op({pad2d_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version

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at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\nimport {Tensor3D} from '../tensor';\nimport {TensorLike} from '../types';\nimport {assert} from '../util';\nimport {op} from './operation';\nimport {pad} from './pad';\n\n/**\n * Pads a `tf.Tensor3D` with a given value and paddings. See `pad` for details.\n */\nfunction pad3d_(\n x: Tensor3D|TensorLike,\n paddings: [[number, number], [number, number], [number, number]],\n constantValue = 0): Tensor3D {\n assert(\n paddings.length === 3 && paddings[0].length === 2 &&\n paddings[1].length === 2 &&
paddings[2].length === 2,\n () => 'Invalid number of paddings. Must be length of 2 each.');\n return pad(x, paddings, constantValue);\n}\n\nexport const pad3d = op({pad3d_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\nimport {Tensor4D} from '../tensor';\nimport {TensorLike} from '../types';\nimport {assert}
from '../util';\nimport {op} from './operation';\nimport {pad} from './pad';\n\n/**\n * Pads a `tf.Tensor4D` with a given value and paddings. See `pad` for details.\n */\nfunction pad4d_(\n x: Tensor4D|TensorLike,\n paddings:\n [\n [number, number], [number, number], [number, number], [number, number]\n],\n constantValue = 0): Tensor4D {\n assert(\n paddings.length === 4 && paddings[0].length === 2 &&\n paddings[1].length === 2 && paddings[2].length === 2 &&\n paddings[3].length === 2,\n () => 'Invalid number of paddings. Must be length of 2 each.');\n return pad(x, paddings, constantValue);\n}\n\nexport const pad4d = op({pad4d_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {ENGINE} from '../engine';\nimport {SpaceToBatchND, SpaceToBatchNDAttrs, SpaceToBatchNDInputs} from '../kernel_names';\nimport {NamedAttrMap} from '../kernel_registry';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\nimport * as util from '../util';\n\nimport {op} from './operation';\n\n/**\n * This operation divides \"spatial\" dimensions `[1, ..., M]` of the input into\n * a grid of blocks of shape `blockShape`, and interleaves
these blocks with\n * the \"batch\" dimension (0) such that in the output, the spatial\n * dimensions `[1, ..., M]` correspond to the position within the grid,\n * and the batch dimension combines both the position within a spatial block\n * and the original batch position. Prior to division into blocks,\n * the spatial dimensions of the input are optionally zero padded\n * according to `paddings`. See below for a precise description.\n *\n * ```js\n * const x = tf.tensor4d([1, 2, 3, 4], [1, 2, 2, 1]);\n * const blockShape = [2, 2];\n * const paddings = [[0, 0], [0, 0]];\n *\n * x.spaceToBatchND(blockShape, paddings).print();\n * ```\n *\n * @param x A `tf.Tensor`. N-D with `x.shape` =

`[batch] + spatialShape +\n * remainingShape`, where spatialShape has `M` dimensions.\n * @param blockShape A 1-D array. Must have shape `[M]`, all values must\n * be >= 1.\n * @param paddings A 2-D array. Must have shape `[M, 2]`, all values must be >=\n * 0. `paddings[i] = [padStart, padEnd]` specifies
the amount to zero-pad\n * from input dimension `i + 1`, which corresponds to spatial dimension `i`. It\n * is required that\n * `(inputShape[i + 1] + padStart + padEnd) % blockShape[i] === 0`\n *\n * This operation is equivalent to the following steps:\n *\n * 1. Zero-pad the start and end of dimensions `[1, ..., M]` of the input\n * according to `paddings` to produce `padded` of shape paddedShape.\n *\n * 2. Reshape `padded` to `reshapedPadded` of shape:\n * `[batch] + [paddedShape[1] / blockShape[0], blockShape[0], ...,\n * paddedShape[M] / blockShape[M-1], blockShape[M-1]] + remainingShape`\n *\n * 3. Permute dimensions of `reshapedPadded` to produce `permutedReshapedPadded`\n * of shape: `blockShape + [batch] + [paddedShape[1] / blockShape[0], ...,\n * paddedShape[M] / blockShape[M-1]] + remainingShape`\n *\n * 4. Reshape `permutedReshapedPadded` to flatten `blockShape` into the\n * batch dimension, producing an output tensor of shape:\n * `[batch * prod(blockShape)] + [paddedShape[1]
/ blockShape[0], ...,\n * paddedShape[M] / blockShape[M-1]] + remainingShape`\n *\n * @doc {heading: 'Tensors', subheading: 'Transformations'}\n */\nfunction spaceToBatchND_<T extends Tensor>(\n x: T|TensorLike, blockShape: number[], paddings: number[][]): T {\n const $x = convertToTensor(x, 'x', 'spaceToBatchND');\n\n util.assert(\n $x.rank >= 1 + blockShape.length,\n () => `input rank ${$x.rank} should be > than [blockShape] ${\n blockShape.length}`);\n\n util.assert(\n paddings.length === blockShape.length,\n () => `paddings.shape[0] ${\n paddings.length} must be equal to [blockShape] ${blockShape.length}`);\n\n util.assert(\n $x.shape.reduce(\n (a, b, i) => {\n if (i > 0 && i <= blockShape.length) {\n return a &&\n ((b + paddings[i - 1][0] + paddings[i - 1][1]) %\n blockShape[i - 1] ===\n 0);\n }\n return a;\n
},\n true),\n () => `input spatial dimensions ${$x.shape.slice(1)} with paddings ${\n paddings.toString()} must be divisible by blockShapes ${\n blockShape.toString()}`);\n\n const inputs: SpaceToBatchNDInputs = {x: $x};\n const attrs: SpaceToBatchNDAttrs = {blockShape, paddings};\n\n return ENGINE.runKernel(\n SpaceToBatchND, inputs as {} as NamedTensorMap,\n attrs as {} as NamedAttrMap);\n}\n\nexport const spaceToBatchND = op({spaceToBatchND_});\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF
ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n */\n\nimport {Tensor3D, Tensor4D} from '../tensor';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\nimport * as util from '../util';\n\nimport {avgPool} from './avg_pool';\nimport {batchToSpaceND} from './batch_to_space_nd';\nimport * as conv_util from './conv_util';\nimport {maxPool} from './max_pool';\nimport {op} from './operation';\nimport {reshape} from './reshape';\nimport {spaceToBatchND} from './space_to_batch_nd';\n\n/**\n * Performs an N-D pooling operation\n *\n * @param input The input tensor, of rank 4 or rank 3 of shape\n * `[batch, height, width, inChannels]`. If rank 3, batch of 1 is assumed.\n * @param windowShape The filter size: `[filterHeight, filterWidth]`. If\n * `filterSize` is a single number,
then `filterHeight == filterWidth`.\n * @param poolingType The type of pooling, either 'max' or 'avg'.\n * @param pad The type of padding algorithm:\n * - `same` and stride 1: output will be of same size as input,\n * regardless of filter size.\n * - `valid`: output will be smaller than input if filter is larger\n * than 1x1.\n * - For more info, see this guide:\n * [https://www.tensorflow.org/api_guides/python/nn#Convolution](\n * https://www.tensorflow.org/api_guides/python/nn#Convolution)\n * @param dilations The dilation rates: `[dilationHeight, dilationWidth]`\n * in which we sample input values across the height and width dimensions\n *

```
 in dilated pooling. Defaults to `[1, 1]`. If `dilationRate` is a single\n *     number, then `dilationHeight == dilationWidth`. If it is greater than\n *     1, then all values of `strides` must be 1.\n * @param strides The strides of the pooling: `[strideHeight, strideWidth]`. If\n *     `strides` is
 a single number, then `strideHeight == strideWidth`.\n *\n * @doc {heading: 'Operations', subheading: 'Convolution'}\n */\nfunction pool_<T extends Tensor3D|Tensor4D>(\n    input: T|TensorLike, windowShape: [number, number]|number,\n    poolingType: 'avg'|'max', pad: 'valid'|'same'|number,\n    dilations?: [number, number]|number, strides?: [number, number]|number) {\n  if (dilations == null) {\n    dilations = [1, 1];\n  }\n  if (strides == null) {\n    strides = 1;\n  }\n  if (pad === 0) {\n    pad = 'valid';\n  }\n\n  const $x = convertToTensor(input, 'x', 'maxPool');\n  let x4D = $x as Tensor4D;\n  let reshapedTo4D = false;\n\n  if ($x.rank === 3) {\n    reshapedTo4D = true;\n    x4D = reshape($x, [1, $x.shape[0], $x.shape[1], $x.shape[2]]);\n  }\n\n  util.assert(\n      conv_util.eitherStridesOrDilationsAreOne(strides, dilations),\n      () => 'Error in pool: Either strides or dilations must be 1. ' +\n          `Got strides ${strides} and dilations '${dilations}'`);\n\n  const
 convInfo = conv_util.computePool2DInfo(\n      x4D.shape, windowShape, strides, dilations, pad);\n  const dilation: [number, number] =\n      [convInfo.dilationHeight, convInfo.dilationWidth];\n\n  // The following implementation does batchToSpace(pool(spaceToBatch(x)))\n  // whenever dilation > 1 since the TF kernels do not support dilation > 1.\n  // tslint:disable-next-line:max-line-length\n  // https://github.com/tensorflow/tensorflow/blob/50f6bb67dc98c9b74630b6047aae7a4f8a40fd02/tensorflow/python/ops/nn_ops.py#L1037\n\n  let basePadding: number[][];\n  if (pad === 'same') {\n    basePadding = withSpaceToBatchBasePaddings(\n        [convInfo.filterHeight, convInfo.filterWidth], dilation);\n  } else {\n    basePadding = [[0, 0], [0, 0]];\n  }\n\n  const isDilationOne = dilation[0] === 1 && dilation[1] === 1;\n  const [adjustedPadding, adjustedCrops] = requiredSpaceToBatchPaddings(\n      [convInfo.inHeight, convInfo.inWidth], dilation, basePadding);\n  const convertedPad = isDilationOne
 ? pad : 'valid';\n  const convertedX =\n      isDilationOne ? x4D : spaceToBatchND(x4D, dilation, adjustedPadding);\n\n  const forwardOp = poolingType === 'avg' ?\n      () => avgPool(convertedX, windowShape, strides, convertedPad) :\n      () => maxPool(convertedX, windowShape, strides, convertedPad);\n  const y = forwardOp();\n\n  const res = isDilationOne ? y : batchToSpaceND(y, dilation, adjustedCrops);\n\n  if (reshapedTo4D) {\n    return reshape(res, [res.shape[1], res.shape[2], res.shape[3]]) as T;\n  }\n\n  return res as T;\n}\n\n// Helper function to compute crops and paddings for pool with dilation > 1.\n// tslint:disable-next-line:max-line-length\n// https://github.com/tensorflow/tensorflow/blob/50f6bb67dc98c9b74630b6047aae7a4f8a40fd02/tensorflow/python/ops/array_ops.py#L2184\nfunction requiredSpaceToBatchPaddings(\n    inputShape: [number, number], blockShape: [number, number],\n    basePadding: number[][]) {\n  const padStart = basePadding.map(b => b[0]);\n  const origPadEnd
 = basePadding.map(b => b[1]);\n  const fullInputShape = inputShape.concat(padStart, origPadEnd);\n  const padEndExtra = blockShape.map((b, i) => (b - fullInputShape[i] % b) % b);\n  const padEnd = origPadEnd.map((s, i) => s + padEndExtra[i]);\n  const paddings = blockShape.map((_, i) => [padStart[i], padEnd[i]]);\n  const crops = blockShape.map((_, i) => [0, padEndExtra[i]]);\n  return [paddings, crops];\n}\n\n// Helper function to compute base paddings for pool with dilation > 1.\n// tslint:disable-next-line:max-line-length\n// https://github.com/tensorflow/tensorflow/blob/50f6bb67dc98c9b74630b6047aae7a4f8a40fd02/tensorflow/python/ops/nn_ops.py#L524\nfunction withSpaceToBatchBasePaddings(\n    filterShape: [number, number], dilation: [number, number]) {\n  // Spatial dimensions of the filters and the upsampled filters in which we\n  // introduce (rate - 1) zeros between consecutive filter values.\n  const dilatedFilterShape = filterShape.map((s, i) => {\n    return s + (s - 1)
 * (dilation[i] - 1);\n  });\n  const padExtraShape = dilatedFilterShape.map(s => s - 1);\n\n  // When padding is odd, we pad more at end, following the same\n  // convention as conv2d.\n  const padExtraStart = padExtraShape.map(s => Math.floor(s / 2));\n  const padExtraEnd = padExtraShape.map((s, i) => s - padExtraStart[i]);\n  return padExtraShape.map((_, i) => {\n    return [padExtraStart[i], padExtraEnd[i]];\n  });\n}\n\nexport const pool = op({pool_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the
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the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n
*/\nimport {ENGINE} from '../engine';\nimport {Pow, PowInputs} from '../kernel_names';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {makeTypesMatch} from '../tensor_util';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\n\nimport {op} from './operation';\n\n/**\n * Computes the power of one `tf.Tensor` to another. Supports broadcasting.\n *\n * Given a `tf.Tensor` x and a `tf.Tensor` y, this operation computes x^y for\n * corresponding elements in x and y. The result's dtype will be the upcasted\n * type of the `base` and `exp` dtypes.\n *\n * ```js\n * const a = tf.tensor([[2, 3], [4, 5]])\n * const b = tf.tensor([[1, 2], [3, 0]]).toInt();\n *\n * a.pow(b).print(); // or tf.pow(a, b)\n * ```\n *\n * ```js\n * const
a = tf.tensor([[1, 2], [3, 4]])\n * const b = tf.tensor(2).toInt();\n *\n * a.pow(b).print(); // or tf.pow(a, b)\n * ```\n * We also expose `powStrict` which has the same signature as this op and\n * asserts that `base` and `exp` are the same shape (does not broadcast).\n *\n * @param base The base `tf.Tensor` to pow element-wise.\n * @param exp The exponent `tf.Tensor` to pow element-wise.\n *\n * @doc {heading: 'Operations', subheading: 'Arithmetic'}\n */\nfunction pow_<T extends Tensor>(\n   base: Tensor|TensorLike, exp: Tensor|TensorLike): T {\n let $base = convertToTensor(base, 'base', 'pow');\n let $exp = convertToTensor(exp, 'exp', 'pow');\n [$base, $exp] = makeTypesMatch($base, $exp);\n\n const inputs: PowInputs = {a: $base, b: $exp};\n\n return ENGINE.runKernel(Pow, inputs as {} as NamedTensorMap);\n}\n\nexport const pow = op({pow_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n
* you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n
*/\n\nimport {ENGINE} from '../engine';\nimport {Prelu, PreluInputs} from '../kernel_names';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\n\nimport {op} from './operation';\n\n/**\n * Computes leaky rectified linear element-wise with parametric alphas.\n *\n * `x < 0 ? alpha * x :
f(x) = x`\n *\n * ```js\n * const x = tf.tensor1d([-1, 2, -3, 4]);\n * const alpha = tf.scalar(0.1);\n *\n * x.prelu(alpha).print(); // or tf.prelu(x, alpha)\n * ```\n * @param x The input tensor.\n * @param alpha Scaling factor for negative values.\n *\n * @doc {heading: 'Operations', subheading: 'Basic math'}\n */\nfunction prelu_<T extends Tensor>(x: T|TensorLike, alpha: T|TensorLike): T {\n const $x = convertToTensor(x, 'x', 'prelu');\n const $alpha = convertToTensor(alpha, 'alpha', 'prelu');\n\n const inputs: PreluInputs = {x: $x, alpha: $alpha};\n return ENGINE.runKernel(Prelu, inputs as {} as NamedTensorMap);\n}\n\nexport const prelu = op({prelu_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required
by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
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*/\n\nimport {ENGINE} from '../engine';\nimport {Prod, ProdAttrs, ProdInputs} from '../kernel_names';\nimport {NamedAttrMap} from '../kernel_registry';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\n\nimport {cast} from './cast';\nimport {op} from './operation';\n\n/**\n * Computes the product of elements across dimensions of a `tf.Tensor`.\n *\n * Reduces the input along the dimensions given in `axes`. Unless `keepDims`\n * is true, the rank of the `tf.Tensor` is reduced by
1 for each entry in\n * `axes`. If `keepDims` is true, the reduced dimensions are retained with\n * length 1. If `axes` has no entries, all dimensions are reduced, and a\n * `tf.Tensor` with a single element is returned.\n *\n * ```js\n * const x = tf.tensor1d([1, 2, 3]);\n *\n * x.prod().print(); // or tf.prod(x)\n * ```\n *\n * ```js\n * const x = tf.tensor2d([1, 2, 3, 4], [2, 2]);\n *\n * const axis = 1;\n * x.prod(axis).print(); // or tf.prod(x, axis)\n * ```\n *\n * @param x The input tensor to compute the product over. If the dtype is `bool`\n *   it will be converted to `int32` and the output dtype will be `int32`.\n * @param axis The dimension(s) to reduce. By default it reduces\n *   all dimensions.\n * @param keepDims If true, retains reduced dimensions with size 1.\n *\n * @doc {heading: 'Operations', subheading: 'Reduction'}\n */\nfunction prod_<T extends Tensor>(\n   x: Tensor|TensorLike, axis: number|number[] = null, keepDims = false): T {\n let $x = convertToTensor(x,
'x', 'prod');\n\n if ($x.dtype === 'bool') {\n   // bool is not an allowed type for the underlying kernel.\n $x = cast($x, 'int32');\n }\n\n const inputs: ProdInputs = {x: $x};\n const attrs: ProdAttrs = {axis, keepDims};\n\n return ENGINE.runKernel(\n   Prod, inputs as {} as NamedTensorMap, attrs as {} as NamedAttrMap);\n}\n\nexport const prod = op({prod_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations
under the License.\n *
==\n */\n\nimport {ENGINE} from '../engine';\nimport {Tensor} from '../tensor';\nimport {DataType, Rank, ShapeMap} from '../types';\nimport {sizeFromShape} from '../util';\n\nimport {op} from './operation';\n\n/**\n * Creates a `tf.Tensor` with values sampled from a random number generator\n * function defined by the user.\n *\n * @param shape An array of integers defining the output tensor shape.\n * @param randFunction A random number generator function which is called\n * for each element in the output tensor.\n * @param dtype The data type of the output tensor. Defaults to 'float32'.\n */\nfunction rand_<R extends Rank>(\n   shape: ShapeMap[R], randFunction: () => number,\n   dtype?: DataType): Tensor<R> {\n const size = sizeFromShape(shape);\n let values = null;\n if (dtype == null || dtype === 'float32') {\n   values = new Float32Array(size);\n } else if (dtype === 'int32') {\n   values = new Int32Array(size);\n } else if (dtype === 'bool') {\n   values = new Uint8Array(size);\n } else {\n   throw new Error(`Unknown data type ${dtype}`);\n }\n for (let i = 0; i < size; i++) {\n   values[i] = randFunction();\n }\n return ENGINE.makeTensor(values, shape, dtype) as Tensor<R>;\n}\n\nexport const rand = op({rand_});\n","// A port of an algorithm by Johannes Baagøe <baagoe@baagoe.com>, 2010\n// http://baagoe.com/en/RandomMusings/javascript/\n// https://github.com/nquinlan/better-random-numbers-for-javascript-mirror\n// Original work is under MIT license -\n\n// Copyright (C) 2010 by Johannes Baagøe <baagoe@baagoe.org>\n//\n// Permission is hereby granted, free of charge, to any person obtaining a copy\n// of this software and associated documentation files (the \"Software\"), to deal\n// in the Software without restriction, including without limitation the rights\n// to use, copy, modify, merge, publish, distribute, sublicense, and/or sell\n// copies of
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  {\n   data = data.toString();\n   for (var i = 0; i < data.length; i++) {\n   n += data.charCodeAt(i);\n   var h = 0.02519603282416938 * n;\n   n = h >>> 0;\n   h -= n;\n   h *= n;\n   n = h >>> 0;\n   h -= n;\n   n += h * 0x100000000; // 2^32\n   }\n   return (n >>> 0) * 2.3283064365386963e-10; // 2^-32\n };\n\n return mash;\n}\n\n\nif (module && module.exports) {\n module.exports = impl;\n} else if (define && define.amd) {\n define(function() { return impl; });\n} else {\n this.alea = impl;\n}\n\n})(\n this,\n (typeof module) == 'object' && module,   // present in node.js\n (typeof define) == 'function' && define   // present with an AMD loader\n);\n\n\n","// A Javascript implementaion of the \"xor128\" prng algorithm by\n// George Marsaglia. See http://www.jstatsoft.org/v08/i14/paper\n\n\n(function(global, module, define) {\n\nfunction XorGen(seed) {\n var me = this, strseed = '';\n\n me.x = 0;\n me.y = 0;\n me.z = 0;\n me.w = 0;\n\n
  // Set up generator function.\n me.next = function() {\n   var t = me.x ^ (me.x << 11);\n   me.x = me.y;\n   me.y = me.z;\n   me.z = me.w;\n   return me.w ^= (me.w >>> 19) ^ t ^ (t >>> 8);\n };\n\n if (seed === (seed | 0)) {\n   // Integer seed.\n   me.x = seed;\n } else {\n   // String seed.\n   strseed += seed;\n }\n\n // Mix in string seed, then discard an initial batch of 64 values.\n for (var k = 0; k < strseed.length + 64; k++) {\n   me.x ^= strseed.charCodeAt(k) | 0;\n   me.next();\n }\n}\n\nfunction copy(f, t) {\n t.x = f.x;\n t.y = f.y;\n t.z = f.z;\n t.w = f.w;\n return t;\n}\n\nfunction impl(seed, opts) {\n var xg = new XorGen(seed),\n   state = opts && opts.state,\n   prng = function() { return (xg.next() >>> 0) / 0x100000000; };\n prng.double = function() {\n   do {\n   var top = xg.next() >>> 11,\n   bot = (xg.next() >>> 0) / 0x100000000,\n   result = (top + bot) / (1 << 21);\n   } while (result === 0);\n   return
  result;\n };\n prng.int32 = xg.next;\n prng.quick = prng;\n if (state) {\n   if (typeof(state) == 'object') copy(state, xg);\n   prng.state = function() { return copy(xg, {}); }\n }\n return prng;\n}\n\nif (module && module.exports) {\n module.exports = impl;\n} else if (define && define.amd) {\n define(function() { return impl; });\n} else {\n this.xor128 = impl;\n}\n\n})(\n this,\n (typeof module) == 'object' && module,   // present in node.js\n (typeof define) == 'function' && define   // present with an AMD loader\n);\n\n\n","// A Javascript implementaion of the \"xorwow\" prng algorithm by\n// George Marsaglia. See http://www.jstatsoft.org/v08/i14/paper\n\n\n(function(global, module, define) {\n\nfunction XorGen(seed) {\n var me = this, strseed = '';\n\n // Set up generator function.\n me.next = function() {\n   var t = (me.x ^ (me.x >>> 2));\n   me.x = me.y; me.y = me.z; me.z = me.w; me.w = me.v;\n   return (me.d = (me.d + 362437 | 0)) +\n   (me.v = (me.v
  ^ (me.v << 4)) ^ (t ^ (t << 1))) | 0;\n };\n\n me.x = 0;\n me.y = 0;\n me.z = 0;\n me.w = 0;\n me.v = 0;\n\n if (seed === (seed | 0)) {\n   // Integer seed.\n   me.x = seed;\n } else {\n   // String seed.\n   strseed += seed;\n }\n\n // Mix in string seed, then discard an initial batch of 64 values.\n for (var k = 0; k < strseed.length + 64; k++) {\n

me.x ^= strseed.charCodeAt(k) | 0;\n if (k == strseed.length) {\n me.d = me.x << 10 ^ me.x >>> 4;\n }\n me.next();\n }\n}\n\nfunction copy(f, t) {\n t.x = f.x;\n t.y = f.y;\n t.z = f.z;\n t.w = f.w;\n t.v = f.v;\n t.d = f.d;\n return t;\n}\n\nfunction impl(seed, opts) {\n var xg = new XorGen(seed),\n state = opts && opts.state,\n prng = function() { return (xg.next() >>> 0) / 0x100000000; };\n prng.double = function() {\n do {\n var top = xg.next() >>> 11,\n bot = (xg.next() >>> 0) / 0x100000000,\n result = (top + bot) / (1 << 21);\n } while (result === 0);\n
  return result;\n };\n prng.int32 = xg.next;\n prng.quick = prng;\n if (state) {\n if (typeof(state) == 'object') copy(state, xg);\n prng.state = function() { return copy(xg, {}); }\n }\n return prng;\n}\n\nif (module && module.exports) {\n module.exports = impl;\n} else if (define && define.amd) {\n define(function() { return impl; });\n} else {\n this.xorwow = impl;\n}\n\n})(\n this,\n (typeof module) == 'object' && module, // present in node.js\n (typeof define) == 'function' && define // present with an AMD loader\n);\n\n\n","// A Javascript implementaion of the \"xorshift7\" algorithm by\n// François Panneton and Pierre L'ecuyer:\n// \"On the Xorgshift Random Number Generators\"\n// http://saluc.engr.uconn.edu/refs/crypto/rng/panneton05onthexorshift.pdf\n\n(function(global, module, define) {\n\nfunction XorGen(seed) {\n var me = this;\n\n // Set up generator function.\n me.next = function() {\n // Update xor generator.\n var X = me.x, i = me.i, t,
 v, w;\n t = X[i]; t ^= (t >>> 7); v = t ^ (t << 24);\n t = X[(i + 1) & 7]; v ^= t ^ (t >>> 10);\n t = X[(i + 3) & 7]; v ^= t ^ (t >>> 3);\n t = X[(i + 4) & 7]; v ^= t ^ (t << 7);\n t = X[(i + 7) & 7]; t = t ^ (t << 13); v ^= t ^ (t << 9);\n X[i] = v;\n me.i = (i + 1) & 7;\n return v;\n };\n\n function init(me, seed) {\n var j, w, X = [];\n\n if (seed === (seed | 0)) {\n // Seed state array using a 32-bit integer.\n w = X[0] = seed;\n } else {\n // Seed state using a string.\n seed = '' + seed;\n for (j = 0; j < seed.length; ++j) {\n X[j & 7] = (X[j & 7] << 15) ^\n (seed.charCodeAt(j) + X[(j + 1) & 7] << 13);\n }\n }\n // Enforce an array length of 8, not all zeroes.\n while (X.length < 8) X.push(0);\n for (j = 0; j < 8 && X[j] === 0; ++j);\n if (j == 8) w = X[7] = -1; else w = X[j];\n\n me.x = X;\n me.i = 0;\n\n // Discard an initial 256 values.\n for (j = 256; j > 0; --j) {\n
  me.next();\n }\n }\n\n init(me, seed);\n}\n\nfunction copy(f, t) {\n t.x = f.x.slice();\n t.i = f.i;\n return t;\n}\n\nfunction impl(seed, opts) {\n if (seed == null) seed = +(new Date);\n var xg = new XorGen(seed),\n state = opts && opts.state,\n prng = function() { return (xg.next() >>> 0) / 0x100000000; };\n prng.double = function() {\n do {\n var top = xg.next() >>> 11,\n bot = (xg.next() >>> 0) / 0x100000000,\n result = (top + bot) / (1 << 21);\n } while (result === 0);\n return result;\n };\n prng.int32 = xg.next;\n prng.quick = prng;\n if (state) {\n if (state.x) copy(state, xg);\n prng.state = function() { return copy(xg, {}); }\n }\n return prng;\n}\n\nif (module && module.exports) {\n module.exports = impl;\n} else if (define && define.amd) {\n define(function() { return impl; });\n} else {\n this.xorshift7 = impl;\n}\n\n})(\n this,\n (typeof module) == 'object' && module, // present in node.js\n
  (typeof define) == 'function' && define // present with an AMD loader\n);\n\n\n","// A Javascript implementaion of Richard Brent's Xorgens xor4096 algorithm.\n//\n// This fast non-cryptographic random number generator is designed for\n// use in Monte-Carlo algorithms. It combines a long-period xorshift\n// generator with a Weyl generator, and it passes all common batteries\n// of stasticial tests for randomness while consuming only a few nanoseconds\n// for each prng generated. For background on the generator, see Brent's\n// paper: \"Some long-period random number generators using shifts and xors.\"\n// http://arxiv.org/pdf/1004.3115v1.pdf\n//\n// Usage:\n//\n// var xor4096 = require('xor4096');\n// random = xor4096(1);   // Seed with int32 or string.\n// assert.equal(random(), 0.1520436450538547); // (0, 1) range, 53 bits.\n// assert.equal(random.int32(), 1806534897);   // signed int32, 32 bits.\n//\n// For nonzero numeric keys, this impelementation provides a
 sequence\n// identical to that by Brent's xorgens 3 implementaion in C. This\n// implementation also provides for initalizing the generator with\n// string seeds, or for saving and restoring the state of the generator.\n//\n// On Chrome, this prng benchmarks about 2.1 times slower than\n// Javascript's built-in Math.random().\n\n(function(global, module, define) {\n\nfunction XorGen(seed) {\n var me = this;\n\n // Set up generator function.\n me.next = function() {\n var w = me.w,\n X = me.X, i = me.i, t, v;\n // Update Weyl generator.\n me.w = w = (w + 0x61c88647) | 0;\n // Update xor generator.\n v = X[(i + 34) & 127];\n t = X[i

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= ((i + 1) & 127)];\n    v ^= v << 13;\n    t ^= t << 17;\n    v ^= v >>> 15;\n    t ^= t >>> 12;\n    // Update Xor generator array state.\n    v = X[i] = v ^ t;\n    me.i = i;\n    // Result is the combination.\n    return (v + (w ^ (w >>> 16))) | 0;\n  };\n\n  function init(me, seed) {\n    var t, v, i, j, w, X = [], limit = 128;\n    if (seed === (seed | 0)) {\n      // Numeric seeds initialize v, which is used to generates X.\n      v = seed;\n      seed = null;\n    } else {\n      // String seeds are mixed into v and X one character at a time.\n      seed = seed + '\\0';\n      v = 0;\n      limit = Math.max(limit, seed.length);\n    }\n    // Initialize circular array and weyl value.\n    for (i = 0, j = -32; j < limit; ++j) {\n      // Put the unicode characters into the array, and shuffle them.\n      if (seed) v ^= seed.charCodeAt((j + 32) % seed.length);\n      // After 32 shuffles, take v as the starting w value.\n      if (j === 0) w = v;\n      v ^= v << 10;\n      v ^= v >>> 15;\n      v ^= v << 4;\n      v ^= v >>> 13;\n      if (j >= 0) {\n        w = (w + 0x61c88647) | 0;     // Weyl.\n        t = (X[j & 127] ^= (v + w));  // Combine xor and weyl to init array.\n        i = (0 == t) ? i + 1 : 0;     // Count zeroes.\n      }\n    }\n    // We have detected all zeroes; make the key nonzero.\n    if (i >= 128) {\n      X[(seed && seed.length || 0) & 127] = -1;\n    }\n    // Run the generator 512 times to further mix the state before using it.\n    // Factoring this as a function slows the main generator, so it is just\n    // unrolled here.  The weyl generator is not advanced while warming up.\n    i = 127;\n    for (j = 4 * 128; j > 0; --j) {\n      v = X[(i + 34) & 127];\n      t = X[i = ((i + 1) & 127)];\n      v ^= v << 13;\n      t ^= t << 17;\n      v ^= v >>> 15;\n      t ^= t >>> 12;\n      X[i] = v ^ t;\n    }\n    // Storing state as object members is faster than using closure variables.\n    me.w = w;\n    me.X = X;\n    me.i = i;\n  }\n\n  init(me, seed);\n}\n\nfunction copy(f, t) {\n  t.i = f.i;\n  t.w = f.w;\n  t.X = f.X.slice();\n  return t;\n};\n\nfunction impl(seed, opts) {\n  if (seed == null) seed = +(new Date);\n  var xg = new XorGen(seed),\n      state = opts && opts.state,\n      prng = function() { return (xg.next() >>> 0) / 0x100000000; };\n  prng.double = function() {\n    do {\n      var top = xg.next() >>> 11,\n          bot = (xg.next() >>> 0) / 0x100000000,\n          result = (top + bot) / (1 << 21);\n    } while (result === 0);\n    return result;\n  };\n  prng.int32 = xg.next;\n  prng.quick = prng;\n  if (state) {\n    if (state.X) copy(state, xg);\n    prng.state = function() { return copy(xg, {}); }\n  }\n  return prng;\n}\n\nif (module && module.exports) {\n  module.exports = impl;\n} else if (define && define.amd) {\n  define(function() { return impl; });\n} else {\n  this.xor4096 = impl;\n}\n\n})(\n  this,
          // window object or global\n  (typeof module) == 'object' && module,    // present in node.js\n  (typeof define) == 'function' && define   // present with an AMD loader\n);\n","// A Javascript implementaion of the \"Tyche-i\" prng algorithm by\n// Samuel Neves and Filipe Araujo.\n// See https://eden.dei.uc.pt/~sneves/pubs/2011-snfa2.pdf\n\n(function(global, module, define) {\n\nfunction XorGen(seed) {\n  var me = this, strseed = '';\n\n  // Set up generator function.\n  me.next = function() {\n    var b = me.b, c = me.c, d = me.d, a = me.a;\n    b = (b << 25) ^ (b >>> 7) ^ c;\n    c = (c - d) | 0;\n    d = (d << 24) ^ (d >>> 8) ^ a;\n    a = (a - b) | 0;\n    me.b = b = (b << 20) ^ (b >>> 12) ^ c;\n    me.c = c = (c - d) | 0;\n    me.d = (d << 16) ^ (c >>> 16) ^ a;\n    return me.a = (a - b) | 0;\n  };\n\n  /* The following is non-inverted tyche, which has better internal\n   * bit diffusion, but which is about 25% slower than tyche-i in JS.\n  me.next = function() {\n    var a = me.a, b = me.b, c = me.c, d = me.d;\n    a = (me.a + me.b | 0) >>> 0;\n    d = me.d ^ a; d = d << 16 ^ d >>> 16;\n    c = me.c + d | 0;\n    b = me.b ^ c; b = b << 12 ^ d >>> 20;\n    me.a = a = a + b | 0;\n    d = d ^ a; me.d = d = d << 8 ^ d >>> 24;\n    me.c = c = c + d | 0;\n    b = b ^ c;\n    return me.b = (b << 7 ^ b >>> 25);\n  }\n  */\n\n  me.a = 0;\n  me.b = 0;\n  me.c = 2654435769 | 0;\n  me.d = 1367130551;\n\n  if (seed === Math.floor(seed)) {\n    // Integer seed.\n    me.a = (seed / 0x100000000) | 0;\n    me.b = seed | 0;\n  } else {\n    // String seed.\n    strseed += seed;\n  }\n\n  // Mix in string seed, then discard an initial batch of 64 values.\n  for (var k = 0; k < strseed.length + 20; k++) {\n    me.b ^= strseed.charCodeAt(k) | 0;\n    me.next();\n  }\n}\n\nfunction copy(f, t) {\n  t.a = f.a;\n  t.b = f.b;\n  t.c = f.c;\n  t.d = f.d;\n  return t;\n};\n\nfunction impl(seed, opts) {\n  var xg = new XorGen(seed),\n      state = opts && opts.state,\n      prng = function() { return (xg.next() >>> 0) / 0x100000000; };\n  prng.double = function() {\n    do {\n      var top = xg.next() >>> 11,\n          bot = (xg.next() >>> 0) / 0x100000000,\n          result = (top + bot) / (1 << 21);\n    } while (result === 0);\n    return result;\n  };\n  prng.int32 = xg.next;\n  prng.quick = prng;\n  if (state) {\n    if (typeof(state) == 'object') copy(state,
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xg);\n prng.state = function() { return copy(xg, {}); }\n }\n return prng;\n}\n\nif (module && module.exports) {\n module.exports = impl;\n} else if (define && define.amd) {\n define(function() { return impl; });\n} else {\n this.tychei = impl;\n}\n\n})(\n this,\n (typeof module) == 'object' && module, // present in node.js\n (typeof define) == 'function' && define // present with an AMD loader\n);\n\n\n","/*\nCopyright 2014 David Bau.\n\nPermission is hereby granted, free of charge, to any person obtaining\na copy of this software and associated documentation files (the\n\"Software\"), to deal in the Software without restriction, including\nwithout limitation the rights to use, copy, modify, merge, publish,\ndistribute, sublicense, and/or sell copies of the Software, and to\npermit persons to whom the Software is furnished to do so, subject to\nthe following conditions:\n\nThe above copyright notice and this permission notice shall be\nincluded in all copies or substantial portions of the Software.\n\nTHE SOFTWARE IS PROVIDED \"AS IS\", WITHOUT WARRANTY OF ANY KIND,\nEXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF\nMERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND NONINFRINGEMENT.\nIN NO EVENT SHALL THE AUTHORS OR COPYRIGHT HOLDERS BE LIABLE FOR ANY\nCLAIM, DAMAGES OR OTHER LIABILITY, WHETHER IN AN ACTION OF CONTRACT,\nTORT OR OTHERWISE, ARISING FROM, OUT OF OR IN CONNECTION WITH THE\nSOFTWARE OR THE USE OR OTHER DEALINGS IN THE SOFTWARE.\n\n*/\n\n(function (pool, math) {\n//\n// The following constants are related to IEEE 754 limits.\n//\nvar global = this,\n width = 256, // each RC4 output is 0 <= x < 256\n chunks = 6, // at least six RC4 outputs for each double\n digits = 52, // there are 52 significant digits in a double\n rngname = 'random', // rngname: name for Math.random and Math.seedrandom\n startdenom = math.pow(width, chunks),\n significance = math.pow(2, digits),\n overflow = significance * 2,\n mask = width - 1,\n nodecrypto; // node.js crypto module, initialized at the bottom.\n\n//\n// seedrandom()\n// This is the seedrandom function described above.\n//\nfunction seedrandom(seed, options, callback) {\n var key = [];\n options = (options == true) ? { entropy: true } : (options || {});\n\n // Flatten the seed string or build one from local entropy if needed.\n var shortseed = mixkey(flatten(\n options.entropy ? [seed, tostring(pool)] :\n (seed == null) ? autoseed() : seed, 3), key);\n\n // Use the seed to initialize an ARC4 generator.\n var arc4 = new ARC4(key);\n\n // This function returns a random double in [0, 1) that contains\n // randomness in every bit of the mantissa of the IEEE 754 value.\n var prng = function() {\n var n = arc4.g(chunks), // Start with a numerator n < 2 ^ 48\n d = startdenom, // and denominator d = 2 ^ 48.\n x = 0; // and no 'extra last byte'.\n while (n < significance) { // Fill up all significant digits by\n n = (n + x) * width; // shifting numerator and\n d *= width; // denominator and generating a\n x = arc4.g(1); // new least-significant-byte.\n }\n while (n >= overflow) { // To avoid rounding up, before adding\n n /= 2; // last byte, shift everything\n d /= 2; // right using integer math until\n x >>>= 1; // we have exactly the desired bits.\n }\n return (n + x) / d; // Form the number within [0, 1).\n };\n\n prng.int32 = function() { return arc4.g(4) | 0; }\n prng.quick = function() { return arc4.g(4) / 0x100000000; }\n prng.double = prng;\n\n // Mix the randomness into accumulated entropy.\n mixkey(tostring(arc4.S), pool);\n\n // Calling convention: what to return as a function of prng, seed, is_math.\n return (options.pass || callback ||\n function(prng, seed, is_math_call, state) {\n if (state) {\n // Load the arc4 state from the given state if it has an S array.\n if (state.S) { copy(state, arc4); }\n // Only provide the .state method if requested via options.state.\n prng.state = function() { return copy(arc4, {}); }\n }\n\n // If called as a method of Math (Math.seedrandom()), mutate\n // Math.random because that is how seedrandom.js has worked since v1.0.\n if (is_math_call) { math[rngname] = prng; return seed; }\n\n // Otherwise, it is a newer calling convention, so return the\n // prng directly.\n else return prng;\n })(\n prng,\n shortseed,\n 'global' in options ? options.global : (this == math),\n options.state);\n}\n\nmath['seed' + rngname] = seedrandom;\n\n//\n// ARC4\n//\n// An ARC4 implementation. The constructor takes a key in the\n// form of\n// an array of at most (width) integers that should be 0 <= x < (width).\n//\n// The g(count) method returns a pseudorandom integer that concatenates\n// the next (count) outputs from ARC4. Its return value is a number x\n//

that is in the range 0 <= x < (width ^ count).\n//\nfunction ARC4(key) {\n var t, keylen = key.length,\n   me = this, i = 0, j = me.i = me.j = 0, s = me.S = [];\n\n // The empty key [] is treated as [0].\n if (!keylen) { key = [keylen++]; }\n\n // Set up S using the standard key scheduling algorithm.\n while (i < width) {\n   s[i] = i++;\n }\n for (i = 0; i < width; i++) {\n   s[i] = s[j = mask & (j + key[i % keylen] + (t = s[i]))];\n   s[j] = t;\n }\n\n // The \"g\" method returns the next (count) outputs as one number.\n (me.g = function(count) {\n   // Using instance members instead of closure state nearly doubles speed.\n   var t, r = 0,\n   i = me.i, j = me.j, s = me.S;\n   while (count--) {\n   t = s[i = mask & (i + 1)];\n   r = r * width + s[mask & ((s[i] = s[j = mask & (j + t)]) + (s[j] = t))];\n   }\n   me.i = i; me.j = j;\n   return r;\n   // For robust unpredictability, the function call below automatically\n   // discards an initial batch of values. This is called RC4-drop[256].\n   // See http://google.com/search?q=rsa+fluhrer+response&btnI\n })(width);\n}\n\n//\n// copy()\n// Copies internal state of ARC4 to or from a plain object.\n//\nfunction copy(f, t) {\n t.i = f.i;\n t.j = f.j;\n t.S = f.S.slice();\n return t;\n};\n\n//\n// flatten()\n// Converts an object tree to nested arrays of strings.\n//\nfunction flatten(obj, depth) {\n var result = [], typ = (typeof obj), prop;\n if (depth && typ == 'object') {\n   for (prop in obj) {\n   try { result.push(flatten(obj[prop], depth - 1)); } catch (e) {}\n   }\n }\n return (result.length ? result : typ == 'string' ? obj : obj + '\\0');\n}\n\n//\n// mixkey()\n// Mixes a string seed into a key that is an array of integers, and\n// returns a shortened string seed that is equivalent to the result key.\n//\nfunction mixkey(seed, key) {\n var stringseed = seed + '', smear, j = 0;\n while (j < stringseed.length) {\n   key[mask & j] =\n   mask & ((smear ^= key[mask & j] * 19) + stringseed.charCodeAt(j++));\n }\n return tostring(key);\n}\n\n//\n// autoseed()\n// Returns an object for autoseeding, using window.crypto and Node crypto\n// module if available.\n//\nfunction autoseed() {\n try {\n   var out;\n   if (nodecrypto && (out = nodecrypto.randomBytes)) {\n   // The use of 'out' to remember randomBytes makes tight minified code.\n   out = out(width);\n   } else {\n   out = new Uint8Array(width);\n   (global.crypto || global.msCrypto).getRandomValues(out);\n   }\n   return tostring(out);\n } catch (e) {\n   var browser = global.navigator,\n   plugins = browser && browser.plugins;\n   return [+new Date, global, plugins, global.screen, tostring(pool)];\n }\n}\n\n//\n// tostring()\n// Converts an array of charcodes to a string\n//\nfunction tostring(a) {\n return String.fromCharCode.apply(0, a);\n}\n\n//\n// When seedrandom.js is loaded, we immediately mix a few bits\n// from the built-in RNG into the entropy pool. Because we do\n// not want to interfere with deterministic PRNG state later,\n// seedrandom will not call math.random on its own again after\n// initialization.\n//\nmixkey(math.random(), pool);\n\n//\n// Nodejs and AMD support: export the implementation as a module using\n// either convention.\n//\nif ((typeof module) == 'object' && module.exports) {\n module.exports = seedrandom;\n // When in node.js, try using crypto package for autoseeding.\n try {\n   nodecrypto = require('crypto');\n } catch (ex) {}\n} else if ((typeof define) == 'function' && define.amd) {\n define(function() { return seedrandom; });\n}\n\n// End anonymous scope, and pass initial values.\n})(\n [],   // pool: entropy pool starts empty\n Math   // math: package containing random, pow, and seedrandom\n);\n","// A library of seedable RNGs implemented in Javascript.\n//\n// Usage:\n//\n// var seedrandom = require('seedrandom');\n// var random = seedrandom(1); // or any seed.\n// var x = random();   // 0 <= x < 1. Every bit is random.\n// var x = random.quick(); // 0 <= x < 1. 32 bits of randomness.\n\n// alea, a 53-bit multiply-with-carry generator by Johannes Baagøe.\n// Period: ~2^116\n// Reported to pass all BigCrush tests.\nvar alea = require('./lib/alea');\n\n// xor128, a pure xor-shift generator by George Marsaglia.\n// Period: 2^128-1.\n// Reported to fail: MatrixRank and LinearComp.\nvar xor128 = require('./lib/xor128');\n\n// xorwow, George Marsaglia's 160-bit xor-shift combined plus weyl.\n// Period: 2^192-2^32\n// Reported to fail: CollisionOver, SimpPoker, and LinearComp.\nvar xorwow = require('./lib/xorwow');\n\n// xorshift7, by François Panneton and Pierre L'ecuyer, takes\n// a different approach: it adds robustness by allowing more shifts\n// than Marsaglia's original three. It is a 7-shift generator\n// with 256 bits, that passes BigCrush with no systmatic failures.\n// Period 2^256-1.\n// No systematic BigCrush failures reported.\nvar xorshift7 = require('./lib/xorshift7');\n\n// xor4096, by Richard Brent, is a 4096-bit xor-shift with a\n// very long period that also adds a Weyl generator. It also passes\n// BigCrush with no systematic failures. Its long period may\n// be useful if you have many generators and need to avoid\n// collisions.\n// Period: 2^4128-2^32.\n// No systematic BigCrush

failures reported.\nvar xor4096 = require('./lib/xor4096');\n\n// Tyche-i, by Samuel Neves and Filipe Araujo, is a bit-shifting random\n// number generator derived from ChaCha, a modern stream cipher.\n// https://eden.dei.uc.pt/~sneves/pubs/2011-snfa2.pdf\n// Period: ~2^127\n// No systematic BigCrush failures reported.\nvar tychei = require('./lib/tychei');\n\n// The original ARC4-based prng included in this library.\n// Period: ~2^1600\nvar sr = require('./seedrandom');\n\nsr.alea = alea;\nsr.xor128 = xor128;\nsr.xorwow = xorwow;\nsr.xorshift7 = xorshift7;\nsr.xor4096 = xor4096;\nsr.tychei = tychei;\n\nmodule.exports = sr;\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==\n */\n\nimport * as seedrandom from 'seedrandom';\n\nimport {expectNumbersClose, testEpsilon} from '../test_util';\nimport {TypedArray} from '../types';\n\nexport interface RandomBase {\n nextValue(): number;\n}\n\nexport interface RandomGamma {\n nextValue(): number;\n}\n\nexport interface RandNormalDataTypes {\n float32: Float32Array;\n int32: Int32Array;\n}\n\nexport interface RandGammaDataTypes {\n float32: Float32Array;\n int32: Int32Array;\n}\n\n// https://en.wikipedia.org/wiki/Marsaglia_polar_method\nexport class MPRandGauss implements RandomBase {\n private mean: number;\n private stdDev: number;\n private nextVal: number;\n private dtype?: keyof RandNormalDataTypes;\n private truncated?: boolean;\n private upper?: number;\n private lower?: number;\n private random: seedrandom.prng;\n\n constructor(\n mean: number, stdDeviation: number, dtype?: keyof RandNormalDataTypes,\n truncated?: boolean, seed?: number) {\n this.mean = mean;\n this.stdDev = stdDeviation;\n this.dtype = dtype;\n this.nextVal = NaN;\n this.truncated = truncated;\n if (this.truncated) {\n this.upper = this.mean + this.stdDev * 2;\n this.lower = this.mean - this.stdDev * 2;\n }\n const seedValue = seed ? seed : Math.random();\n this.random = seedrandom.alea(seedValue.toString());\n }\n\n /** Returns next sample from a Gaussian distribution. */\n public nextValue(): number {\n if (!isNaN(this.nextVal)) {\n const value = this.nextVal;\n this.nextVal = NaN;\n return value;\n }\n\n let resultX: number, resultY: number;\n let isValid = false;\n while (!isValid) {\n let v1: number, v2: number, s: number;\n do {\n v1 = 2 * this.random() - 1;\n v2 = 2 * this.random() - 1;\n s = v1 * v1 + v2 * v2;\n } while (s >= 1 || s === 0);\n\n const mul = Math.sqrt(-2.0 * Math.log(s) / s);\n resultX = this.mean + this.stdDev * v1 * mul;\n resultY = this.mean + this.stdDev * v2 * mul;\n\n if (!this.truncated || this.isValidTruncated(resultX)) {\n isValid = true;\n }\n }\n\n if (!this.truncated || this.isValidTruncated(resultY)) {\n this.nextVal = this.convertValue(resultY);\n }\n return this.convertValue(resultX);\n }\n\n /** Handles proper rounding for non-floating-point numbers. */\n private convertValue(value: number): number {\n if (this.dtype == null || this.dtype === 'float32') {\n return value;\n }\n return Math.round(value);\n }\n\n /** Returns true if less than 2-standard-deviations from the mean. */\n private isValidTruncated(value: number): boolean {\n return value <= this.upper && value >= this.lower;\n }\n}\n\n// Marsaglia, George, and Wai Wan Tsang. 2000. \"A Simple Method for Generating\n// Gamma Variables.\"\nexport class RandGamma implements RandomGamma {\n private alpha: number;\n private beta: number;\n private d: number;\n private c: number;\n private dtype?: keyof RandGammaDataTypes;\n private randu: seedrandom.prng;\n private randn: MPRandGauss;\n\n constructor(\n alpha: number, beta: number, dtype: keyof RandGammaDataTypes,\n seed?: number) {\n this.alpha = alpha;\n this.beta = 1 / beta; // convert rate to scale parameter\n this.dtype = dtype;\n\n const seedValue = seed ? seed : Math.random();\n this.randu = seedrandom.alea(seedValue.toString());\n this.randn = new MPRandGauss(0, 1, dtype, false, this.randu());\n\n if (alpha < 1) {\n this.d = alpha + (2 / 3);\n } else {\n this.d = alpha - (1 / 3);\n }\n this.c = 1 / Math.sqrt(9 * this.d);\n }\n\n /** Returns next sample from a gamma distribution. */\n public nextValue(): number {\n let x2:

number, v0: number, v1: number, x: number, u: number, v: number;\n while (true) {\n do {\n x = this.randn.nextValue();\n v = 1 + (this.c * x);\n } while (v <= 0);\n v *= v * v;\n x2 = x * x;\n v0 = 1 - (0.331 * x2 * x2);\n v1 = (0.5 * x2) + (this.d * (1 - v + Math.log(v)));\n u = this.randu();\n if (u < v0 || Math.log(u) < v1) {\n break;\n }\n }\n v = (1 / this.beta) * this.d * v;\n if (this.alpha < 1) {\n v *= Math.pow(this.randu(), 1 / this.alpha);\n }\n return this.convertValue(v);\n }\n /** Handles proper rounding for non-floating-point numbers. */\n private convertValue(value: number): number {\n if (this.dtype === 'float32') {\n return value;\n }\n return Math.round(value);\n }\n}\n\nexport class UniformRandom implements RandomBase {\n private min: number;\n private range: number;\n private random: seedrandom.prng;\n private dtype?: keyof RandNormalDataTypes;\n\n constructor(\n min = 0, max = 1, dtype?: keyof RandNormalDataTypes,\n seed?: string|number) {\n this.min = min;\n this.range = max - min;\n this.dtype = dtype;\n if (seed == null) {\n seed = Math.random();\n }\n if (typeof seed === 'number') {\n seed = seed.toString();\n }\n\n if (!this.canReturnFloat()\n && this.range <= 1) {\n throw new Error(\n `The difference between ${min} - ${max} <= 1 and dtype is not float`);\n }\n this.random = seedrandom.alea(seed);\n }\n\n /** Handles proper rounding for non floating point numbers. */\n private canReturnFloat = () =>\n (this.dtype == null || this.dtype === 'float32');\n\n private convertValue(value: number): number {\n if (this.canReturnFloat()) {\n return value;\n }\n return Math.round(value);\n }\n\n nextValue() {\n return this.convertValue(this.min + this.range * this.random());\n }\n}\n\nexport function jarqueBeraNormalityTest(values: TypedArray|number[]) {\n // https://en.wikipedia.org/wiki/Jarque%E2%80%93Bera_test\n const n = values.length;\n const s = skewness(values);\n const k = kurtosis(values);\n const jb = n / 6 * (Math.pow(s, 2) + 0.25 * Math.pow(k - 3, 2));\n // JB test requires 2-degress of freedom from Chi-Square @ 0.95:\n // http://www.itl.nist.gov/div898/handbook/eda/section3/eda3674.htm\n const CHI_SQUARE_2DEG = 5.991;\n if (jb > CHI_SQUARE_2DEG) {\n throw new Error(`Invalid p-value for JB: ${jb}`);\n }\n}\n\nexport function expectArrayInMeanStdRange(\n actual: TypedArray|number[], expectedMean: number, expectedStdDev: number,\n epsilon?: number) {\n if (epsilon == null) {\n epsilon = testEpsilon();\n }\n const actualMean = mean(actual);\n expectNumbersClose(actualMean, expectedMean, epsilon);\n expectNumbersClose(\n standardDeviation(actual, actualMean), expectedStdDev, epsilon);\n}\n\nfunction mean(values: TypedArray|number[]) {\n let sum = 0;\n for (let i = 0; i < values.length; i++) {\n sum += values[i];\n }\n return sum / values.length;\n}\n\nfunction standardDeviation(values: TypedArray|number[], mean: number) {\n let squareDiffSum = 0;\n for (let i = 0; i < values.length; i++) {\n const diff = values[i] - mean;\n squareDiffSum += diff * diff;\n }\n return Math.sqrt(squareDiffSum / values.length);\n}\n\nfunction kurtosis(values: TypedArray|number[]) {\n // https://en.wikipedia.org/wiki/Kurtosis\n const valuesMean = mean(values);\n const n = values.length;\n let sum2 = 0;\n let sum4 = 0;\n for (let i = 0; i < n; i++) {\n const v = values[i] - valuesMean;\n sum2 += Math.pow(v, 2);\n sum4 += Math.pow(v, 4);\n }\n return (1 / n) * sum4 / Math.pow((1 / n) * sum2, 2);\n}\n\nfunction skewness(values: TypedArray|number[]) {\n // https://en.wikipedia.org/wiki/Skewness\n const valuesMean = mean(values);\n const n = values.length;\n let sum2 = 0;\n let sum3 = 0;\n for (let i = 0; i < n; i++) {\n const v = values[i] - valuesMean;\n sum2 += Math.pow(v, 2);\n sum3 += Math.pow(v, 3);\n }\n return (1 / n) * sum3 / Math.pow((1 / (n - 1)) * sum2, 3 / 2);\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ===\n */\n\nimport {Tensor} from '../tensor';\nimport {Rank, ShapeMap} from '../types';\n\nimport {buffer} from

'./buffer';\nimport {op} from './operation';\nimport {RandGamma} from './rand_util';\n\n/**\n * Creates a `tf.Tensor` with values sampled from a gamma distribution.\n *\n * ```js\n * tf.randomGamma([2, 2], 1).print();\n * ```\n *\n * @param shape An array of integers defining the output tensor shape.\n * @param alpha The shape parameter of the gamma distribution.\n
 * @param beta The inverse scale parameter of the gamma distribution. Defaults\n * to 1.\n * @param dtype The data type of the output. Defaults to float32.\n * @param seed The seed for the random number generator.\n *\n * @doc {heading: 'Tensors', subheading: 'Random'}\n */\nfunction randomGamma_<R extends Rank>(\n shape: ShapeMap[R], alpha: number, beta = 1,\n dtype: 'float32'|'int32' = 'float32', seed?: number): Tensor<R> {\n if (beta == null) {\n beta = 1;\n }\n if (dtype == null) {\n dtype = 'float32';\n }\n if (dtype !== 'float32' && dtype !== 'int32') {\n throw new Error(`Unsupported data type ${dtype}`);\n }\n const rgamma = new RandGamma(alpha, beta, dtype, seed);\n const res = buffer(shape, dtype);\n for (let i = 0; i < res.values.length; i++) {\n res.values[i] = rgamma.nextValue();\n }\n return res.toTensor();\n}\n\nexport const randomGamma = op({randomGamma_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n *
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http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
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*/\n\nimport {Tensor} from '../tensor';\nimport {DataType, Rank, ShapeMap} from '../types';\n\nimport {buffer} from './buffer';\nimport {op} from './operation';\nimport {MPRandGauss} from './rand_util';\n\n/**\n * Creates a `tf.Tensor` with values sampled from a normal distribution.\n *\n * ```js\n * tf.randomNormal([2, 2]).print();\n * ```\n *\n * @param
 shape An array of integers defining the output tensor shape.\n * @param mean The mean of the normal distribution.\n * @param stdDev The standard deviation of the normal distribution.\n * @param dtype The data type of the output.\n * @param seed The seed for the random number generator.\n *\n * @doc {heading: 'Tensors', subheading: 'Random'}\n */\nfunction randomNormal_<R extends Rank>(\n shape: ShapeMap[R], mean = 0, stdDev = 1, dtype?: 'float32'|'int32',\n seed?: number): Tensor<R> {\n if (dtype != null && (dtype as DataType) === 'bool') {\n throw new Error(`Unsupported data type ${dtype}`);\n }\n const randGauss =\n new MPRandGauss(mean, stdDev, dtype, false /* truncated */, seed);\n const res = buffer(shape, dtype);\n for (let i = 0; i < res.values.length; i++) {\n res.values[i] = randGauss.nextValue();\n }\n return res.toTensor();\n}\n\nexport const randomNormal = op({randomNormal_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n
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http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n
*/\n\nimport {Tensor} from '../tensor';\nimport {DataType, Rank, ShapeMap} from '../types';\n\nimport {buffer} from './buffer';\nimport {op} from './operation';\nimport {UniformRandom} from './rand_util';\n\n/**\n * Creates a `tf.Tensor` with values sampled from a uniform distribution.\n *\n * The generated values follow a uniform distribution in
 the range [minval,\n * maxval). The lower bound minval is included in the range, while the upper\n * bound maxval is excluded.\n *\n * ```js\n * tf.randomUniform([2, 2]).print();\n * ```\n *\n * @param shape An array of integers defining the output tensor shape.\n * @param minval The lower bound on the range of random values to generate.\n

* Defaults to 0.\n * @param maxval The upper bound on the range of random values to generate.\n * Defaults to 1.\n * @param dtype The data type of the output tensor. Defaults to 'float32'.\n *\n * @doc {heading: 'Tensors', subheading: 'Random'}\n */\nfunction randomUniform_<R extends Rank>(\n shape: ShapeMap[R], minval = 0, maxval = 1, dtype: DataType = 'float32',\n seed?: number|string): Tensor<R> {\n const res = buffer(shape, dtype);\n const random = new UniformRandom(minval, maxval, null, seed);\n for (let i = 0; i < res.values.length; i++) {\n res.values[i] = random.nextValue();\n }\n return res.toTensor();\n}\n\nexport const randomUniform = op({randomUniform_});\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {ENGINE} from '../engine';\nimport {Range, RangeAttrs} from '../kernel_names';\nimport {NamedAttrMap} from '../kernel_registry';\nimport {Tensor1D} from '../tensor';\n\n/**\n * Creates a new `tf.Tensor1D` filled with the numbers in the range provided.\n *\n * The tensor is a is half-open interval meaning it includes start, but\n * excludes stop. Decrementing ranges and negative step values are also\n * supported.sv\n *\n *\n * ```js\n * tf.range(0, 9, 2).print();\n * ```\n *\n * @param start An integer start value\n * @param stop An integer stop value\n * @param step An integer increment (will default to 1 or -1)\n * @param dtype The data type of the output tensor. Defaults to 'float32'.\n *\n * @doc {heading: 'Tensors', subheading: 'Creation'}\n */\nexport function range(\n start: number, stop: number, step = 1,\n dtype: 'float32'|'int32' = 'float32'): Tensor1D {\n if (step === 0) {\n throw new Error('Cannot have a step of zero');\n }\n\n const attrs: RangeAttrs = {start, stop, step, dtype};\n\n return ENGINE.runKernel(Range, {} /* inputs */, attrs as {} as NamedAttrMap);\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {ENGINE} from '../engine';\nimport {Real, RealInputs} from '../kernel_names';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\nimport {op} from './operation';\n\n/**\n * Returns the real part of a complex (or real) tensor.\n *\n * Given a tensor input, this operation returns a tensor of type float that is\n * the real part of each element in input considered as a complex number.\n *\n * If the input is real, it simply makes a clone.\n *\n * ```js\n * const x = tf.complex([-2.25, 3.25], [4.75, 5.75]);\n * tf.real(x).print();\n * ```\n *\n * @doc {heading: 'Tensors', subheading: 'Creation'}\n */\nfunction real_<T extends Tensor>(input: T|TensorLike): T {\n const $input = convertToTensor(input, 'input', 'real');\n\n const inputs: RealInputs = {input: $input};\n return ENGINE.runKernel(Real, inputs as {} as NamedTensorMap);\n}\n\nexport const real = op({real_});\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing

permissions and\n * limitations under the License.\n *
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*/\n\nimport {ENGINE} from '../engine';\nimport {Reciprocal, ReciprocalInputs} from '../kernel_names';\nimport
{Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from
'../tensor_util_env';\nimport {TensorLike} from '../types';\n\nimport {op} from './operation';\n\n/**\n * Computes
reciprocal of x element-wise: `1 / x`\n *\n * ```js\n * const x = tf.tensor1d([0, 1, 2]);\n *\n * x.reciprocal().print(); //
or tf.reciprocal(x)\n * ```\n * @param x The input tensor.\n *\n * @doc {heading: 'Operations', subheading: 'Basic
math'}\n */\nfunction reciprocal_<T extends Tensor>(x: T|TensorLike): T {\n const $x
 = convertToTensor(x, 'x', 'reciprocal');\n\n const inputs: ReciprocalInputs = {x: $x};\n return
ENGINE.runKernel(Reciprocal, inputs as {} as NamedTensorMap);\n}\nexport const reciprocal =
op({reciprocal_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under
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License.\n *
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*/\n\nimport {ENGINE} from '../engine';\nimport {Relu, ReluInputs} from
 '../kernel_names';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport
{convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\n\nimport {op} from
'./operation';\n\n/**\n * Computes rectified linear element-wise: `max(x, 0)`.\n *\n * ```js\n * const x = tf.tensor1d([-
1, 2, -3, 4]);\n *\n * x.relu().print(); // or tf.relu(x)\n * ```\n * @param x The input tensor. If the dtype is `bool`, the
output dtype will be\n *   `int32'.\n *\n * @doc {heading: 'Operations', subheading: 'Basic math'}\n */\nfunction
relu_<T extends Tensor>(x: T|TensorLike): T {\n const $x = convertToTensor(x, 'x', 'relu');\n\n const inputs:
ReluInputs = {x: $x};\n\n return ENGINE.runKernel(Relu, inputs as {} as NamedTensorMap);\n}\n\nexport const
relu = op({relu_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under
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OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language
governing permissions and\n * limitations under the License.\n *
==========\n
*/\n\nimport {ENGINE} from '../engine';\nimport {Relu6, Relu6Inputs} from '../kernel_names';\nimport {Tensor}
from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from
'../tensor_util_env';\nimport {TensorLike} from '../types';\n\nimport {op} from './operation';\n\n/**\n * Computes
rectified linear 6 element-wise: `min(max(x, 0), 6)`.\n *\n * ```js\n * const x = tf.tensor1d([-1, 2, -3, 8]);\n *\n *
x.relu6().print();
  // or tf.relu6(x)\n * ```\n * @param x The input tensor. If the dtype is `bool`, the output dtype will be\n *
`int32'.\n *\n * @doc {heading: 'Operations', subheading: 'Basic math'}\n */\nfunction relu6_<T extends Tensor>(x:
T|TensorLike): T {\n const $x = convertToTensor(x, 'x', 'relu6');\n\n const inputs: Relu6Inputs = {x: $x};\n\n
return ENGINE.runKernel(Relu6, inputs as {} as NamedTensorMap);\n}\n\nexport const relu6 =
op({relu6_});\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the
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on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or

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for the specific language governing permissions and\n * limitations under the License.\n *
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*/\n\nimport {ENGINE} from '../engine';\nimport {Reverse, ReverseAttrs, ReverseInputs} from
'../kernel_names';\nimport {NamedAttrMap} from '../kernel_registry';\nimport {Tensor} from '../tensor';\nimport
{NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport
{TensorLike} from '../types';\n\nimport {op} from './operation';\n\n/**\n * Reverses a `tf.Tensor` along a specified
axis.\n *\n * Also available are stricter rank-specific methods that assert that `x` is\n * of the given rank:\n *
- `tf.reverse1d`\n * - `tf.reverse2d`\n * - `tf.reverse3d`\n * - `tf.reverse4d`\n *\n * Except `tf.reverse1d` (which
does not have axis param), all methods have\n * same signature as this method.\n *\n * ```js\n * const x =
tf.tensor1d([1, 2, 3, 4]);\n *\n * x.reverse().print();\n
* ```\n *\n * ```js\n * const x = tf.tensor2d([1, 2, 3, 4], [2, 2]);\n *\n * const axis = 1;\n * x.reverse(axis).print();\n *
```\n * @param x The input tensor to be reversed.\n * @param axis The set of dimensions to reverse. Must be in
the\n * range [-rank(x), rank(x)). Defaults to all axes.\n *\n * @doc {heading: 'Tensors', subheading: 'Slicing and
Joining'}\n */\nfunction reverse_<T extends Tensor>(\n x: T|TensorLike, axis?: number|number[]): T {\n const $x
= convertToTensor(x, 'x', 'reverse');\n\n const inputs: ReverseInputs = {x: $x};\n const attrs: ReverseAttrs = {dims:
axis};\n\n return ENGINE.runKernel(\n Reverse, inputs as {} as NamedTensorMap, attrs as {} as
NamedAttrMap);\n}\n\nexport const reverse = op({reverse_});\n","/**\n * @license\n * Copyright 2020 Google
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the specific language governing permissions and\n * limitations under the License.\n *
==========\n
*/\n\nimport {Tensor1D} from '../tensor';\nimport {convertToTensor} from '../tensor_util_env';\nimport
{TensorLike} from '../types';\nimport * as util from '../util';\nimport {op} from './operation';\nimport {reverse} from
'./reverse';\n\n/**\n * Reverses a `tf.Tensor1D`.\n *\n * @param x The input tensor.\n */\nfunction reverse1d_(x:
Tensor1D|TensorLike): Tensor1D {\n const $x = convertToTensor(x, 'x', 'reverse');\n util.assert(\n $x.rank ===
1,\n () => `Error in reverse1D: x must be rank 1 but got rank
${$x.rank}.`);\n return reverse($x, 0);\n}\n\nexport const reverse1d = op({reverse1d_});\n","/**\n * @license\n *
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WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for
the specific language governing permissions and\n * limitations under the License.\n *
==========\n
*/\n\nimport {Tensor2D} from '../tensor';\nimport {convertToTensor} from '../tensor_util_env';\nimport
{TensorLike} from '../types';\nimport * as util from '../util';\nimport {op} from
'./operation';\nimport {reverse} from './reverse';\n\n/**\n * Reverses a `tf.Tensor2D` along a specified axis.\n *\n *
@param x The input tensor.\n * @param axis The set of dimensions to reverse. Must be in the\n * range [-
rank(x), rank(x)). Defaults to all axes.\n */\nfunction reverse2d_(x: Tensor2D|TensorLike, axis?: number|number[]):
Tensor2D {\n const $x = convertToTensor(x, 'x', 'reverse');\n util.assert(\n $x.rank === 2,\n () => `Error in
reverse2D: x must be rank 2 but got rank ${$x.rank}.`);\n return reverse($x, axis);\n}\n\nexport const reverse2d =
op({reverse2d_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under
the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the
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```

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under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n
*/\n\nimport {Tensor3D} from '../tensor';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\nimport * as util from '../util';\nimport {op} from './operation';\nimport {reverse} from './reverse';\n\n/**\n * Reverses a `tf.Tensor3D` along a specified axis.\n *\n * @param x The input tensor.\n * @param axis The set of dimensions to reverse. Must be in the\n * range [-rank(x), rank(x)). Defaults to all axes.\n */\nfunction reverse3d_(x: Tensor3D|TensorLike, axis?: number|number[]): Tensor3D {\n const $x = convertToTensor(x, 'x', 'reverse');\n util.assert(\n $x.rank === 3,\n () => `Error in reverse3D: x must be rank 3 but got rank ${$x.rank}.`);\n return reverse($x, axis);\n}\n\nexport const reverse3d = op({reverse3d_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n
*/\n\nimport {Tensor4D} from '../tensor';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\nimport * as util from '../util';\nimport
{op} from './operation';\nimport {reverse} from './reverse';\n\n/**\n * Reverses a `tf.Tensor4D` along a specified axis.\n *\n * @param x The input tensor.\n * @param axis The set of dimensions to reverse. Must be in the\n * range [-rank(x), rank(x)). Defaults to all axes.\n */\nfunction reverse4d_(x: Tensor4D|TensorLike, axis?: number|number[]): Tensor4D {\n const $x = convertToTensor(x, 'x', 'reverse');\n util.assert(\n $x.rank === 4,\n () => `Error in reverse4D: x must be rank 4 but got rank ${$x.rank}.`);\n return reverse($x, axis);\n}\n\nexport const reverse4d = op({reverse4d_});\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n
* distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n
*/\n\nimport {ENGINE} from '../engine';\nimport {Round, RoundInputs} from '../kernel_names';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\n\nimport {op} from './operation';\n\n/**\n * Computes round of input `tf.Tensor` element-wise: `round(x)`.\n * It implements banker's rounding.\n *\n * ```js\n * const x = tf.tensor1d([.6, 1.1, -3.3]);\n *\n * x.round().print(); // or tf.round(x)\n * ```\n * @param x The input tensor.\n *\n * @doc {heading: 'Operations', subheading: 'Basic math'}\n */\nfunction round_<T extends Tensor>(x: T|TensorLike): T {\n const $x = convertToTensor(x, 'x', 'round');\n const inputs: RoundInputs = {x: $x};\n\n return ENGINE.runKernel(Round, inputs as {} as NamedTensorMap);\n}\n\nexport const round = op({round_});\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or

implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==========\n */\n\nimport {ENGINE} from '../engine';\nimport {Rsqrt, RsqrtInputs} from '../kernel_names';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\n\nimport {op} from './operation';\n\n/**\n * Computes reciprocal of square root of the input `tf.Tensor` element-wise:\n * `y = 1 / sqrt(x)`\n *\n * ```js\n * const x = tf.tensor1d([1, 2, 4, -1]);\n *\n * x.rsqrt().print(); // or tf.rsqrt(x)\n * ```\n * @param x The input tensor.\n *\n * @doc {heading: 'Operations', subheading: 'Basic math'}\n */\nfunction rsqrt_<T extends Tensor>(x: T|TensorLike): T {\n const $x = convertToTensor(x, 'x', 'rsqrt');\n\n const inputs: RsqrtInputs = {x: $x};\n\n return ENGINE.runKernel(Rsqrt, inputs as {} as NamedTensorMap);\n}\nexport const rsqrt = op({rsqrt_});\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==========\n */\n\nimport {Scalar} from '../tensor';\nimport {DataType} from '../types';\nimport {isTypedArray} from '../util';\nimport {makeTensor} from './tensor_ops_util';\n\n/**\n * Creates rank-0 `tf.Tensor` (scalar) with the provided value and dtype.\n *\n * The same functionality can be achieved with `tf.tensor`, but in general\n * we recommend using `tf.scalar` as it makes the code more readable.\n *\n * ```js\n * tf.scalar(3.14).print();\n * ```\n *\n * @param value The value of the scalar.\n * @param dtype The data type.\n *\n * @doc {heading: 'Tensors', subheading: 'Creation'}\n */\nexport function scalar(\n   value: number|boolean|string|Uint8Array, dtype?: DataType): Scalar {\n if (((isTypedArray(value) && dtype !== 'string') || Array.isArray(value)) &&\n   dtype !== 'complex64') {\n   throw new Error(\n   'Error creating a new Scalar: value must be a primitive ' +\n   '(number|boolean|string)');\n }\n if (dtype === 'string' && isTypedArray(value) &&\n   !(value instanceof Uint8Array)) {\n   throw new Error(\n   'When making a scalar from encoded string, ' +\n   'the value must be `Uint8Array`.');\n }\n const shape: number[] = [];\n const inferredShape: number[] = [];\n return makeTensor(value, shape, inferredShape, dtype) as Scalar;\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==========\n */\n\nimport {ENGINE} from '../engine';\nimport {Selu, SeluInputs} from '../kernel_names';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\n\nimport {op} from './operation';\n\n/**\n * Computes scaled exponential linear element-wise.\n *\n * `x < 0 ? scale * alpha * (exp(x) - 1) : x`\n *\n * ```js\n * const x = tf.tensor1d([-1, 2, -3, 4]);\n *\n * x.selu().print(); // or tf.selu(x)\n * ```\n * @param x The input tensor.\n *\n * @doc {heading: 'Operations', subheading: 'Basic math'}\n */\nfunction selu_<T extends Tensor>(x: T|TensorLike): T {\n const $x = convertToTensor(x, 'x', 'selu');\n\n const inputs: SeluInputs = {x: $x};\n\n return ENGINE.runKernel(Selu, inputs

as {} as NamedTensorMap);\n}\n\nexport const selu = op({selu_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\nimport {Tensor3D, Tensor4D} from '../tensor';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\nimport * as util from '../util';\n\nimport {conv2d} from './conv2d';\nimport {depthwiseConv2d} from './depthwise_conv2d';\nimport {op} from './operation';\nimport {reshape} from './reshape';\n\n/**\n * 2-D convolution with separable filters.\n *\n * Performs a depthwise convolution that acts separately on channels followed\n * by a pointwise convolution that mixes channels. Note that this is\n * separability between dimensions [1, 2] and 3, not spatial separability\n * between dimensions 1 and 2.\n *\n * See\n * [https://www.tensorflow.org/api_docs/python/tf/nn/separable_conv2d](\n * https://www.tensorflow.org/api_docs/python/tf/nn/separable_conv2d)\n * for more details.\n *\n * @param x The input tensor, of rank 4 or rank 3, of shape\n *   `[batch, height, width, inChannels]`. If rank 3, batch of 1 is\n * assumed.\n * @param depthwiseFilter The depthwise filter tensor, rank 4, of shape\n *   `[filterHeight, filterWidth, inChannels, channelMultiplier]`. This is\n *   the filter used in the first step.\n * @param pointwiseFilter The pointwise filter tensor, rank 4, of shape\n *   `[1, 1, inChannels * channelMultiplier, outChannels]`. This is\n * the filter used in the second step.\n * @param strides The strides of the convolution: `[strideHeight,\n * strideWidth]`. If strides is a single number, then `strideHeight ==\n * strideWidth`.\n * @param pad The type of padding algorithm.\n *   - `same` and stride 1: output will be of same size as input,\n *   regardless of filter size.\n *   - `valid`: output will be smaller than input if filter is larger\n *   than 1x1.\n *   - For more info, see this guide:\n *   [https://www.tensorflow.org/api_guides/python/nn#Convolution](\n *   https://www.tensorflow.org/api_guides/python/nn#Convolution)\n * @param dilations The dilation rates: `[dilationHeight, dilationWidth]`\n *   in which we sample input values across the height and width dimensions\n *   in atrous convolution. Defaults to `[1, 1]`. If `rate` is a single\n *   number, then `dilationHeight == dilationWidth`. If it is greater than\n *   1, then all values of `strides` must be 1.\n * @param dataFormat: An optional string from: \"NHWC\", \"NCHW\". Defaults to\n *   \"NHWC\". Specify the data format of the input and output data. With the\n *   default format \"NHWC\", the data is stored in the order of: [batch,\n *   height, width, channels]. Only \"NHWC\" is currently supported.\n *\n * @doc {heading: 'Operations', subheading: 'Convolution'}\n */\nfunction separableConv2d_<T extends Tensor3D|Tensor4D>(\n   x: T|TensorLike, depthwiseFilter: Tensor4D|TensorLike,\n   pointwiseFilter: Tensor4D|TensorLike, strides: [number, number]|number,\n   pad: 'valid'|'same', dilation: [number, number]|number = [1, 1],\n   dataFormat: 'NHWC'|'NCHW' = 'NHWC'): T {\n const $x = convertToTensor(x, 'x', 'separableConv2d');\n const $depthwiseFilter =\n   convertToTensor(depthwiseFilter, 'depthwiseFilter', 'separableConv2d');\n const $pointwiseFilter =\n   convertToTensor(pointwiseFilter, 'pointwiseFilter', 'separableConv2d');\n\n let x4D = $x as Tensor4D;\n let reshapedTo4D = false;\n if ($x.rank === 3) {\n   reshapedTo4D = true;\n   x4D = reshape($x, [1, $x.shape[0], $x.shape[1], $x.shape[2]]);\n }\n\n if (dataFormat === 'NCHW') {\n   throw new Error(\n   'separableConv2d currently does not support dataFormat NCHW; only ' +\n   'NHWC is supported');\n }\n\n util.assert(\n   x4D.rank === 4,\n   () => `Error in separableConv2d: input must be rank 4, but got ` +\n   `rank ${x4D.rank}.`);\n util.assert(\n $depthwiseFilter.rank === 4,\n   () => `Error in separableConv2d: depthwise filter must be rank 4, but ` +\n   `got rank ${$depthwiseFilter.rank}.`);\n util.assert(\n $pointwiseFilter.rank === 4,\n   () => `Error in separableConv2d: pointwise filter must be rank 4, but ` +\n   `got rank ${$depthwiseFilter.rank}.`);\n util.assert(\n $pointwiseFilter.shape[0] === 1,\n   () =>\n   `Error in

separableConv2d: the first dimension of pointwise filter ` +\n ` must be 1, but got ${$pointwiseFilter.shape[0]}.`);\n util.assert(\n $pointwiseFilter.shape[1] === 1,\n () => `Error in separableConv2d: the second dimension of pointwise ` +\n `filter must be 1, but got ${$pointwiseFilter.shape[1]}.`);\n\n const inChannels = $depthwiseFilter.shape[2];\n const channelMultiplier = $depthwiseFilter.shape[3];\n util.assert(\n $pointwiseFilter.shape[2] === inChannels * channelMultiplier,\n () =>\n `Error in separableConv2d: the third dimension of pointwise filter ` +\n `must be ${inChannels * channelMultiplier}, ` +\n `but got ${$pointwiseFilter.shape[2]}.`);\n\n const depthwise = depthwiseConv2d(\n x4D, $depthwiseFilter, strides, pad, dataFormat, dilation);\n const pointwiseStride = 1;\n const res =\n conv2d(depthwise, $pointwiseFilter, pointwiseStride, 'valid', dataFormat);\n\n if (reshapedTo4D) {\n return reshape(res, [res.shape[1], res.shape[2], res.shape[3]]) as T;\n }\n return res as T;\n}\n\nexport const separableConv2d = op({separableConv2d_});\n","/**\n * @license\n * Copyright 2020 Google Inc. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS
OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n */\nimport {Tensor, TensorBuffer} from '../tensor';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\nimport * as util from '../util';\n\n/**\n * Computes the difference between two lists of numbers.\n *\n * Given a Tensor `x` and a Tensor `y`, this operation returns a Tensor `out`\n * that represents all values that are in `x` but not in `y`. The returned\n * Tensor `out` is sorted in the same order that the numbers appear in `x`\n * (duplicates are preserved). This operation also returns a Tensor indices that\n * represents the position of each out element in `x`. In other words:\n *\n * `out[i] = x[idx[i]] for i in [0, 1, ..., out.length - 1]`\n *\n * ```js\n * const x = [1, 2, 3, 4, 5, 6];\n * const y = [1, 3,
5];\n *\n * const [out, indices] = await tf.setdiff1dAsync(x, y);\n * out.print(); // [2, 4, 6]\n * indices.print(); // [1, 3, 5]\n * ```\n *\n * @param x 1-D Tensor. Values to keep.\n * @param y 1-D Tensor. Must have the same type as x. Values to exclude in the\n * output.\n * @returns Promise of Tensor tuple [out, indices].\n * out: Tensor with the same type as x.\n * indices: A Tensor of type int32.\n *\n * @doc {heading: 'Tensors', subheading: 'Transformations'}\n */\nasync function setdiff1dAsync_(\n x: Tensor|TensorLike, y: Tensor|TensorLike): Promise<[Tensor, Tensor]> {\n const $x = convertToTensor(x, 'x', 'setdiff1d');\n const $y = convertToTensor(y, 'y', 'setdiff1d');\n\n util.assert(\n $x.dtype === $y.dtype,\n () => `x and y should have the same dtype, but got x (${\n $x.dtype}) and y (${$y.dtype}).`);\n\n util.assert(\n $x.rank === 1, () => `x should be 1D tensor, but got x (${$x.shape}).`);\n\n util.assert(\n $y.rank === 1, () =>
`y should be 1D tensor, but got y (${$y.shape}).`);\n\n const xVals = await $x.data();\n const yVals = await $y.data();\n const ySet = new Set(yVals);\n\n let outputSize = 0;\n for (let i = 0; i < xVals.length; i++) {\n if (!ySet.has(xVals[i])) {\n outputSize++;\n }\n }\n\n const buffer = new TensorBuffer([outputSize], $x.dtype);\n const indices = new TensorBuffer([outputSize], 'int32');\n for (let i = 0, p = 0; i < xVals.length; i++) {\n if (!ySet.has(xVals[i])) {\n buffer.values[p] = xVals[i];\n indices.values[p] = i;\n p++;\n }\n }\n return [buffer.toTensor(), indices.toTensor()];\n}\nexport const setdiff1dAsync = setdiff1dAsync_;\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n *
Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *

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=============================================================================\n
*/\n\nimport {ENGINE} from '../engine';\nimport {Sign, SignInputs} from '../kernel_names';\nimport {Tensor}
from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from
'../tensor_util_env';\nimport {TensorLike} from '../types';\n\nimport {op} from './operation';\n\n/**\n * Returns an
element-wise indication of the sign of a number.\n *\n * ```js\n * const x = tf.tensor1d([.6, 1.1, -3.3, NaN, 0]);\n *\n
* x.sign().print();  // or tf.sign(x)\n * ```\n * @param x The input Tensor.\n *\n * @doc {heading: 'Operations',
subheading: 'Basic math'}\n */\nfunction
 sign_<T extends Tensor>(x: T|TensorLike): T {\n  const $x = convertToTensor(x, 'x', 'sign');\n  const inputs:
SignInputs = {x: $x};\n  return ENGINE.runKernel(Sign, inputs as {} as NamedTensorMap);\n}\nexport const sign
= op({sign_});\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the
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on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or
implied.\n * See the License for the specific language governing permissions and\n * limitations under the
License.\n *
=============================================================================\n
*/\n\nimport {ENGINE} from '../engine';\nimport
 {Sin, SinInputs} from '../kernel_names';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from
'../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from
'../types';\n\nimport {op} from './operation';\n\n/**\n * Computes sin of the input Tensor element-wise: `sin(x)`\n *\n
* ```js\n * const x = tf.tensor1d([0, Math.PI / 2, Math.PI * 3 / 4]);\n *\n * x.sin().print();  // or tf.sin(x)\n * ```\n *
@param x The input tensor.\n *\n * @doc {heading: 'Operations', subheading: 'Basic math'}\n */\nfunction sin_<T
extends Tensor>(x: T|TensorLike): T {\n  const $x = convertToTensor(x, 'x', 'sin');\n\n  const inputs: SinInputs = {x:
$x};\n\n  return ENGINE.runKernel(Sin, inputs as {} as NamedTensorMap);\n}\nexport const sin =
op({sin_});\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the
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on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or
implied.\n * See the License for the specific language governing permissions and\n * limitations under the
License.\n *
=============================================================================\n
*/\n\nimport {ENGINE} from '../engine';\nimport {Sinh, SinhInputs} from '../kernel_names';\nimport {Tensor}
from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from
'../tensor_util_env';\nimport {TensorLike} from '../types';\n\nimport {op} from './operation';\n\n/**\n * Computes
hyperbolic sin of the input `tf.Tensor` element-wise: `sinh(x)`\n *\n * ```js\n * const x = tf.tensor1d([0, 1, -1, .7]);\n
*\n * x.sinh().print();  // or tf.sinh(x)\n
 * ```\n * @param x The input tensor.\n *\n * @doc {heading: 'Operations', subheading: 'Basic math'}\n */\nfunction
sinh_<T extends Tensor>(x: T|TensorLike): T {\n  const $x = convertToTensor(x, 'x', 'sinh');\n  const inputs:
SinhInputs = {x: $x};\n\n  return ENGINE.runKernel(Sinh, inputs as {} as NamedTensorMap);\n}\nexport const
sinh = op({sinh_});\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under
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implied.\n * See the License for the specific language governing permissions and\n * limitations under the
License.\n
```

```
 * ==========================================================================\n
*/\n\nimport {Tensor1D} from '../tensor';\nimport {convertToTensor} from '../tensor_util_env';\nimport
{TensorLike} from '../types';\nimport * as util from '../util';\n\nimport {op} from './operation';\nimport {slice} from
'./slice';\n\n/**\n * Extracts a 1D slice from 1D array starting at coordinates `begin` and is\n * of length `size`. See
`slice` for details.\n */\nfunction slice1d_(\n    x: Tensor1D|TensorLike, begin: number, size: number): Tensor1D {\n
const $x = convertToTensor(x, 'x', 'slice1d');\n  util.assert(\n      $x.rank === 1,\n      () =>\n          `slice1d expects a
rank-1 tensor, but got a rank-${$x.rank} tensor`);\n  return slice($x, [begin], [size]);\n}\nexport const slice1d =
op({slice1d_});\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the
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express or implied.\n * See the License for the specific language governing permissions and\n * limitations under
the License.\n *
==========================================================================\n
*/\n\nimport {Tensor2D} from '../tensor';\nimport {convertToTensor} from '../tensor_util_env';\nimport
{TensorLike} from '../types';\nimport * as util from '../util';\n\nimport {op} from './operation';\nimport {slice} from
'./slice';\n\n/**\n * Extracts a 2D slice from a 2D array starting at coordinates `begin` and\n * is of size `size`. See
`slice` for details.\n */\nfunction slice2d_(\n    x: Tensor2D|TensorLike, begin: [number, number],\n    size: [number,
number]):
 Tensor2D {\n  const $x = convertToTensor(x, 'x', 'slice2d');\n  util.assert(\n      $x.rank === 2,\n      () =>\n
`slice2d expects a rank-2 tensor, but got a rank-${$x.rank} tensor`);\n  return slice($x, begin, size);\n}\nexport const
slice2d = op({slice2d_});\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed
under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the
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on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or
implied.\n * See the License for the specific language governing permissions and\n * limitations under the
License.\n *
==========================================================================\n
*/\n\nimport
 {Tensor3D} from '../tensor';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from
'../types';\nimport * as util from '../util';\n\nimport {op} from './operation';\nimport {slice} from './slice';\n\n/**\n *
Extracts a 3D slice from a 3D array starting at coordinates `begin` and\n * is of size `size`. See `slice` for details.\n
*/\nfunction slice3d_(\n    x: Tensor3D|TensorLike, begin: [number, number, number],\n    size: [number, number,
number]): Tensor3D {\n  const $x = convertToTensor(x, 'x', 'slice3d');\n  util.assert(\n      $x.rank === 3,\n      ()
=>\n          `slice3d expects a rank-3 tensor, but got a rank-${$x.rank} tensor`);\n  return slice($x, begin,
size);\n}\nexport const slice3d = op({slice3d_});\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights
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the specific language governing permissions and\n * limitations under the License.\n *
==========================================================================\n
*/\n\nimport {Tensor4D} from '../tensor';\nimport {convertToTensor} from '../tensor_util_env';\nimport
{TensorLike} from '../types';\nimport * as util from '../util';\n\nimport {op} from './operation';\nimport {slice} from
'./slice';\n\n/**\n * Extracts a 4D slice from a 4D array starting at coordinates `begin` and\n * is of size `size`. See
```

`slice` for details.\n */\nfunction slice4d_(\n   x: Tensor4D|TensorLike, begin: [number, number, number, number],\n   size: [number, number, number, number]): Tensor4D {\n const $x = convertToTensor(x, 'x', 'slice4d');\n util.assert(\n $x.rank === 4,\n   () =>\n   `slice4d expects a rank-4 tensor, but got a rank-${$x.rank} tensor`);\n return slice($x, begin, size);\n}\nexport const slice4d = op({slice4d_});\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {ENGINE}
 from '../engine';\nimport {Softmax, SoftmaxAttrs, SoftmaxInputs} from '../kernel_names';\nimport {NamedAttrMap} from '../kernel_registry';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\n\nimport {op} from './operation';\n\n/**\n * Computes the softmax normalized vector given the logits.\n *\n * ```js\n * const a = tf.tensor1d([1, 2, 3]);\n *\n * a.softmax().print(); // or tf.softmax(a)\n * ```\n *\n * ```js\n * const a = tf.tensor2d([2, 4, 6, 1, 2, 3], [2, 3]);\n *\n * a.softmax().print(); // or tf.softmax(a)\n * ```\n *\n * @param logits The logits array.\n * @param dim The dimension softmax would be performed on. Defaults to `-1`\n * which indicates the last dimension.\n *\n * @doc {heading: 'Operations', subheading: 'Normalization'}\n */\nfunction softmax_<T extends Tensor>(logits: T|TensorLike, dim = -1): T {\n const $logits = convertToTensor(logits,
 'logits', 'softmax', 'float32');\n\n if (dim === -1) {\n   dim = $logits.rank - 1;\n }\n if (dim !== $logits.rank - 1) {\n
 throw Error(\n   'Softmax along a non-last dimension is not yet supported. ' +\n   `Logits was rank ${$logits.rank} and dim was ${dim}`);\n }\n\n const inputs: SoftmaxInputs = {logits: $logits};\n const attrs: SoftmaxAttrs = {dim};\n\n return ENGINE.runKernel(\n   Softmax, inputs as {} as NamedTensorMap, attrs as {} as NamedAttrMap);\n}\n\nexport const softmax = op({softmax_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT
 WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {ENGINE} from '../../engine';\nimport {FFT, FFTInputs} from '../../kernel_names';\nimport {Tensor} from '../../tensor';\nimport {NamedTensorMap} from '../../tensor_types';\nimport {assert} from '../../util';\nimport {op} from '../operation';\n\n/**\n * Fast Fourier transform.\n *\n * Computes the 1-dimensional discrete Fourier transform over the inner-most\n * dimension of input.\n *\n * ```js\n * const real = tf.tensor1d([1, 2, 3]);\n * const imag = tf.tensor1d([1, 2, 3]);\n * const x = tf.complex(real, imag);\n *\n * x.fft().print(); // tf.spectral.fft(x).print();\n * ```\n * @param input The complex input to compute an fft over.\n *\n * @doc {heading: 'Operations', subheading: 'Spectral', namespace: 'spectral'}\n */\nfunction
 fft_(input: Tensor): Tensor {\n assert(\n   input.dtype === 'complex64',\n   () => `The dtype for tf.spectral.fft() must be complex64 ` +\n   `but got ${input.dtype}.`);\n\n const inputs: FFTInputs = {input};\n\n return ENGINE.runKernel(FFT, inputs as {} as NamedTensorMap);\n}\n\nexport const fft = op({fft_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable

law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {ENGINE} from '../../engine';\nimport {IFFT, IFFTInputs} from '../../kernel_names';\nimport {Tensor} from '../../tensor';\nimport {NamedTensorMap} from '../../tensor_types';\nimport {assert} from '../../util';\nimport {op} from '../operation';\n\n/**\n * Inverse fast Fourier transform.\n *\n * Computes the inverse 1-dimensional discrete Fourier transform over the\n * inner-most dimension of input.\n *\n * ```js\n * const real = tf.tensor1d([1, 2, 3]);\n * const imag = tf.tensor1d([1, 2, 3]);\n * const x = tf.complex(real, imag);\n *\n * x.ifft().print(); // tf.spectral.ifft(x).print();\n * ```\n * @param input The complex input to compute an ifft over.\n *\n * @doc {heading: 'Operations', subheading: 'Spectral', namespace: 'spectral'}\n */\nfunction ifft_(input: Tensor): Tensor {\n assert(\n   input.dtype === 'complex64',\n   () => `The dtype for tf.spectral.ifft() must be complex64 ` +\n   `but got ${input.dtype}.`);\n\n const inputs: IFFTInputs = {input};\n\n return ENGINE.runKernel(IFFT, inputs as {} as NamedTensorMap);\n}\n\nexport const ifft = op({ifft_});\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {Tensor, Tensor2D} from '../../tensor';\nimport {complex} from '../complex';\nimport {concat} from '../concat';\nimport {imag} from '../imag';\nimport {mul} from '../mul';\nimport {op} from '../operation';\nimport {real} from '../real';\nimport {reshape} from '../reshape';\nimport {reverse} from '../reverse';\nimport {scalar} from '../scalar';\nimport {slice} from '../slice';\n\nimport {ifft} from './ifft';\n\n/**\n * Inversed real value input fast Fourier transform.\n *\n * Computes the 1-dimensional inversed discrete Fourier transform over the\n * inner-most dimension of the real input.\n *\n * ```js\n * const real = tf.tensor1d([1, 2, 3]);\n * const imag = tf.tensor1d([0, 0, 0]);\n * const x = tf.complex(real, imag);\n *\n * x.irfft().print();\n * ```\n * @param input The real value input to compute an irfft over.\n *\n * @doc {heading: 'Operations', subheading: 'Spectral', namespace: 'spectral'}\n */\nfunction irfft_(input: Tensor): Tensor {\n const innerDimensionSize = input.shape[input.shape.length - 1];\n const batch = input.size / innerDimensionSize;\n let ret: Tensor;\n if (innerDimensionSize <= 2) {\n   const complexInput = reshape(input, [batch, innerDimensionSize]);\n   ret = ifft(complexInput);\n } else {\n   // The length of unique components of the DFT of a real-valued signal\n   // is 2 * (input_len - 1)\n   const outputShape = [batch, 2 * (innerDimensionSize - 1)];\n   const realInput = reshape(real(input), [batch, innerDimensionSize]);\n   const imagInput = reshape(imag(input), [batch, innerDimensionSize]);\n\n   const realConjugate =\n   reverse(slice(realInput, [0, 1], [batch, innerDimensionSize - 2]), 1);\n   const imagConjugate: Tensor2D = mul(\n   reverse(slice(imagInput, [0, 1], [batch, innerDimensionSize - 2]), 1),\n   scalar(-1));\n\n   const r = concat([realInput, realConjugate], 1);\n   const i = concat([imagInput, imagConjugate], 1);\n   const complexInput =\n   reshape(complex(r, i), [outputShape[0], outputShape[1]]);\n   ret = ifft(complexInput);\n }\n ret = real(ret);\n // reshape the result if the input is 3D tensor.\n if (input.rank === 3 && input.shape[0] !== 0) {\n   const temp = ret;\n   const batch = input.shape[0];\n   ret = reshape(ret, [batch, ret.shape[0] / batch, ret.shape[1]]);\n   temp.dispose();\n }\n return ret;\n}\n\nexport const irfft = op({irfft_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES

OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==========\n */\nimport {ENGINE} from '../engine';\nimport {SplitV, SplitVAttrs, SplitVInputs} from '../kernel_names';\nimport {NamedAttrMap} from '../kernel_registry';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\n\nimport {op} from './operation';\n\n/**\n * Splits a `tf.Tensor` into sub tensors.\n *\n * If `numOrSizeSplits` is a number, splits `x` along dimension `axis`\n * into `numOrSizeSplits` smaller tensors.\n * Requires that `numOrSizeSplits` evenly divides `x.shape[axis]`.\n *\n * If `numOrSizeSplits` is a number array, splits `x` into\n * `numOrSizeSplits.length` pieces. The shape of the `i`-th piece has the\n * same size as `x` except along dimension `axis` where the size is\n * `numOrSizeSplits[i]`.\n *\n * ```js\n * const x = tf.tensor2d([1, 2, 3, 4, 5, 6, 7, 8], [2, 4]);\n * const [a, b] = tf.split(x, 2, 1);\n * a.print();\n * b.print();\n *\n * const [c, d, e] = tf.split(x, [1, 2, 1], 1);\n * c.print();\n * d.print();\n * e.print();\n * ```\n *\n * @param x The input tensor to split.\n * @param numOrSizeSplits Either an integer indicating the number of\n * splits along the axis or an array of integers containing the sizes of\n * each output tensor along the axis. If a number then it must evenly divide\n * `x.shape[axis]`; otherwise the sum of sizes must match `x.shape[axis]`.\n * Can contain one -1 indicating that dimension is to be inferred.\n * @param axis The dimension along which to split. Defaults to 0 (the first\n * dim).\n *\n * @doc {heading: 'Tensors', subheading: 'Slicing and Joining'}\n */\nfunction split_<T extends Tensor>(\n   x: Tensor|TensorLike, numOrSizeSplits: number[]|number, axis = 0): T[] {\n const $x = convertToTensor(x, 'x', 'split');\n\n const inputs: SplitVInputs = {x: $x};\n const attr: SplitVAttrs = {numOrSizeSplits, axis};\n\n return ENGINE.runKernel(\n   SplitV, inputs as {} as NamedTensorMap,\n   attr as {} as NamedAttrMap) as {} as T[];\n}\n\nexport const split = op({split_});\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==========\n */\n\nimport {Tensor} from '../../tensor';\nimport {assert} from '../../util';\nimport {complex} from '../complex';\nimport {concat} from '../concat';\nimport {imag} from '../imag';\nimport {op} from '../operation';\nimport {real} from '../real';\nimport {reshape} from '../reshape';\nimport {slice} from '../slice';\nimport {split} from '../split';\nimport {zeros} from '../zeros';\nimport {zerosLike} from '../zeros_like';\n\nimport {fft} from './fft';\n\n/**\n * Real value input fast Fourier transform.\n *\n * Computes the 1-dimensional discrete Fourier transform over the\n * inner-most dimension of the real input.\n *\n * ```js\n * const real = tf.tensor1d([1, 2, 3]);\n *\n * real.rfft().print();\n * ```\n * @param input The real value input to compute an rfft over.\n *\n * @doc {heading: 'Operations', subheading: 'Spectral', namespace: 'spectral'}\n */\nfunction rfft_(input: Tensor, fftLength?: number): Tensor {\n assert(\n   input.dtype === 'float32',\n   () => `The dtype for rfft() must be real value but got ${input.dtype}`);\n\n let innerDimensionSize = input.shape[input.shape.length - 1];\n const batch = input.size / innerDimensionSize;\n\n let adjustedInput: Tensor;\n if (fftLength != null && fftLength < innerDimensionSize) {\n   // Need to crop\n   const begin = input.shape.map(v => 0);\n   const size = input.shape.map(v => v);\n   size[input.shape.length - 1] = fftLength;\n   adjustedInput = slice(input, begin, size);\n   innerDimensionSize = fftLength;\n } else if (fftLength != null && fftLength > innerDimensionSize) {\n   // Need to pad with zeros\n   const zerosShape = input.shape.map(v => v);\n   zerosShape[input.shape.length - 1] = fftLength - innerDimensionSize;\n   adjustedInput = concat([input, zeros(zerosShape)], input.shape.length - 1);\n   innerDimensionSize = fftLength;\n } else {\n   adjustedInput = input;\n }\n\n // Complement the input with zero imaginary numbers.\n const zerosInput

= zerosLike(adjustedInput);\n const complexInput =\n   reshape(complex(adjustedInput, zerosInput), [batch, innerDimensionSize]);\n\n const ret = fft(complexInput);\n\n // Exclude complex conjugations. These conjugations are put symmetrically.\n const half = Math.floor(innerDimensionSize / 2) + 1;\n const realValues = real(ret);\n const imagValues = imag(ret);\n const realComplexConjugate = split(\n   realValues, [half, innerDimensionSize - half],\n   realValues.shape.length - 1);\n const imagComplexConjugate = split(\n imagValues, [half, innerDimensionSize - half],\n   imagValues.shape.length - 1);\n\n const outputShape = adjustedInput.shape.slice();\n outputShape[adjustedInput.shape.length - 1] = half;\n\n return reshape(\n complex(realComplexConjugate[0], imagComplexConjugate[0]), outputShape);\n}\n\nexport const rfft = op({rfft_});\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ===\n */\n\nimport {ENGINE} from '../engine';\nimport {Sqrt, SqrtInputs} from '../kernel_names';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\n\nimport {op} from './operation';\n\n/**\n * Computes square root of the input `tf.Tensor` element-wise: `y = sqrt(x)`\n *\n * ```js\n * const x = tf.tensor1d([1, 2, 4, -1]);\n *\n * x.sqrt().print(); // or tf.sqrt(x)\n * ```\n * @param x The input tensor.\n *\n * @doc {heading: 'Operations', subheading: 'Basic math'}\n */\nfunction sqrt_<T extends Tensor>(x: T|TensorLike): T {\n const $x = convertToTensor(x, 'x', 'sqrt');\n\n const inputs: SqrtInputs = {x: $x};\n\n return ENGINE.runKernel(Sqrt, inputs as {} as NamedTensorMap);\n}\nexport const sqrt = op({sqrt_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ===\n */\n\nimport {ENGINE} from '../engine';\nimport {SquaredDifference, SquaredDifferenceInputs} from '../kernel_names';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {makeTypesMatch} from '../tensor_util';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\n\nimport {assertAndGetBroadcastShape} from './broadcast_util';\nimport {op} from './operation';\n\n/**\n * Returns (a - b) * (a - b) element-wise.\n * Supports broadcasting.\n *\n * ```js\n * const a = tf.tensor1d([1, 4, 3, 16]);\n * const b = tf.tensor1d([1, 2, 9, 4]);\n *\n * a.squaredDifference(b).print(); // or tf.squaredDifference(a, b)\n * ```\n *\n * ```js\n * // Broadcast squared difference a with b.\n * const a = tf.tensor1d([2, 4, 6, 8]);\n * const b = tf.scalar(5);\n *\n * a.squaredDifference(b).print(); // or tf.squaredDifference(a, b)\n * ```\n *\n * @param a The first tensor.\n * @param b The second tensor. Must have the same type as `a`.\n *\n * @doc {heading: 'Operations', subheading: 'Arithmetic'}\n */\nfunction squaredDifference_<T extends Tensor>(\n   a: Tensor|TensorLike, b: Tensor|TensorLike): T {\n let $a = convertToTensor(a, 'a', 'squaredDifference');\n let $b = convertToTensor(b, 'b', 'squaredDifference');\n [$a, $b] = makeTypesMatch($a, $b);\n\n assertAndGetBroadcastShape($a.shape, $b.shape);\n\n const inputs: SquaredDifferenceInputs = {a: $a, b: $b};\n const attrs = {};\n\n return ENGINE.runKernel(\n   SquaredDifference, inputs as unknown as NamedTensorMap, attrs);\n}\n\nexport const squaredDifference = op({squaredDifference_});\n","/**\n * @license\n * Copyright 2020

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under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {Tensor} from '../tensor';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\nimport {squeezeShape} from '../util';\n\nimport {op} from './operation';\nimport {reshape} from './reshape';\n\n/**\n * Removes dimensions of size 1 from the shape of a `tf.Tensor`.\n *\n * ```js\n * const x = tf.tensor([1, 2, 3, 4], [1, 1, 4]);\n * x.squeeze().print();\n * ```\n *\n * @param x The input tensor to be squeezed.\n * @param axis An optional list of numbers. If specified, only\n * squeezes the dimensions listed. The dimension index starts at 0. It\n * is an error to squeeze a dimension that is not 1.\n *\n * @doc {heading:
'Tensors', subheading: 'Transformations'}\n */\nfunction squeeze_<T extends Tensor>(x: Tensor|TensorLike, axis?: number[]): T {\n const $x = convertToTensor(x, 'x', 'squeeze');\n return reshape($x, squeezeShape($x.shape, axis).newShape) as T;\n}\n\nexport const squeeze = op({squeeze_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {ENGINE} from '../engine';\nimport {Pack, PackAttrs, PackInputs} from '../kernel_names';\nimport {NamedAttrMap} from '../kernel_registry';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensorArray} from '../tensor_util_env';\nimport {TensorLike} from '../types';\nimport * as util from '../util';\n\nimport {op} from './operation';\n\n/**\n * Stacks a list of rank-`R` `tf.Tensor`s into one rank-`(R+1)` `tf.Tensor`.\n *\n * ```js\n * const a = tf.tensor1d([1, 2]);\n * const b = tf.tensor1d([3, 4]);\n * const c = tf.tensor1d([5, 6]);\n * tf.stack([a, b, c]).print();\n * ```\n *\n * @param tensors A list of tensor objects with the same shape and dtype.\n * @param axis The axis to stack along. Defaults to 0 (the first dim).\n *\n * @doc {heading: 'Tensors', subheading: 'Slicing and Joining'}\n */\nfunction stack_<T extends Tensor>(\n   tensors: Array<T|TensorLike>, axis = 0): Tensor {\n const $tensors =\n   convertToTensorArray(tensors, 'tensors', 'stack', 'string_or_numeric');\n\n util.assert(\n $tensors.length >= 1,
() => 'Pass at least one tensor to tf.stack');\n\n if ($tensors.length > 0) {\n   util.assert(\n   axis <=
$tensors[0].rank, () => 'Axis must be <= rank of the tensor');\n }\n\n const inputs: PackInputs = $tensors;\n const attrs: PackAttrs = {axis};\n\n return ENGINE.runKernel(\n   Pack, inputs as {} as NamedTensorMap, attrs as {} as NamedAttrMap);\n}\n\nexport const stack = op({stack_});\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES
OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {ENGINE} from '../engine';\nimport {Step, StepAttrs, StepInputs} from '../kernel_names';\nimport {NamedAttrMap} from '../kernel_registry';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\nimport {from

'../types';\n\nimport {op} from './operation';\n\n/**\n * Computes step of the input `tf.Tensor` element-wise: `x > 0 ? 1 : alpha * x`\n *\n * ```js\n * const x = tf.tensor1d([0, 2, -1, -3]);\n *\n * x.step(.5).print(); // or tf.step(x, .5)\n * ```\n * @param x The input tensor.\n * @param alpha The gradient when input is negative.\n *\n * @doc {heading: 'Operations', subheading: 'Basic math'}\n */\nfunction step_<T extends Tensor>(x: T|TensorLike, alpha = 0.0): T {\n const $x = convertToTensor(x, 'x', 'step');\n\n const inputs: StepInputs = {x: $x};\n const attrs: StepAttrs = {alpha};\n\n return ENGINE.runKernel(\n   Step, inputs as {} as NamedTensorMap, attrs as {} as NamedAttrMap);\n}\nexport const step = op({step_});\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {ENGINE} from '../engine';\nimport {StridedSlice, StridedSliceAttrs, StridedSliceInputs} from '../kernel_names';\nimport {NamedAttrMap} from '../kernel_registry';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\n\nimport {op} from './operation';\n\n/**\n * Extracts a strided slice of a tensor.\n *\n * Roughly speaking, this op extracts a slice of size (end-begin)/stride from\n * the given input tensor (x). Starting at the location specified by begin the\n * slice continues by adding stride to the index until all dimensions are not\n * less than end. Note that a stride can be negative, which causes a reverse\n * slice.\n *\n * ```js\n * const t = tf.tensor3d([1, 1, 1 ,2, 2, 2, 3, 3, 3, 4, 4, 4, 5, 5, 5, 6, 6, 6],\n *   [3, 2, 3]);\n * t.stridedSlice([1, 0, 0], [2, 1, 3], [1, 1, 1]).print() // [[[3, 3, 3]]]\n * t.stridedSlice([1, 0, 0], [2, 2, 3], [1, 1, 1]).print() // [[[3, 3, 3],\n *   // [4, 4, 4]]]\n * t.stridedSlice([1, -1, 0], [2, -3, 3], [1, -1, 1]).print() // [[[4, 4, 4],\n *   // [3, 3, 3]]]\n * ```\n *\n * @param x The tensor to stride slice.\n * @param begin The coordinates to start the slice from.\n * @param end: The coordinates to end the slice at.\n * @param strides: The size of the slice.\n * @param beginMask: If the ith bit of beginMask is set, begin[i] is ignored\n *   and the fullest possible range in that dimension is used instead.\n * @param endMask: If the ith bit of endMask is set, end[i] is ignored\n *   and the fullest possible range in that dimension is used instead.\n * @param shrinkAxisMask: a bitmask where bit i implies that\n * the ith specification should shrink the dimensionality. begin and end must\n * imply a slice of size 1 in the dimension.\n *\n * @doc {heading:\n 'Operations', subheading: 'Slicing and Joining'}\n */\nfunction stridedSlice_(\n   x: Tensor|TensorLike, begin: number[], end: number[], strides?: number[],\n   beginMask = 0, endMask = 0, ellipsisMask = 0, newAxisMask = 0,\n   shrinkAxisMask = 0): Tensor {\n const $x = convertToTensor(x, 'x', 'stridedSlice');\n\n const inputs: StridedSliceInputs = {x: $x};\n const attrs: StridedSliceAttrs = {\n   begin,\n   end,\n   strides,\n   beginMask,\n   endMask,\n   ellipsisMask,\n   newAxisMask,\n   shrinkAxisMask\n };\n\n return ENGINE.runKernel(\n   StridedSlice, inputs as {} as NamedTensorMap,\n   attrs as {} as NamedAttrMap);\n}\n\nexport const stridedSlice = op({stridedSlice_});\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {ENGINE} from '../engine';\nimport {Tan, TanInputs} from '../kernel_names';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from

'../tensor_util_env';\nimport {TensorLike} from '../types';\n\nimport {op} from './operation';\n\n/**\n * Computes tan of the input `tf.Tensor` element-wise, `tan(x)`\n *\n * ```js\n * const x = tf.tensor1d([0, Math.PI / 2, Math.PI * 3 / 4]);\n *\n * x.tan().print(); // or tf.tan(x)\n * ```\n * @param x The input tensor.\n *\n * @doc {heading: 'Operations', subheading:
'Basic math'}\n */\nfunction tan_<T extends Tensor>(x: T|TensorLike): T {\n const $x = convertToTensor(x, 'x', 'tan');\n\n const inputs: TanInputs = {x: $x};\n\n return ENGINE.runKernel(Tan, inputs as {} as NamedTensorMap);\n}\nexport const tan = op({tan_});\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport
{Tensor1D} from '../tensor';\nimport {inferShape} from '../tensor_util_env';\nimport {TensorLike1D} from '../types';\nimport {DataType} from '../types';\nimport {assertNonNull} from '../util';\nimport {makeTensor} from './tensor_ops_util';\n\n/**\n * Creates rank-1 `tf.Tensor` with the provided values, shape and dtype.\n *\n * The same functionality can be achieved with `tf.tensor`, but in general\n * we recommend using `tf.tensor1d` as it makes the code more readable.\n *\n * ```js\n * tf.tensor1d([1, 2, 3]).print();\n * ```\n *\n * @param values The values of the tensor. Can be array of numbers,\n *   or a `TypedArray`.\n * @param dtype The data type.\n *\n * @doc {heading: 'Tensors', subheading: 'Creation'}\n */\nexport function tensor1d(values: TensorLike1D, dtype?: DataType): Tensor1D {\n assertNonNull(values);\n const inferredShape = inferShape(values, dtype);\n if (inferredShape.length !== 1) {\n   throw new Error('tensor1d() requires values to be a flat/TypedArray');\n }\n const shape: number[] = null;\n return makeTensor(values, shape, inferredShape, dtype) as Tensor1D;\n}\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {Tensor2D} from '../tensor';\nimport {inferShape} from '../tensor_util_env';\nimport {TensorLike2D} from '../types';\nimport {DataType} from '../types';\nimport
{assertNonNull} from '../util';\nimport {makeTensor} from './tensor_ops_util';\n\n/**\n * Creates rank-2 `tf.Tensor` with the provided values, shape and dtype.\n *\n * The same functionality can be achieved with `tf.tensor`, but in general\n * we recommend using `tf.tensor2d` as it makes the code more readable.\n *\n * ```js\n * // Pass a nested array.\n * tf.tensor2d([[1, 2], [3, 4]]).print();\n * ```\n * ```js\n * // Pass a flat array and specify a shape.\n * tf.tensor2d([1, 2, 3, 4], [2, 2]).print();\n * ```\n *\n * @param values The values of the tensor. Can be nested array of numbers,\n *   or a flat array, or a `TypedArray`.\n * @param shape The shape of the tensor. If not provided, it is inferred from\n *   `values`.\n * @param dtype The data type.\n *\n * @doc {heading: 'Tensors', subheading: 'Creation'}\n */\nexport function tensor2d(\n   values: TensorLike2D, shape?: [number, number],\n   dtype?: DataType): Tensor2D {\n assertNonNull(values);\n if (shape
!= null && shape.length !== 2) {\n   throw new Error('tensor2d() requires shape to have two numbers');\n }\n const inferredShape = inferShape(values, dtype);\n if (inferredShape.length !== 2 && inferredShape.length !== 1) {\n   throw new Error(\n   'tensor2d() requires values to be number[][] or flat/TypedArray');\n }\n if (inferredShape.length === 1 && shape == null) {\n   throw new Error(\n   'tensor2d() requires shape to be

provided when `values` ' +\n 'are a flat/TypedArray');\n }\n return makeTensor(values, shape, inferredShape, dtype) as Tensor2D;\n}\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {Tensor4D} from '../tensor';\nimport {inferShape} from '../tensor_util_env';\nimport {TensorLike4D} from '../types';\nimport {DataType} from '../types';\nimport {assertNonNull} from '../util';\nimport {makeTensor} from './tensor_ops_util';\n\n/**\n * Creates rank-4 `tf.Tensor` with the provided values, shape and dtype.\n *\n * The same functionality can be achieved with `tf.tensor`, but in general\n * we recommend using `tf.tensor4d` as it makes the code more readable.\n *\n * ```js\n * // Pass a nested array.\n * tf.tensor4d([[[[1], [2]], [[3], [4]]]]).print();\n * ```\n * ```js\n * // Pass a flat array and specify a shape.\n * tf.tensor4d([1, 2, 3, 4], [1, 2, 2, 1]).print();\n * ```\n *\n * @param values The values of the tensor. Can be nested array of numbers,\n * or a flat array, or a `TypedArray`.\n * @param shape The shape of the tensor. Optional. If not provided,\n * it is inferred from `values`.\n * @param dtype The data type.\n *\n * @doc {heading: 'Tensors', subheading: 'Creation'}\n */\nexport function tensor4d(\n values: TensorLike4D, shape?: [number, number, number, number],\n dtype?: DataType): Tensor4D {\n assertNonNull(values);\n if (shape != null && shape.length !== 4) {\n throw new Error('tensor4d() requires shape to have four numbers');\n }\n const inferredShape = inferShape(values, dtype);\n if (inferredShape.length !== 4 && inferredShape.length !== 1) {\n throw new Error(\n 'tensor4d() requires values to be number[][][][] or flat/TypedArray');\n }\n if (inferredShape.length === 1 && shape == null) {\n throw new Error(\n 'tensor4d() requires shape to be provided when `values` ' +\n 'are a flat array');\n }\n return makeTensor(values, shape, inferredShape, dtype) as Tensor4D;\n}\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {Tensor5D} from '../tensor';\nimport {inferShape} from '../tensor_util_env';\nimport {TensorLike5D} from '../types';\nimport {DataType} from '../types';\nimport {assertNonNull} from '../util';\nimport {makeTensor} from './tensor_ops_util';\n\n/**\n * Creates rank-5 `tf.Tensor` with the provided values, shape and dtype.\n *\n * The same functionality can be achieved with `tf.tensor`, but in general\n * we recommend using `tf.tensor5d` as it makes the code more readable.\n *\n * ```js\n * // Pass a nested array.\n * tf.tensor5d([[[[[1],[2]],[[3],[4]]],[[[5],[6]],[[7],[8]]]]]).print();\n * ```\n * ```js\n * // Pass a flat array and specify a shape.\n * tf.tensor5d([1, 2, 3, 4, 5, 6, 7, 8], [1, 2, 2, 2, 1]).print();\n * ```\n *\n * @param values The values of the tensor. Can be nested array of numbers,\n * or a flat array, or a `TypedArray`.\n * @param shape The shape of the tensor. Optional. If not provided,\n * it is inferred from `values`.\n * @param dtype The data type.\n *\n * @doc {heading: 'Tensors', subheading: 'Creation'}\n */\nexport function tensor5d(\n values: TensorLike5D, shape?: [number, number, number, number, number],\n dtype?: DataType): Tensor5D {\n assertNonNull(values);\n if (shape != null && shape.length !== 5) {\n throw new Error('tensor5d() requires shape to have five numbers');\n }\n const inferredShape = inferShape(values, dtype);\n if (inferredShape.length !== 5 && inferredShape.length !== 1) {\n throw new Error(\n 'tensor5d() requires values to be ' +\n 'number[][][][][] or flat/TypedArray');\n }\n if (inferredShape.length === 1 && shape == null) {\n throw new Error(\n 'tensor5d() requires shape to be provided when `values` ' +\n 'are a

flat array');\n }\n return makeTensor(values, shape, inferredShape, dtype) as Tensor5D;\n}\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless
 required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {Tensor6D} from '../tensor';\nimport {inferShape} from '../tensor_util_env';\nimport {TensorLike6D} from '../types';\nimport {DataType} from '../types';\nimport {assertNonNull} from '../util';\nimport {makeTensor} from './tensor_ops_util';\n\n/**\n * Creates rank-6 `tf.Tensor` with the provided values, shape and dtype.\n *\n * The same functionality can be achieved with `tf.tensor`, but in general\n * we recommend using `tf.tensor6d` as it makes the code more readable.\n *\n * ```js\n * // Pass a nested array.\n * tf.tensor6d([[[[[[1],[2]],[[3],[4]]],[[[5],[6]],[[7],[8]]]]]]).print();\n
 * ```\n * ```js\n * // Pass a flat array and specify a shape.\n * tf.tensor6d([1, 2, 3, 4, 5, 6, 7, 8], [1, 1, 2, 2, 2, 1]).print();\n * ```\n *\n * @param values The values of the tensor. Can be nested array of numbers,\n *   or a flat array, or a `TypedArray`.\n * @param shape The shape of the tensor. Optional. If not provided,\n *   it is inferred from `values`.\n * @param dtype The data type.\n *\n * @doc {heading: 'Tensors', subheading: 'Creation'}\n */\nexport function tensor6d(\n   values: TensorLike6D,\n   shape?: [number, number, number, number, number, number],\n   dtype?: DataType): Tensor6D {\n assertNonNull(values);\n if (shape != null && shape.length !== 6) {\n   throw new Error('tensor6d() requires shape to have six numbers');\n }\n const inferredShape = inferShape(values, dtype);\n if (inferredShape.length !== 6 && inferredShape.length !== 1) {\n   throw new Error(\n   'tensor6d() requires values to be number[][][][][][] or ' +\n   'flat/TypedArray');\n
  }\n if (inferredShape.length === 1 && shape == null) {\n   throw new Error(\n   'tensor6d() requires shape to be provided when `values` ' +\n   'are a flat array');\n }\n shape = shape ||\n   inferredShape as [number, number, number, number, number, number];\n return makeTensor(values, shape, inferredShape, dtype) as Tensor6D;\n}\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the
 License.\n * ==========\n */\n\nimport {ENGINE} from '../engine';\nimport {TopK, TopKAttrs, TopKInputs} from '../kernel_names';\nimport {NamedAttrMap} from '../kernel_registry';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\n\nimport {op} from './operation';\n\n/**\n * Finds the values and indices of the `k` largest entries along the last\n * dimension.\n *\n * If the input is a vector (rank=1), finds the k largest entries in the vector\n * and outputs their values and indices as vectors. Thus values[j] is the j-th\n * largest entry in input, and its index is indices[j].\n * For higher rank inputs, computes the top k entries along the last dimension.\n *\n * If two elements are equal, the lower-index element appears first.\n *\n * ```js\n * const a = tf.tensor2d([[1, 5], [4, 3]]);\n * const {values,
 indices} = tf.topk(a);\n * values.print();\n * indices.print();\n * ```\n * @param x 1-D or higher `tf.Tensor` with last dimension being at least `k`.\n * @param k Number of top elements to look for along the last dimension.\n * @param sorted If true, the resulting `k` elements will be sorted by the\n *   values in descending order.\n *\n * @doc {heading: 'Operations', subheading: 'Evaluation'}\n */\nfunction topk_<T extends Tensor>(\n   x: T|TensorLike, k = 1, sorted = true): {values: T, indices: T} {\n const $x = convertToTensor(x, 'x', 'topk');\n if

($x.rank === 0) {\n throw new Error('topk() expects the input to be of rank 1 or higher');\n }\n const lastDim = $x.shape[$x.shape.length - 1];\n if (k > lastDim) {\n throw new Error(\n `'k' passed to topk() must be <= the last dimension (${lastDim}) ` +\n `but got ${k}`);\n }\n\n const inputs: TopKInputs = {x: $x};\n const attrs: TopKAttrs = {k, sorted};\n\n const [values, indices] = ENGINE.runKernel(\n

TopK, inputs as {} as NamedTensorMap, attrs as {} as NamedAttrMap);\n\n return {values, indices} as {values: T, indices: T};\n}\n\nexport const topk = op({topk_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {Tensor} from '../tensor';\nimport {DataType, Rank, ShapeMap} from '../types';\n\nimport {buffer} from './buffer';\nimport {op} from './operation';\nimport {MPRandGauss} from './rand_util';\n\n/**\n * Creates a `tf.Tensor` with values sampled from a truncated normal\n * distribution.\n *\n * ```js\n * tf.truncatedNormal([2, 2]).print();\n * ```\n *\n * The generated values follow a normal distribution with specified mean and\n * standard deviation, except that values whose magnitude is more than 2\n * standard deviations from the mean are dropped and re-picked.\n *\n * @param shape An array of integers defining the output tensor shape.\n * @param mean The mean of the normal distribution.\n * @param stdDev The standard deviation of the normal distribution.\n * @param dtype The data type of the output tensor.\n * @param seed The seed for the random number generator.\n *\n * @doc {heading: 'Tensors', subheading: 'Creation'}\n */\nfunction truncatedNormal_<R extends Rank>(\n shape: ShapeMap[R], mean = 0, stdDev = 1, dtype?: 'float32'|'int32',\n seed?: number): Tensor<R>

{\n if (dtype != null && (dtype as DataType) === 'bool') {\n throw new Error(`Unsupported data type $ { dtype }`);\n }\n const randGauss =\n new MPRandGauss(mean, stdDev, dtype, true /* truncated */, seed);\n const res = buffer(shape, dtype);\n for (let i = 0; i < res.values.length; i++) {\n res.values[i] = randGauss.nextValue();\n }\n return res.toTensor();\n}\n\nexport const truncatedNormal = op({truncatedNormal_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the

specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {ENGINE} from '../engine';\nimport {Unique, UniqueAttrs, UniqueInputs} from '../kernel_names';\nimport {NamedAttrMap} from '../kernel_registry';\nimport {Tensor, Tensor1D} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\nimport {assert} from '../util';\n\nimport {op} from './operation';\n\n/**\n * Finds unique elements along an axis of a tensor.\n *\n * It returns a tensor `values` containing all of the unique elements along the\n * `axis` of the given tensor `x` in the same order that they occur along the\n * `axis` in `x`; `x` does not need to be sorted. It also returns a tensor\n * `indices` the same size as the number of the elements in `x` along the `axis`\n * dimension. It contains the index in the

unique output `values`.\n *\n * ```js\n * // A 1-D tensor\n * const a = tf.tensor1d([1, 1, 2, 4, 4, 4, 7, 8, 8]);\n * const {values, indices} = tf.unique(a);\n * values.print(); // [1, 2, 4, 7, 8,]\n * indices.print(); // [0, 0, 1, 2, 2, 2, 3, 4, 4]\n * ```\n *\n * ```js\n * // A 2-D tensor with axis=0\n * //\n * // 'a' is: [[1, 0, 0],\n * //   [1, 0, 0],\n * //   [2, 0, 0]]\n * const a = tf.tensor2d([[1, 0, 0], [1, 0, 0], [2, 0, 0]]);\n * const {values, indices} = tf.unique(a, 0)\n *

values.print(); // [[1, 0, 0],\n *   // [2, 0, 0]]\n * indices.print(); // [0, 0, 1]\n * ```\n *\n * ```js\n * // A 2-D tensor with axis=1\n * //\n * // 'a' is: [[1, 0, 0],\n * //   [1, 0, 0],\n * //   [2, 0, 0]]\n * const a = tf.tensor2d([[1, 0, 0], [1, 0, 0], [2, 0, 0]]);\n * const {values, indices} = tf.unique(a, 1)\n * values.print(); // [[1, 0],\n *   // [1, 0],\n *   // [2, 0]]\n * indices.print(); // [0, 1, 1]\n * ```\n * @param x A tensor (int32, string, bool).\n * @param axis The axis of the tensor to find the unique elements.\n * @returns [uniqueElements, indices] (see above for details)\n *\n * @doc {heading: 'Operations', subheading: 'Evaluation'}\n */\nfunction unique_<T extends Tensor>(\n   x: T|TensorLike, axis = 0): {values: T, indices: Tensor1D} {\n const $x = convertToTensor(x, 'x', 'unique', 'string_or_numeric');\n assert($x.rank > 0, () => 'The input tensor must be at least 1D');\n\n const inputs: UniqueInputs = {x: $x};\n const attrs: UniqueAttrs = {axis};\n const [values, indices] = ENGINE.runKernel(\n   Unique, inputs as {} as NamedTensorMap,\n   attrs as {} as NamedAttrMap) as [T, Tensor1D];\n return {values, indices};\n}\n\nexport const unique = op({unique_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n * ==\n */\n\nimport {ENGINE} from '../engine';\nimport {UnsortedSegmentSum, UnsortedSegmentSumAttrs, UnsortedSegmentSumInputs} from '../kernel_names';\nimport {NamedAttrMap} from '../kernel_registry';\nimport {Tensor, Tensor1D} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\nimport {assert, isInt} from '../util';\n\nimport {op} from './operation';\n\n/**\n * Computes the sum along segments of a `tf.Tensor`.\n *\n * ```js\n * const x = tf.tensor1d([1, 2, 3, 4]);\n * const segmentIds = tf.tensor1d([1, 2, 0, 1], 'int32');\n * const numSegments = 3;\n *\n * x.unsortedSegmentSum(segmentIds, numSegments).print()\n * //or tf.unsortedSegmentSum(x, segmentIds, numSegments)\n * ```\n * @param x The `tf.Tensor` that will be summed along its segments.\n * @param segmentIds A `tf.Tensor1D` whose rank is equal to the rank of `x`'s\n * dimension along the `axis`. Maps each element of `x` to a segment.\n * @param numSegments The number of distinct `segmentIds`.\n *\n * @doc {heading: 'Operations', subheading: 'Segment'}\n */\nfunction unsortedSegmentSum_<T extends Tensor>(\n   x: T|TensorLike, segmentIds: Tensor1D|TensorLike, numSegments: number): T {\n const $x = convertToTensor(x, 'x', 'unsortedSegmentSum');\n const $segmentIds =\n   convertToTensor(segmentIds, 'segmentIds', 'unsortedSegmentSum', 'int32');\n assert(isInt(numSegments),\n   () => 'numSegments must be of dtype int');\n\n const inputs: UnsortedSegmentSumInputs = {x: $x, segmentIds: $segmentIds};\n const attrs: UnsortedSegmentSumAttrs = {numSegments};\n\n return ENGINE.runKernel(\n   UnsortedSegmentSum, inputs as {} as NamedTensorMap,\n   attrs as {} as NamedAttrMap);\n}\n\nexport const unsortedSegmentSum = op({unsortedSegmentSum_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n * ==\n */\n\nimport {ENGINE} from '../engine';\nimport {Unpack, UnpackAttrs, UnpackInputs} from '../kernel_names';\nimport {NamedAttrMap} from '../kernel_registry';\nimport {Tensor} from '../tensor';\nimport

{NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\nimport * as util from '../util';\n\nimport {op} from './operation';\n\n/**\n * Unstacks a `tf.Tensor` of rank-`R` into a list of rank-`(R-1)` `tf.Tensor`s.\n *\n * ```js\n * const a = tf.tensor2d([1, 2, 3, 4], [2, 2]);\n *\n * tf.unstack(a).forEach(tensor => tensor.print());\n * ```\n *\n * @param x A tensor object.\n * @param axis The axis to unstack along. Defaults to 0 (the first dim).\n *\n * @doc {heading: 'Tensors', subheading: 'Slicing and Joining'}\n */\nfunction unstack_(x: Tensor|TensorLike, axis = 0): Tensor[] {\n const $x = convertToTensor(x, 'x', 'unstack', 'string_or_numeric');\n util.assert(\n   axis >= -$x.shape.length && axis < $x.shape.length,\n   () =>\n   `Axis = ${axis} is not in [-${$x.shape.length}, ${$x.shape.length})`);\n\n const inputs: UnpackInputs = {value: $x};\n const attrs: UnpackAttrs = {axis};\n\n return ENGINE.runKernel(\n   Unpack, inputs as {} as NamedTensorMap, attrs as {} as NamedAttrMap);\n}\n\nexport const unstack = op({unstack_});\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {ENGINE} from '../engine';\nimport {Tensor, Variable} from '../tensor';\nimport {DataType, Rank} from '../types';\n\n/**\n * Creates a new variable with the provided initial value.\n * ```js\n * const x = tf.variable(tf.tensor([1, 2, 3]));\n * x.assign(tf.tensor([4, 5, 6]));\n *\n * x.print();\n * ```\n *\n * @param initialValue Initial value for the tensor.\n * @param trainable If true, optimizers are allowed to update it.\n * @param name Name of the variable. Defaults to a unique id.\n * @param dtype If set, initialValue will be converted to the given type.\n *\n * @doc {heading: 'Tensors', subheading: 'Creation'}\n */\nexport function variable<R extends Rank>(\n   initialValue: Tensor<R>, trainable = true, name?: string,\n   dtype?: DataType): Variable<R> {\n return ENGINE.makeVariable(initialValue,\n   trainable, name, dtype) as\n   Variable<R>;\n}\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\n/** An implementation of the Where kernel shared between cpu and webgl */\n\nimport {buffer} from '../ops/buffer';\nimport {Tensor2D} from '../tensor';\nimport {TypedArray} from '../types';\n\nexport function whereImpl(condShape: number[], condVals: TypedArray): Tensor2D {\n const indices = [];\n for (let i = 0; i < condVals.length; i++) {\n   if (condVals[i]) {\n   indices.push(i);\n   }\n }\n\n const inBuffer = buffer(condShape, 'int32');\n\n const out = buffer([indices.length, condShape.length], 'int32');\n for (let i = 0; i < indices.length; i++) {\n   const loc = inBuffer.indexToLoc(indices[i]);\n   const offset = i * condShape.length;\n   out.values.set(loc, offset);\n }\n return out.toTensor() as Tensor2D;\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\nimport {whereImpl} from '../backends/where_impl';\nimport {Tensor, Tensor2D} from '../tensor';\nimport

{convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\n\n/**\n * Returns the coordinates of true elements of condition.\n *\n * The coordinates are returned in a 2-D tensor where the first dimension (rows)\n * represents the number of true elements, and the second dimension (columns)\n * represents the coordinates of the true elements. Keep in mind, the shape of\n * the output tensor can vary depending on how many true values there are in\n * input. Indices are output in row-major order. The resulting tensor has the\n * shape `[numTrueElems, condition.rank]`.\n *\n * This is analogous to calling the python `tf.where(cond)` without an x or y.\n *\n * ```js\n * const cond = tf.tensor1d([false, false, true], 'bool');\n * const result = await tf.whereAsync(cond);\n * result.print();\n * ```\n *\n * @doc {heading: 'Operations', subheading: 'Logical'}\n */\nasync function whereAsync_(condition: Tensor|TensorLike): Promise<Tensor2D> {\n const $condition =\n convertToTensor(condition, 'condition', 'whereAsync', 'bool');\n const vals = await $condition.data();\n const res = whereImpl($condition.shape, vals);\n if (condition !== $condition) {\n $condition.dispose();\n }\n return res;\n}\n\nexport const whereAsync = whereAsync_;\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {Tensor} from '../tensor';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\nimport * as util from '../util';\n\nimport {gather} from './gather';\nimport {reshape} from './reshape';\nimport {squeeze} from './squeeze';\nimport {whereAsync} from './where_async';\n\n/**\n * Apply boolean mask to tensor.\n *\n * ```js\n * const tensor = tf.tensor2d([1, 2, 3, 4, 5, 6], [3, 2]);\n * const mask = tf.tensor1d([1, 0, 1], 'bool');\n * const result = await tf.booleanMaskAsync(tensor, mask);\n * result.print();\n * ```\n *\n * @param tensor N-D tensor.\n * @param mask K-D boolean tensor, K <= N and K must be known statically.\n * @param axis A 0-D int Tensor representing the axis in tensor to mask from.\n * By default, axis is 0 which will mask from the first dimension.\n * Otherwise K + axis <= N.\n *\n * @doc {heading: 'Tensors', subheading: 'Slicing and Joining'}\n */\nasync function booleanMaskAsync_(\n tensor: Tensor|TensorLike, mask: Tensor|TensorLike,\n axis?: number): Promise<Tensor> {\n const $tensor = convertToTensor(tensor, 'tensor', 'boolMask');\n const $mask = convertToTensor(mask, 'mask', 'boolMask', 'bool');\n\n const axisFrom = axis == null ? 0 : axis;\n const maskDim = $mask.rank;\n const tensorShape = $tensor.shape;\n\n util.assert(maskDim > 0, () => 'mask cannot be scalar');\n util.assertShapesMatch(\n tensorShape.slice(axisFrom, axisFrom + maskDim), $mask.shape,\n `mask's shape must match the first K dimensions of tensor's shape,`);\n\n let leadingSize = 1;\n for (let i = axisFrom; i < axisFrom + maskDim; i++)\n {\n leadingSize *= tensorShape[i];\n }\n const targetTensorShape =\n tensorShape.slice(0, axisFrom)\n .concat([leadingSize], tensorShape.slice(axisFrom + maskDim));\n const reshapedTensor = reshape($tensor, targetTensorShape);\n const reshapedMask = reshape($mask, [-1]);\n const positivePositions = await whereAsync(reshapedMask);\n const indices = squeeze(positivePositions, [1]);\n\n const res = gather(reshapedTensor, indices, axisFrom);\n\n // Ensure no memory leak.\n if (tensor !== $tensor) {\n $tensor.dispose();\n }\n if (mask !== $mask) {\n $mask.dispose();\n }\n indices.dispose();\n reshapedTensor.dispose();\n reshapedMask.dispose();\n positivePositions.dispose();\n\n return res;\n}\n\nexport const booleanMaskAsync = booleanMaskAsync_;\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n
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* See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========================================================================\n */\n\nimport {Tensor} from '../tensor';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\nimport {parseAxisParam} from '../util';\n\nimport {abs} from './abs';\nimport * as axis_util from './axis_util';\nimport {max} from './max';\nimport {min} from './min';\nimport {op} from './operation';\nimport {pow} from './pow';\nimport {reshape} from './reshape';\nimport {scalar} from './scalar';\nimport {sqrt} from './sqrt';\nimport {square} from
 './square';\nimport {sum} from './sum';\n\n/**\n * Computes the norm of scalar, vectors, and matrices.\n * This function can compute several different vector norms (the 1-norm, the\n * Euclidean or 2-norm, the inf-norm, and in general the p-norm for p > 0)\n * and matrix norms (Frobenius, 1-norm, and inf-norm).\n *\n * ```js\n * const x = tf.tensor1d([1, 2, 3, 4]);\n *\n * x.norm().print();  // or tf.norm(x)\n * ```\n *\n * @param x The input array.\n * @param ord Optional. Order of the norm. Supported norm types are\n * following:\n *\n *  | ord        | norm for matrices         | norm for vectors\n *  |------------|---------------------------|---------------------\n *  |'euclidean' |Frobenius norm             |2-norm\n *  |'fro'       |Frobenius norm\t           |\n *  |Infinity    |max(sum(abs(x), axis=1))   |max(abs(x))\n *  |-Infinity   |min(sum(abs(x), axis=1))   |min(abs(x))\n *  |1           |max(sum(abs(x), axis=0))   |sum(abs(x))\n *  |2           |
  |sum(abs(x)^2)^1/2*\n *\n * @param axis Optional. If axis is null (the default), the input is\n * considered a vector and a single vector norm is computed over the entire\n * set of values in the Tensor, i.e. norm(x, ord) is equivalent\n * to norm(x.reshape([-1]), ord). If axis is a integer, the input\n * is considered a batch of vectors, and axis determines the axis in x\n * over which to compute vector norms. If axis is a 2-tuple of integer it is\n * considered a batch of matrices and axis determines the axes in NDArray\n * over which to compute a matrix norm.\n * @param keepDims Optional. If true, the norm have the same dimensionality\n * as the input.\n *\n * @doc {heading: 'Operations', subheading: 'Matrices'}\n */\nfunction norm_(\n    x: Tensor|TensorLike, ord: number|'euclidean'|'fro' = 'euclidean',\n    axis: number|number[] = null, keepDims = false): Tensor {\n  x = convertToTensor(x, 'x', 'norm');\n\n  const norm = normImpl(x, ord, axis);\n  let keepDimsShape = norm.shape;\n
  if (keepDims) {\n    const axes = parseAxisParam(axis, x.shape);\n    keepDimsShape = axis_util.expandShapeToKeepDim(norm.shape, axes);\n  }\n  return reshape(norm, keepDimsShape);\n}\n\nfunction normImpl(\n    x: Tensor, p: number|string, axis: number|number[] = null): Tensor {\n  if (x.rank === 0) {\n    return abs(x);\n  }\n\n  // consider vector when no axis is specified\n  if (x.rank !== 1 && axis === null) {\n    return normImpl(reshape(x, [-1]), p, axis);\n  }\n\n  // vector\n  if (x.rank === 1 || typeof axis === 'number' ||\n      Array.isArray(axis) && axis.length === 1) {\n    if (p === 1) {\n      return sum(abs(x), axis);\n    }\n    if (p === Infinity) {\n      return max(abs(x), axis);\n    }\n    if (p === -Infinity) {\n      return min(abs(x), axis);\n    }\n    if (p === 'euclidean' || p === 2) {\n      // norm(x, 2) = sum(abs(xi) ^ 2) ^ 1/2\n      return sqrt(sum(pow(abs(x), scalar(2, 'int32')), axis));\n    }\n\n    throw new Error(`Error in norm: invalid ord value: ${p}`);\n  }\n\n  // matrix (assumption axis[0] < axis[1])\n  if (Array.isArray(axis) && axis.length === 2) {\n    if (p === 1) {\n      return max(sum(abs(x), axis[0]), axis[1] - 1);\n    }\n    if (p === Infinity) {\n      return max(sum(abs(x), axis[1]), axis[0]);\n    }\n    if (p === -Infinity) {\n      return min(sum(abs(x), axis[1]), axis[0]);\n    }\n    if (p === 'fro' || p === 'euclidean') {\n      // norm(x) = sqrt(sum(pow(x, 2)))\n      return sqrt(sum(square(x), axis));\n    }\n\n    throw new Error(`Error in norm: invalid ord value: ${p}`);\n  }\n\n  throw new Error(`Error in norm: invalid axis: ${axis}`);\n}\n\nexport const norm = op({norm_});\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required
 by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========================================================================\n */\n\nimport {Scalar, Tensor} from '../tensor';\nimport {assertTypesMatch} from '../tensor_util';\nimport
```

{convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\nimport * as util from '../util';\n\nimport {add} from './add';\nimport {div} from './div';\nimport {mul} from './mul';\nimport {op} from './operation';\nimport {pow} from './pow';\nimport {scalar} from './scalar';\nimport {sub} from './sub';\n\n/**\n * Compute the moving average of a variable.\n *\n * Without zeroDebias, the moving average operation is defined by:\n *   `v += delta`\n * where\n *   `delta = (1 - decay) * (x - v)`\n *\n * With zeroDebias (default), the `delta` term is scaled to debias the\n * effect of the (assumed) zero-initialization of `v`.\n *   `delta /= (1 - decay ^ step)`\n *\n * For more details on the zero-debiasing algorithm, see:\n *   https://arxiv.org/abs/1412.6980\n *\n * Note that this function is completely stateless and does not keep track of\n * step count. The step count needs to be maintained by the caller and passed\n * in as `step`.\n *\n * @param v The current moving average value.\n * @param x New input value, must have the same shape and dtype as `v`.\n * @param decay The decay factor. Typical values are 0.95 and 0.99.\n * @param step Step count.\n * @param zeroDebias: Whether zeroDebias is to be performed (default: `true`).\n * @returns The new moving average value.\n *\n * @doc {heading: 'Operations', subheading: 'Moving Average'}\n */\nfunction movingAverage_<T extends Tensor>(\n   v: T|TensorLike, x: T|TensorLike, decay: number|Scalar,\n   step?: number|Scalar, zeroDebias = true): T {\n const $v = convertToTensor(v, 'v', 'movingAverage');\n const $x = convertToTensor(x, 'x', 'movingAverage');\n const $decay = convertToTensor(decay, 'decay', 'movingAverage');\n\n assertTypesMatch($v, $x);\n util.assert(\n   util.arraysEqual($v.shape, $x.shape), () => 'Shape mismatch in v and x');\n\n const one = scalar(1);\n const oneMinusDecay = sub(one, $decay);\n\n let update = mul(sub($x, $v), oneMinusDecay);\n if (zeroDebias) {\n   util.assert(\n   step != null, () => 'When using zeroDebias: true, step is required.');\n   const $step = convertToTensor(step, 'step', 'movingAverage');\n   update = div(update, sub(one, pow($decay, $step)));\n }\n return add($v, update);\n}\n\nexport const movingAverage = op({movingAverage_});\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n * ===\n */\n\nimport {ENGINE} from '../engine';\nimport {ScatterNd, ScatterNdAttrs, ScatterNdInputs} from '../kernel_names';\nimport {NamedAttrMap} from '../kernel_registry';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {Rank, ShapeMap, TensorLike} from '../types';\n\nimport {op} from './operation';\nimport * as scatter_nd_util from './scatter_nd_util';\n\n/**\n * Creates a new tensor by applying sparse updates to individual\n * values or slices within a zero tensor of the given shape tensor according to\n * indices. This operator is the inverse of the `tf.gatherND` operator which\n * extracts values or slices from a given tensor.\n *\n * ```js\n * const indices = tf.tensor2d([4, 3, 1, 7], [4, 1], 'int32');\n * const updates = tf.tensor1d([9, 10, 11, 12]);\n * const shape = [8];\n * tf.scatterND(indices, updates, shape).print() //[0, 11, 0, 10, 9, 0, 0, 12]\n * ```\n *\n * @param indices The tensor contains the indices into the output tensor.\n * @param updates The tensor contains the value for the indices.\n * @param shape: The shape of the output tensor.\n *\n * @doc {heading: 'Operations', subheading: 'Slicing and Joining'}\n */\nfunction scatterND_<R extends Rank>(\n   indices: Tensor|TensorLike, updates: Tensor|TensorLike,\n   shape: ShapeMap[R]): Tensor<R> {\n const $indices = convertToTensor(indices, 'indices', 'scatterND', 'int32');\n const $updates = convertToTensor(updates, 'updates', 'scatterND');\n scatter_nd_util.validateInput($updates, $indices, shape);\n\n const inputs: ScatterNdInputs = {indices: $indices, updates: $updates};\n const attrs: ScatterNdAttrs = {shape};\n\n // tslint:disable-next-line: no-unnecessary-type-assertion\n return ENGINE.runKernel(\n   ScatterNd, inputs as {} as NamedTensorMap,\n   attrs as {} as NamedAttrMap) as Tensor<R>;\n}\n\nexport const scatterND = op({scatterND_});\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under

the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==========\n */\nimport {Tensor} from '../tensor';\n\n/**\n * Validate sparseToDense inputs.\n *\n * @param sparseIndices A 0-D, 1-D, or 2-D Tensor of type int32.\n * sparseIndices[i] contains the complete index where sparseValues[i] will be\n * placed.\n * @param sparseValues A 0-D or 1-D Tensor. Values\n * corresponding to each row of sparseIndices, or a scalar value to be used for\n * all sparse indices.\n * @param outputShape number[]. Shape of the dense output tensor.\n * @param validateIndices boolean. indice validation is not supported, error\n * will be thrown if it is set.\n */\nexport function validateInput(\n sparseIndices: Tensor, sparseValues: Tensor, outputShape: number[],\n defaultValues: Tensor) {\n if (sparseIndices.dtype !== 'int32') {\n throw new Error(\n 'tf.sparseToDense()
expects the indices to be int32 type,' +\n ` but the dtype was ${sparseIndices.dtype}.`);\n }\n if (sparseIndices.rank > 2) {\n throw new Error(\n 'sparseIndices should be a scalar, vector, or matrix,' +\n ` but got shape ${sparseIndices.shape}.`);\n }\n\n const numElems = sparseIndices.rank > 0 ? sparseIndices.shape[0] : 1;\n const numDims = sparseIndices.rank > 1 ? sparseIndices.shape[1] : 1;\n\n if (outputShape.length !== numDims) {\n throw new Error(\n 'outputShape has incorrect number of elements:,' +\n ` ${outputShape.length}, should be: ${numDims}.`);\n }\n\n const numValues = sparseValues.size;\n if (!(sparseValues.rank === 0 ||\n sparseValues.rank === 1 && numValues === numElems)) {\n throw new Error(\n 'sparseValues has incorrect shape ' +\n `${sparseValues.shape}, should be [] or [${numElems}]`);\n }\n\n if (sparseValues.dtype !== defaultValues.dtype) {\n throw new Error('sparseValues.dtype
must match defaultValues.dtype');\n }\n}\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==========\n */\n\nimport {ENGINE} from '../engine';\nimport {SparseToDense, SparseToDenseAttrs, SparseToDenseInputs} from '../kernel_names';\nimport {NamedAttrMap} from '../kernel_registry';\nimport * as sparse_to_dense from '../ops/sparse_to_dense_util';\nimport
{Scalar, Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {Rank, ScalarLike, ShapeMap, TensorLike} from '../types';\n\nimport {op} from './operation';\n\n/**\n * Converts a sparse representation into a dense tensor.\n *\n * Builds an array dense with shape outputShape such that:\n *\n * // If sparseIndices is scalar\n * dense[i] = (i == sparseIndices ? sparseValues : defaultValue)\n *\n * // If sparseIndices is a vector, then for each i\n * dense[sparseIndices[i]] = sparseValues[i]\n *\n * // If sparseIndices is an n by d matrix, then for each i in [0, n)\n * dense[sparseIndices[i][0], ..., sparseIndices[i][d-1]] = sparseValues[i]\n * All other values in dense are set to defaultValue. If sparseValues is a\n * scalar, all sparse indices are set to this single value.\n *\n * If indices are repeated the final value is summed over all values for those\n * indices.\n *\n * ```js\n
* const indices = tf.tensor1d([4, 5, 6, 1, 2, 3], 'int32');\n * const values = tf.tensor1d([10, 11, 12, 13, 14, 15], 'float32');\n * const shape = [8];\n * tf.sparseToDense(indices, values, shape).print();\n * ```\n *\n * @param sparseIndices A 0-D, 1-D, or 2-D Tensor of type int32.\n * sparseIndices[i] contains the complete index where

sparseValues[i] will be\n * placed.\n * @param sparseValues A 0-D or 1-D Tensor. Values\n * corresponding to each row of sparseIndices, or a scalar value to be used for\n * all sparse indices.\n * @param outputShape Shape of the dense output tensor. the type is inferred.\n * @param defaultValue Scalar. Value to set for indices not specified in\n * sparseIndices. Defaults to zero.\n *\n * @doc {heading: 'Operations', subheading: 'Normalization'}\n */\nfunction sparseToDense_<R extends Rank>(\n sparseIndices: Tensor|TensorLike, sparseValues: Tensor|TensorLike,\n outputShape: ShapeMap[R], defaultValue: Scalar|ScalarLike = 0): Tensor<R> {\n const $sparseIndices =\n convertToTensor(sparseIndices, 'sparseIndices', 'sparseToDense', 'int32');\n const $sparseValues =\n convertToTensor(sparseValues, 'sparseValues', 'sparseToDense');\n const $defaultValue = convertToTensor(\n defaultValue, 'defaultValue', 'sparseToDense', $sparseValues.dtype);\n\n sparse_to_dense.validateInput(\n $sparseIndices, $sparseValues, outputShape, $defaultValue);\n\n const inputs: SparseToDenseInputs = {\n sparseIndices: $sparseIndices,\n sparseValues: $sparseValues,\n defaultValue: $defaultValue\n };\n\n const attrs: SparseToDenseAttrs = {outputShape};\n\n return ENGINE.runKernel(\n SparseToDense, inputs as {} as NamedTensorMap,\n attrs as {} as NamedAttrMap);\n}\n\nexport const sparseToDense = op({sparseToDense_});\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with
the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\nimport {ENGINE} from '../engine';\nimport {GatherNd, GatherNdInputs} from '../kernel_names';\nimport {Tensor} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\nimport {op} from './operation';\n\n/**\n * Gather slices from input tensor into a Tensor with shape specified by\n * `indices`.\n *\n * `indices` is an K-dimensional integer tensor, best thought of as
a\n * (K-1)-dimensional tensor of indices into input, where each element defines a\n * slice of input:\n * output[\\\\(i_0, ..., i_{K-2}\\\\)] = input[indices[\\\\(i_0, ..., i_{K-2}\\\\)]]\n *\n * Whereas in `tf.gather`, `indices` defines slices into the first dimension of\n * input, in `tf.gatherND`, `indices` defines slices into the first N dimensions\n * of input, where N = indices.shape[-1].\n *\n * The last dimension of indices can be at most the rank of input:\n * indices.shape[-1] <= input.rank\n *\n * The last dimension of `indices` corresponds to elements\n * (if indices.shape[-1] == input.rank) or slices\n * (if indices.shape[-1] < input.rank) along dimension indices.shape[-1] of\n * input.\n * The output tensor has shape\n * indices.shape[:-1] + input.shape[indices.shape[-1]:]\n *\n * Note that on CPU, if an out of bound index is found, an error is returned. On\n * GPU, if an out of bound index is found, a 0 is stored in the corresponding\n * output value.\n *\n * ```js\n *
const indices = tf.tensor2d([0, 1, 1, 0], [2,2], 'int32');\n * const input = tf.tensor2d([9, 10, 11, 12], [2, 2]);\n * tf.gatherND(input, indices).print() // [10, 11]\n * ```\n *\n * @param x The tensor from which to gather values.\n * @param indices Index tensor, must be of type int32.\n *\n * @doc {heading: 'Operations', subheading: 'Slicing and Joining'}\n */\nfunction gatherND_(x: Tensor|TensorLike, indices: Tensor|TensorLike): Tensor {\n const $indices = convertToTensor(indices, 'indices', 'gatherND', 'int32');\n const $x = convertToTensor(x, 'x', 'gatherND');\n\n const inputs: GatherNdInputs = {params: $x, indices: $indices};\n\n return ENGINE.runKernel(GatherNd, inputs as {} as NamedTensorMap);\n}\n\nexport const gatherND = op({gatherND_});\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy
of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for

the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {Tensor} from '../tensor';\nimport * as util from '../util';\n\n/**\n * Normalize noise shape based on provided tensor and noise shape.\n *\n * @param x Tensor.\n * @param noiseShape The shape for the randomly generated keep/drop flags, as\n * an array of numbers. Optional.\n * @returns Normalized noise shape.\n */\nexport function getNoiseShape(x: Tensor, noiseShape?: number[]): number[] {\n if (noiseShape == null) {\n return x.shape.slice();\n }\n if (util.arraysEqual(x.shape, noiseShape))
{\n return noiseShape;\n }\n if (x.shape.length === noiseShape.length) {\n const newDimension: number[] = [];\n for (let i = 0; i < x.shape.length; i++) {\n if (noiseShape[i] == null && x.shape[i] != null) {\n newDimension.push(x.shape[i]);\n } else {\n newDimension.push(noiseShape[i]);\n }\n }\n return newDimension;\n }\n\n return noiseShape;\n}\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions
and\n * limitations under the License.\n * ==========\n */\n\nimport {Tensor} from '../tensor';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\nimport * as util from '../util';\n\nimport {add} from './add';\nimport {div} from './div';\nimport {getNoiseShape} from './dropout_util';\nimport {floor} from './floor';\nimport {mul} from './mul';\nimport {op} from './operation';\nimport {randomUniform} from './random_uniform';\n\n/**\n * Computes dropout.\n *\n * ```js\n * const x = tf.tensor1d([1, 2, 2, 1]);\n * const rate = 0.75;\n * const output = tf.dropout(x, rate);\n * output.print();\n * ```\n *\n * @param x A floating point Tensor or TensorLike.\n * @param rate A float in the range [0, 1). The probability that each element\n * of x is discarded.\n * @param noiseShape An array of numbers of type int32, representing the\n * shape for randomly generated keep/drop flags. If the
noiseShape has null\n * value, it will be automatically replaced with the x's relative dimension\n * size. Optional.\n * @param seed Used to create random seeds. Optional.\n * @returns A Tensor of the same shape of x.\n *\n * @doc {heading: 'Operations', subheading: 'Dropout'}\n */\nfunction dropout_(\n x: Tensor|TensorLike, rate: number, noiseShape?: number[],\n seed?: number|string): Tensor {\n const $x = convertToTensor(x, 'x', 'dropout');\n\n util.assert(\n $x.dtype === 'float32',\n () => `x has to be a floating point tensor since it's going to be ` +\n `scaled, but got a ${$x.dtype} tensor instead.`);\n util.assert(\n rate >= 0 && rate < 1,\n () => `rate must be a float in the range [0, 1), but got ${rate}.`);\n\n if (rate === 0) {\n return x instanceof Tensor ? $x.clone() : $x;\n }\n\n const $noiseShape = getNoiseShape($x, noiseShape);\n const keepProb = 1 - rate;\n const multiplier = div(\n floor(add(randomUniform($noiseShape,
0, 1, 'float32', seed), keepProb)),\n keepProb);\n\n return mul($x, multiplier);\n}\n\nexport const dropout = op({dropout_});\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {Tensor1D} from '../tensor';\nimport {tensor1d} from './tensor1d';\n\nexport function enclosingPowerOfTwo(value: number) {\n // Return

2**N for integer N such that 2**N >= value.\n return Math.floor(Math.pow(2, Math.ceil(Math.log(value) / Math.log(2.0))));\n}\n\nexport function cosineWindow(\n   windowLength: number, a: number, b: number): Tensor1D {\n const even = 1 - windowLength % 2;\n const newValues = new Float32Array(windowLength);\n for (let i = 0; i < windowLength; ++i) {\n   const cosArg = (2.0 * Math.PI * i) / (windowLength + even - 1);\n newValues[i] = a - b * Math.cos(cosArg);\n }\n return tensor1d(newValues, 'float32');\n}\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES
 OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==\n */\n\nimport {Tensor} from '../tensor';\nimport {convertToTensor} from '../tensor_util_env';\nimport {TensorLike} from '../types';\nimport {assert, assertShapesMatch, getTypedArrayFromDType} from '../util';\nimport {tensor} from './tensor';\n\n/**\n * Returns whether the targets are in the top K predictions.\n *\n * ```js\n * const predictions = tf.tensor2d([[20, 10, 40, 30], [30, 50, -20, 10]]);\n * const targets = tf.tensor1d([2, 0]);\n * const precision = await tf.inTopKAsync(predictions, targets);\n * precision.print();\n * ```\n * @param predictions 2-D or higher `tf.Tensor` with last dimension being\n *   at least `k`.\n * @param targets 1-D or higher `tf.Tensor`.\n * @param k Optional Number of top elements to look at for computing precision,\n
 *   default to 1.\n *\n * @doc {heading: 'Operations', subheading: 'Evaluation'}\n */\nasync function inTopKAsync_<T extends Tensor, U extends Tensor>(\n   predictions: T|TensorLike, targets: U|TensorLike, k = 1): Promise<U> {\n const $predictions = convertToTensor(predictions, 'predictions', 'inTopK');\n const $targets = convertToTensor(targets, 'targets', 'inTopK');\n\n assert(\n $predictions.rank > 1,\n   () => 'inTopK() expects the predictions to be of rank 2 or higher, ' +\n   `but got ${$predictions.rank}`);\n assert(\n $predictions.rank - 1 === $targets.rank,\n   () => `predictions rank should be 1 larger than ` +\n   `targets rank, but got predictions rank ` +\n   `${$predictions.rank} and targets rank ${$targets.rank}`);\n assertShapesMatch(\n $predictions.shape.slice(0, $predictions.shape.length - 1),\n $targets.shape,\n   `predictions's shape should be align with the targets' shape, ` +\n   'except the
 last dimension.');\n const lastDim = $predictions.shape[$predictions.shape.length - 1];\n assert(\n   k > 0 && k <= lastDim,\n   () => `'k' passed to inTopK() must be > 0 && <= the predictions last ` +\n   `dimension (${lastDim}), but got ${k}`);\n\n const predictionsVals = await $predictions.data();\n const targetsVals = await $targets.data();\n\n // Reshape predictionsVals into a 2d tensor [batch, lastDim]\n // and look up topK along lastDim.\n const [batch, size] = [predictionsVals.length / lastDim, lastDim];\n const precision = getTypedArrayFromDType('bool', batch);\n\n for (let b = 0; b < batch; b++) {\n   const offset = b * size;\n   const vals = predictionsVals.subarray(offset, offset + size);\n   const valAndInd: Array<{value: number, index: number}> = [];\n   for (let i = 0; i < vals.length; i++) {\n   valAndInd.push({value: vals[i], index: i});\n   }\n valAndInd.sort((a, b) => b.value - a.value);\n\n   precision[b] = 0;\n   for (let i = 0;
 i < k; i++) {\n   if (valAndInd[i].index === targetsVals[b]) {\n   precision[b] = 1;\n   break;\n   }\n   }\n }\n\n if (predictions !== $predictions) {\n $predictions.dispose();\n }\n if (targets !== $targets) {\n $targets.dispose();\n }\n\n // Output precision has the same shape as targets.\n return tensor(precision, $targets.shape, 'bool') as U;\n}\n\nexport const inTopKAsync = inTopKAsync_;\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language

governing permissions and\n * limitations under the License.\n *
==========\n
*/\nimport {ENGINE} from '../engine';\nimport {Conv2DBackpropFilter, Conv2DBackpropFilterAttrs,
Conv2DBackpropFilterInputs} from '../kernel_names';\nimport {NamedAttrMap} from '../kernel_registry';\nimport
{Tensor3D, Tensor4D} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\nimport * as util from
'../util';\n\nimport * as conv_util from './conv_util';\nimport {op} from './operation';\nimport {reshape} from
'./reshape';\n\n/**\n * Computes the derivative of the filter of a 2D convolution.\n *\n * @param x The input tensor,
of rank 4 or rank 3 of shape\n * [batch, height, width, inChannels]. If rank 3, batch of 1 is assumed.\n * @param
dy The dy image, of rank 4 or rank 3, of shape\n * [batch, height, width, outDepth]. If rank 3, batch of 1 is
assumed.\n * @param filterShape The shape of the filter, length 4,\n
 * [filterHeight, filterWidth, inDepth, outDepth].\n * @param strides The strides of the convolution:
[strideHeight,\n * strideWidth].\n * @param pad A string from: 'same', 'valid'. The type of padding algorithm\n *
used in the forward prop of the op.\n * @param dataFormat: An optional string from: \"NHWC\", \"NCHW\".
Defaults to\n * \"NHWC\". Specify the data format of the input and output data. With the\n * default format
\"NHWC\", the data is stored in the order of: [batch,\n * height, width, channels].\n * @param
dimRoundingMode A string from: 'ceil', 'round', 'floor'. If none is\n * provided, it will default to truncate.\n
*/\nfunction conv2DBackpropFilter_<T extends Tensor3D|Tensor4D>(\n x: T, dy: T, filterShape: [number,
number, number, number],\n strides: [number, number]|number,\n pad:
'valid'|'same'|number|conv_util.ExplicitPadding,\n dataFormat: 'NHWC'|'NCHW' = 'NHWC',\n
dimRoundingMode?: 'floor'|'round'|'ceil'): Tensor4D {\n let x4D =
 x as Tensor4D;\n if (x.rank === 3) {\n x4D = reshape(x, [1, x.shape[0], x.shape[1], x.shape[2]]);\n }\n let dy4D
= dy as Tensor4D;\n if (dy4D.rank === 3) {\n dy4D = reshape(dy, [1, dy.shape[0], dy.shape[1], dy.shape[2]]);\n
}\n util.assert(\n x4D.rank === 4,\n () => `Error in conv2dDerFilter: input must be rank 4, but got shape ` +\n
 `${x4D.shape}.`);\n util.assert(\n dy4D.rank === 4,\n () => `Error in conv2dDerFilter: dy must be rank
4, but got shape ` +\n  `${dy4D.shape}.`);\n  util.assert(\n  filterShape.length === 4,\n  () => `Error in
conv2dDerFilter: filterShape must be length 4, but got ` +\n  `${filterShape}.`);\n const inDepth = dataFormat
=== 'NHWC' ? x4D.shape[3] : x4D.shape[1];\n const outDepth = dataFormat === 'NHWC' ? dy4D.shape[3] :
dy4D.shape[1];\n util.assert(\n inDepth === filterShape[2],\n () => `Error in conv2dDerFilter: depth of input
${inDepth}) must ` +\n  `match input depth in
 filter (${filterShape[2]}.`);\n  util.assert(\n  outDepth === filterShape[3],\n  () => `Error in conv2dDerFilter:
depth of dy (${outDepth}) must ` +\n  `match output depth for filter (${filterShape[3]}).`);\n if
(dimRoundingMode != null) {\n util.assert(\n util.isInt(pad as number),\n () => `Error in conv2dDerFilter:
pad must be an integer when using, ` +\n  `dimRoundingMode ${dimRoundingMode} but got pad
${pad}.`);\n }\n\n const inputs: Conv2DBackpropFilterInputs = {x: x4D, dy: dy4D};\n const attrs:
Conv2DBackpropFilterAttrs =\n {strides, pad, dataFormat, dimRoundingMode, filterShape};\n\n //
tslint:disable-next-line: no-unnecessary-type-assertion\n return ENGINE.runKernel(\n
Conv2DBackpropFilter, inputs as {} as NamedTensorMap,\n attrs as {} as NamedAttrMap) as
Tensor4D;\n}\n\nexport const conv2DBackpropFilter = op({conv2DBackpropFilter_});\n","/**\n * @license\n *
Copyright 2019 Google LLC. All Rights Reserved.\n
 * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in
compliance with the License.\n * You may obtain a copy of the License at\n *\n *
http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing,
software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES
OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language
governing permissions and\n * limitations under the License.\n *
==========\n
*/\n\nimport {Tensor} from '../tensor';\n\nimport * as broadcast_util from './broadcast_util';\nimport {elu} from
'./elu';\nimport {Activation} from './fused_types';\nimport {leakyRelu} from './leaky_relu';\nimport {mul} from

'./mul';\nimport {prelu} from './prelu';\nimport {relu} from './relu';\nimport {relu6} from './relu6';\nimport {reshape} from './reshape';\nimport {step} from './step';\nimport {sum} from './sum';\n\n// Returns gradient for fused activation.\nexport function getFusedDyActivation(\n dy: Tensor, y: Tensor, activation: Activation): Tensor {\n if (activation == null || activation === 'linear') {\n return dy;\n }\n if (activation === 'relu') {\n return mul(dy, step(y));\n }\n throw new Error(\n `Cannot compute gradient for fused activation ${activation}.`);\n}\n\n// Returns gradient for fused bias.\nexport function getFusedBiasGradient(\n bias: Tensor, dyActivation: Tensor): Tensor {\n let res = dyActivation;\n const reduceAxes =\n broadcast_util.getReductionAxes(bias.shape, dyActivation.shape);\n if (reduceAxes.length > 0) {\n res = sum(res, reduceAxes);\n }\n return reshape(res, bias.shape);\n}\n\nexport function applyActivation(\n x: Tensor, activation: Activation, preluActivationWeights?: Tensor,\n leakyreluAlpha?: number): Tensor {\n if (activation === 'linear')
{\n return x;\n } else if (activation === 'relu') {\n return relu(x);\n } else if (activation === 'elu') {\n return elu(x);\n } else if (activation === 'relu6') {\n return relu6(x);\n } else if (activation === 'prelu') {\n return prelu(x, preluActivationWeights);\n } else if (activation === 'leakyrelu') {\n return leakyRelu(x, leakyreluAlpha);\n }\n throw new Error(`Unknown fused activation ${activation}.`);\n}\n\n// Whether we should call fused ops.\nexport const shouldFuse = (gradientDepth: number, activation: Activation) => {\n const gradientMode = gradientDepth > 0;\n return !gradientMode || activation === 'linear';\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable
law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n */\n\nimport {ENGINE} from '../../engine';\nimport {customGrad} from '../../gradients';\nimport {FusedConv2D, FusedConv2DAttrs, FusedConv2DInputs} from '../../kernel_names';\nimport {NamedAttrMap} from '../../kernel_registry';\nimport {Tensor, Tensor3D, Tensor4D} from '../../tensor';\nimport {GradSaveFunc, NamedTensorMap} from '../../tensor_types';\nimport {makeTypesMatch} from '../../tensor_util';\nimport {convertToTensor} from '../../tensor_util_env';\nimport {TensorLike} from '../../types';\nimport * as util from '../../util';\nimport {add} from '../add';\nimport * as broadcast_util from '../broadcast_util';\nimport
{conv2d as unfusedConv2d} from '../conv2d';\nimport {conv2DBackpropFilter} from '../conv2d_backprop_filter';\nimport {conv2DBackpropInput} from '../conv2d_backprop_input';\nimport * as conv_util from '../conv_util';\nimport {Activation} from '../fused_types';\nimport {applyActivation, getFusedBiasGradient, getFusedDyActivation, shouldFuse} from '../fused_util';\nimport {op} from '../operation';\nimport {reshape} from '../reshape';\n\n/**\n * Computes a 2D convolution over the input x, optionally fused with adding a\n * bias and applying an activation.\n *\n * ```js\n * const inputDepth = 2;\n * const inShape = [2, 2, 2, inputDepth];\n * const outputDepth = 2;\n * const fSize = 1;\n * const pad = 0;\n * const strides = 1;\n *\n * const x = tf.tensor4d([1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15,\n * 16], inShape);\n * const w = tf.tensor4d([-1, 1, -2, 0.5], [fSize, fSize, inputDepth,\n * outputDepth]);\n *\n * tf.fused.conv2d({ x, filter: w, strides, pad, dataFormat:
'NHWC',\n * dilations: [1, 1], bias: tf.scalar(5), activation: 'relu' }).print();\n * ```\n *\n * @param obj An object with the following properties:\n * @param x The input tensor, of rank 4 or rank 3, of shape\n * `[batch, height, width, inChannels]`. If rank 3, batch of 1 is\n * assumed.\n * @param filter The filter, rank 4, of shape\n * `[filterHeight, filterWidth, inDepth, outDepth]`.\n * @param strides The strides of the convolution: `[strideHeight,\n * strideWidth]`.\n * @param pad The type of padding algorithm.\n * - `same` and stride 1: output will be of same size as input,\n * regardless of filter size.\n * - `valid` output will be smaller than input if filter is larger\n * than 1x1.\n * - For more info, see this guide:\n * [https://www.tensorflow.org/api_guides/python/nn#Convolution](\n * https://www.tensorflow.org/api_guides/python/nn#Convolution)\n * @param dataFormat An optional string from:

```
\"NHWC\", \"NCHW\". Defaults to\n *     \"NHWC\".
 Specify the data format of the input and output data. With the\n *     default format \"NHWC\", the data is stored in
the order of: [batch,\n *     height, width, channels]. Only \"NHWC\" is currently supported.\n * @param dilations
The dilation rates: `[dilationHeight, dilationWidth]`\n *     in which we sample input values across the height and
width dimensions\n *     in atrous convolution. Defaults to `[1, 1]`. If `dilations` is a single\n *     number, then
`dilationHeight == dilationWidth`. If it is greater than\n *     1, then all values of `strides` must be 1.\n * @param
dimRoundingMode A string from: 'ceil', 'round', 'floor'. If none is\n *     provided, it will default to truncate.\n *
@param bias Tensor to be added to the result.\n * @param activation Name of activation kernel (defaults to `linear`)
to be\n *     applied\n *     after biasAdd.\n * @param preluActivationWeights Tensor of prelu weights to be applied
as part\n *     of a `prelu` activation, typically
 the same shape as `x`.\n * @param leakyreluAlpha Optional. Alpha to be applied as part of a `leakyrelu`\n *
activation.\n */\nfunction fusedConv2d_<T extends Tensor3D|Tensor4D>({\n  x,\n  filter,\n  strides,\n  pad,\n
dataFormat = 'NHWC',\n  dilations = [1, 1],\n  dimRoundingMode,\n  bias,\n  activation = 'linear',\n
preluActivationWeights,\n  leakyreluAlpha\n}: {\n  x: T|TensorLike,\n  filter: Tensor4D|TensorLike,\n  strides:
[number, number]|number,\n  pad: 'valid'|'same'|number|conv_util.ExplicitPadding,\n  dataFormat?:
'NHWC'|'NCHW',\n  dilations?: [number, number]|number,\n  dimRoundingMode?: 'floor'|'round'|'ceil',\n  bias?:
Tensor|TensorLike,\n  activation?: Activation,\n  preluActivationWeights?: Tensor,\n  leakyreluAlpha?: number\n}):
T {\n  activation = activation || 'linear';\n\n  if (shouldFuse(ENGINE.state.gradientDepth, activation) === false) {\n
let result = unfusedConv2d(\n      x, filter, strides, pad, dataFormat, dilations, dimRoundingMode);\n    if (bias !=
 null) {\n      result = add(result, bias);\n    }\n\n    return applyActivation(\n        result, activation,
preluActivationWeights, leakyreluAlpha) as T;\n  }\n\n  const $x = convertToTensor(x, 'x', 'conv2d');\n  const $filter
= convertToTensor(filter, 'filter', 'conv2d');\n\n  let x4D = $x as Tensor4D;\n  let reshapedTo4D = false;\n\n  if
($x.rank === 3) {\n    reshapedTo4D = true;\n    x4D = reshape($x, [1, $x.shape[0], $x.shape[1], $x.shape[2]]);\n
}\n  util.assert(\n      x4D.rank === 4,\n      () => `Error in fused conv2d: input must be rank 4, but got rank ` +\n
 `${x4D.rank}.`);\n  util.assert(\n      $filter.rank === 4,\n      () => `Error in fused conv2d: filter must be rank 4, but
got rank ` +\n          `${$filter.rank}.`);\n  if (dimRoundingMode != null) {\n    util.assert(\n        util.isInt(pad as
number),\n        () => `Error in fused conv2d: pad must be an integer when using, ` +\n            `dimRoundingMode
${dimRoundingMode} but got pad ${pad}.`);\n
  }\n\n  util.assert(\n      x4D.shape[3] === $filter.shape[2],\n      () => `Error in conv2d: depth of input
(${x4D.shape[3]}) must match ` +\n          `input depth for filter ${$filter.shape[2]}.`);\n  util.assert(\n
conv_util.eitherStridesOrDilationsAreOne(strides, dilations),\n      () => 'Error in conv2D: Either strides or dilations
must be 1. ' +\n          `Got strides ${strides} and dilations '${dilations}'`);\n  util.assert(\n      dataFormat ===
'NHWC',\n      () => `Error in conv2d: got dataFormat of ${\n          dataFormat} but only NHWC is currently
supported.`);\n\n  const convInfo = conv_util.computeConv2DInfo(\n      x4D.shape, $filter.shape, strides, dilations,
pad, dimRoundingMode);\n\n  let $bias: Tensor;\n  if (bias != null) {\n    $bias = convertToTensor(bias, 'bias', 'fused
conv2d');\n    [$bias] = makeTypesMatch($bias, $x);\n\n
broadcast_util.assertAndGetBroadcastShape(convInfo.outShape, $bias.shape);\n  }\n\n  let
$preluActivationWeights: Tensor;\n
  if (preluActivationWeights != null) {\n    $preluActivationWeights = convertToTensor(\n
preluActivationWeights, 'prelu weights', 'fused conv2d');\n  }\n\n  const grad = (dy: Tensor4D, saved: Tensor[]) =>
{\n    const [$filter, x4D, y, $bias] =\n        saved as [Tensor4D, Tensor4D, Tensor4D, Tensor];\n\n    const
dyActivation = getFusedDyActivation(dy, y, activation) as Tensor4D;\n\n    util.assert(\n
conv_util.tupleValuesAreOne(dilations),\n        () => 'Error in gradient of fused conv2D: ' +\n            `dilation rates
greater than 1 ` +\n            `are not yet supported in gradients. Got dilations '${dilations}'`);\n\n    const xDer =\n
conv2DBackpropInput(x4D.shape, dyActivation, $filter, strides, pad);\n    const filterDer =\n
conv2DBackpropFilter(x4D, dyActivation, $filter.shape, strides, pad);\n    const der: Tensor[] = [xDer,
filterDer];\n\n    if ($bias != null) {\n      const biasDer = getFusedBiasGradient($bias, dyActivation);\n
der.push(biasDer);\n
```

}\n return der;\n };\n\n const inputs: FusedConv2DInputs = {\n x: x4D,\n filter: $filter,\n bias: $bias,\n preluActivationWeights: $preluActivationWeights\n };\n\n const attrs: FusedConv2DAttrs = {\n strides,\n pad,\n dataFormat,\n dilations,\n dimRoundingMode,\n activation,\n leakyreluAlpha\n };\n\n // Depending on the the params passed in we will have different number of\n // inputs and thus a a different number of elements in the gradient.\n if (bias == null) {\n const customOp =\n customGrad((x4D: Tensor4D, filter: Tensor4D, save: GradSaveFunc) => {\n let res: Tensor4D|Tensor3D =\n // tslint:disable-next-line: no-unnecessary-type-assertion\n ENGINE.runKernel(\n FusedConv2D, inputs as {} as NamedTensorMap,\n attrs as {} as NamedAttrMap);\n\n save([filter, x4D, res]);\n\n if (reshapedTo4D) {\n // tslint:disable-next-line: no-unnecessary-type-assertion\n res = reshape(res, [res.shape[1], res.shape[2], res.shape[3]]) as\n Tensor3D;\n }\n\n return {value: res, gradFunc: grad};\n });\n return customOp(x4D, $filter) as T;\n } else {\n const customOpWithBias = customGrad(\n (x4D: Tensor4D, filter: Tensor4D, bias: Tensor, save: GradSaveFunc) => {\n let res: Tensor4D|Tensor3D = ENGINE.runKernel(\n FusedConv2D, inputs as {} as NamedTensorMap,\n attrs as {} as NamedAttrMap);\n\n save([filter, x4D, res, bias]);\n\n if (reshapedTo4D) {\n // tslint:disable-next-line: no-unnecessary-type-assertion\n res = reshape(res, [res.shape[1], res.shape[2], res.shape[3]]) as\n Tensor3D;\n }\n\n return {value: res, gradFunc: grad};\n });\n\n return customOpWithBias(x4D, $filter, $bias) as T;\n }\n}\nexport const conv2d = op({fusedConv2d_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\nimport {ENGINE} from '../engine';\nimport {DepthwiseConv2dNativeBackpropFilter, DepthwiseConv2dNativeBackpropFilterAttrs, DepthwiseConv2dNativeBackpropFilterInputs} from '../kernel_names';\nimport {NamedAttrMap} from '../kernel_registry';\nimport {Tensor3D, Tensor4D} from '../tensor';\nimport {NamedTensorMap} from '../tensor_types';\n\nimport {op} from './operation';\nimport {reshape} from './reshape';\n\nfunction depthwiseConv2dNativeBackpropFilter_<T extends Tensor3D|Tensor4D>(\n x: T, dy: T, filterShape: [number, number, number, number],\n strides: [number, number]|number, pad: 'valid'|'same'|number,\n dilations: [number, number]|number = [1, 1],\n dimRoundingMode?: 'floor'|'round'|'ceil'): Tensor4D {\n let x4D = x as Tensor4D;\n if (x.rank === 3) {\n x4D = reshape(x, [1, x.shape[0], x.shape[1], x.shape[2]]);\n }\n let dy4D = dy as Tensor4D;\n if (dy4D.rank === 3) {\n dy4D = reshape(dy, [1, dy.shape[0], dy.shape[1], dy.shape[2]]);\n }\n\n const inputs: DepthwiseConv2dNativeBackpropFilterInputs = {x: x4D, dy: dy4D};\n const attrs: DepthwiseConv2dNativeBackpropFilterAttrs =\n {strides, pad, dimRoundingMode, dilations, filterShape};\n\n // tslint:disable-next-line: no-unnecessary-type-assertion\n return ENGINE.runKernel(\n DepthwiseConv2dNativeBackpropFilter,\n inputs as {} as NamedTensorMap, attrs as {} as NamedAttrMap) as\n Tensor4D;\n}\n\nexport const depthwiseConv2dNativeBackpropFilter =\n op({depthwiseConv2dNativeBackpropFilter_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n

*/\nimport {ENGINE} from '../engine';\nimport
{DepthwiseConv2dNativeBackpropInput, DepthwiseConv2dNativeBackpropInputAttrs,
DepthwiseConv2dNativeBackpropInputInputs} from '../kernel_names';\nimport {NamedAttrMap} from
'../kernel_registry';\nimport {Tensor3D, Tensor4D} from '../tensor';\nimport {NamedTensorMap} from
'../tensor_types';\n\nimport {op} from './operation';\nimport {reshape} from './reshape';\n\nfunction
depthwiseConv2dNativeBackpropInput_<T extends Tensor3D|Tensor4D>(\n xShape: [number, number, number,
number], dy: T, filter: Tensor4D,\n strides: [number, number]|number, pad: 'valid'|'same'|number,\n dilations:
[number, number]|number = [1, 1],\n dimRoundingMode?: 'floor'|'round'|'ceil'): T {\n let dy4D = dy as
Tensor4D;\n let reshapedTo4D = false;\n if (dy.rank === 3) {\n reshapedTo4D = true;\n dy4D = reshape(dy, [1,
dy.shape[0], dy.shape[1], dy.shape[2]]);\n }\n\n const inputs: DepthwiseConv2dNativeBackpropInputInputs = {dy:
dy4D, filter};\n const attrs: DepthwiseConv2dNativeBackpropInputAttrs
=\n {strides, pad, dimRoundingMode, dilations, inputShape: xShape};\n\n const res =\n // tslint:disable-next-
line: no-unnecessary-type-assertion\n ENGINE.runKernel(\n DepthwiseConv2dNativeBackpropInput,
inputs as {} as NamedTensorMap,\n attrs as {} as NamedAttrMap) as T;\n\n if (reshapedTo4D) {\n return
reshape(res, [res.shape[1], res.shape[2], res.shape[3]]) as T;\n }\n return res;\n}\n\nexport const
depthwiseConv2dNativeBackpropInput =\n op({depthwiseConv2dNativeBackpropInput_});\n","/**\n *
@license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version
2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a
copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable
law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n
* WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License
for the specific language governing permissions and\n * limitations under the License.\n *
==\n
*/\n\nimport {ENGINE} from '../../engine';\nimport {customGrad} from '../../gradients';\nimport
{FusedDepthwiseConv2D, FusedDepthwiseConv2DAttrs, FusedDepthwiseConv2DInputs} from
'../../kernel_names';\nimport {NamedAttrMap} from '../../kernel_registry';\nimport {Tensor, Tensor3D, Tensor4D}
from '../../tensor';\nimport {GradSaveFunc, NamedTensorMap} from '../../tensor_types';\nimport
{makeTypesMatch} from '../../tensor_util';\nimport {convertToTensor} from '../../tensor_util_env';\nimport
{TensorLike} from '../../types';\nimport * as util from '../../util';\n\nimport {add} from '../add';\nimport * as
broadcast_util from '../broadcast_util';\nimport * as conv_util from '../conv_util';\nimport {depthwiseConv2d as
unfusedDepthwiseConv2d}
from '../depthwise_conv2d';\nimport {depthwiseConv2dNativeBackpropFilter} from
'../depthwise_conv2d_native_backprop_filter';\nimport {depthwiseConv2dNativeBackpropInput} from
'../depthwise_conv2d_native_backprop_input';\nimport {Activation} from '../fused_types';\nimport
{applyActivation, getFusedBiasGradient, getFusedDyActivation, shouldFuse} from '../fused_util';\nimport {op}
from '../operation';\nimport {reshape} from '../reshape';\n\n/**\n * Computes depthwise 2D convolution, optionally
fused with adding a\n * bias and applying an activation.\n *\n * Given a 4D `input` array and a `filter` array of
shape\n * `[filterHeight, filterWidth, inChannels, channelMultiplier]` containing\n * `inChannels` convolutional
filters of depth 1, this op applies a\n * different filter to each input channel (expanding from 1 channel to\n *
`channelMultiplier` channels for each), then concatenates the results\n * together. The output has `inChannels *
channelMultiplier` channels.\n *\n
* See\n * [https://www.tensorflow.org/api_docs/python/tf/nn/depthwise_conv2d](\n *
https://www.tensorflow.org/api_docs/python/tf/nn/depthwise_conv2d)\n * for more details.\n *\n * @param obj An
object with the following properties:\n * @param x The input tensor, of rank 4 or rank 3, of shape\n * `[batch,
height, width, inChannels]`. If rank 3, batch of 1 is\n * assumed.\n * @param filter The filter tensor, rank 4, of
shape\n * `[filterHeight, filterWidth, inChannels, channelMultiplier]`.\n * @param strides The strides of the
convolution: `[strideHeight,\n * strideWidth]`. If strides is a single number, then `strideHeight ==\n *
strideWidth`.\n * @param pad The type of padding algorithm.\n * - `same` and stride 1: output will be of same size

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as input,\n *       regardless of filter size.\n *   - `valid`: output will be smaller than input if filter is larger\n *       than 1x1.\n *   - For more info, see this guide:\n *     [https://www.tensorflow.org/api_guides/python/nn#Convolution](\n *          https://www.tensorflow.org/api_guides/python/nn#Convolution)\n * @param dilations The dilation rates: `[dilationHeight, dilationWidth]`\n *     in which we sample input values across the height and width dimensions\n *   in atrous convolution. Defaults to `[1, 1]`. If `rate` is a single\n *     number, then `dilationHeight == dilationWidth`. If it is greater than\n *     1, then all values of `strides` must be 1.\n * @param dataFormat: An optional string from: \"NHWC\", \"NCHW\". Defaults to\n *     \"NHWC\". Specify the data format of the input and output data. With the\n *     default format \"NHWC\", the data is stored in the order of: [batch,\n *     height, width, channels]. Only \"NHWC\" is currently supported.\n * @param dimRoundingMode A string from: 'ceil', 'round', 'floor'. If none is\n *     provided, it will default to truncate.\n * @param bias Tensor to be added to the result.\n * @param activation Name of activation kernel (defaults to `linear`).\n
 * @param preluActivationWeights Tensor of prelu weights to be applied as part\n *     of a `prelu` activation, typically the same shape as `x`.\n * @param leakyreluAlpha Optional. Alpha to be applied as part of a `leakyrelu`\n *     activation.\n */\nfunction fusedDepthwiseConv2d_<T extends Tensor3D|Tensor4D>({\n  x,\n  filter,\n  strides,\n  pad,\n  dataFormat = 'NHWC',\n  dilations = [1, 1],\n  dimRoundingMode,\n  bias,\n  activation = 'linear',\n  preluActivationWeights,\n  leakyreluAlpha\n}: {\n  x: T|TensorLike,\n  filter: Tensor4D|TensorLike,\n  strides: [number, number]|number,\n  pad: 'valid'|'same'|number,\n  dataFormat?: 'NHWC'|'NCHW',\n  dilations?: [number, number]|number,\n  dimRoundingMode?: 'floor'|'round'|'ceil',\n  bias?: Tensor|TensorLike,\n  activation?: Activation,\n  preluActivationWeights?: Tensor,\n  leakyreluAlpha?: number\n}): T {\n  if (shouldFuse(ENGINE.state.gradientDepth, activation) === false) {\n    let result = unfusedDepthwiseConv2d(\n x,
 filter, strides, pad, dataFormat, dilations, dimRoundingMode);\n    if (bias != null) {\n      result = add(result, bias);\n    }\n\n    return applyActivation(\n                result, activation, preluActivationWeights, leakyreluAlpha) as T;\n  }\n\n  const $x = convertToTensor(x, 'x', 'depthwiseConv2d');\n  const $filter = convertToTensor(filter, 'filter', 'depthwiseConv2d');\n\n  let x4D = $x as Tensor4D;\n  let reshapedTo4D = false;\n  if ($x.rank === 3) {\n    reshapedTo4D = true;\n    x4D = reshape($x, [1, $x.shape[0], $x.shape[1], $x.shape[2]]);\n  }\n  util.assert(\n      x4D.rank === 4,\n      () => `Error in fused depthwiseConv2d: input must be rank 4, but got ` +\n          `rank ${x4D.rank}.`);\n  util.assert(\n      $filter.rank === 4,\n      () => `Error in fused depthwiseConv2d: filter must be rank 4, ` +\n          `but got rank ${$filter.rank}.`);\n  util.assert(\n      x4D.shape[3] === $filter.shape[2],\n      () => `Error in fused depthwiseConv2d: number of input channels
 ` +\n          `(${x4D.shape[3]}) must match the inChannels dimension in ` +\n          `filter ${$filter.shape[2]}.`);\n  if (dilations == null) {\n    dilations = [1, 1];\n  }\n  util.assert(\n      conv_util.eitherStridesOrDilationsAreOne(strides, dilations),\n      () =>\n          'Error in fused depthwiseConv2d: Either strides or dilations must ' +\n          `be 1. Got strides ${strides} and dilations '${dilations}'`);\n\n  if (dimRoundingMode != null) {\n    util.assert(\n        util.isInt(pad as number),\n        () => `Error in fused depthwiseConv2d: pad must be an integer when ` +\n            `using dimRoundingMode ${dimRoundingMode} but got pad ${pad}.`);\n  }\n\n  const convInfo = conv_util.computeConv2DInfo(\n      x4D.shape, $filter.shape, strides, dilations, pad, dimRoundingMode,\n      true /* depthwise */);\n\n  let $bias: Tensor;\n  if (bias != null) {\n    $bias = convertToTensor(bias, 'bias', 'fused conv2d');\n    [$bias] = makeTypesMatch($bias, $x);\n\n
   broadcast_util.assertAndGetBroadcastShape(convInfo.outShape, $bias.shape);\n  }\n\n  let $preluActivationWeights: Tensor;\n  if (preluActivationWeights != null) {\n    $preluActivationWeights = convertToTensor(\n        preluActivationWeights, 'prelu weights', 'fused depthwiseConv2d');\n  }\n\n  const grad = (dy: Tensor4D, saved: Tensor[]) => {\n    util.assert(\n        conv_util.tupleValuesAreOne(dilations),\n        () => 'Error in gradient of fused depthwiseConv2d: dilation rates ' +\n            `greater than 1 are not yet supported. Got dilations ` +\n            `'${dilations}'`);\n    const [$filter, x4D, y, bias] = saved;\n\n    const dyActivation = getFusedDyActivation(dy, y, activation) as Tensor4D;\n\n    const xDer = depthwiseConv2dNativeBackpropInput(\n
      (x4D as Tensor4D).shape, dyActivation, $filter as Tensor4D, strides,\n        pad, dilations, dimRoundingMode);\n    const filterDer = depthwiseConv2dNativeBackpropFilter(\n        x4D as Tensor4D,
```

dyActivation, ($filter
as Tensor4D).shape, strides,\n pad, dilations, dimRoundingMode);\n\n if (bias != null) {\n const biasDer = getFusedBiasGradient($bias, dyActivation);\n return [xDer, filterDer, biasDer];\n }\n return [xDer, filterDer];\n };\n\n const inputs: FusedDepthwiseConv2DInputs = {\n x: x4D,\n filter: $filter,\n bias: $bias,\n preluActivationWeights: $preluActivationWeights\n };\n const attrs: FusedDepthwiseConv2DAttrs = {\n strides,\n pad,\n dataFormat,\n dilations,\n dimRoundingMode,\n activation,\n leakyreluAlpha\n };\n\n // Depending on the the params passed in we will have different number of\n // inputs and thus a a different number of elements in the gradient.\n if (bias == null) {\n const customOp =\n customGrad((x4D: Tensor4D, filter: Tensor4D, save: GradSaveFunc) => {\n // tslint:disable-next-line: no-unnecessary-type-assertion\n let res: Tensor4D|Tensor3D = ENGINE.runKernel(\n FusedDepthwiseConv2D, inputs as {} as NamedTensorMap,\n attrs as {} as NamedAttrMap);\n\n save([filter, x4D, res]);\n\n if (reshapedTo4D) {\n // tslint:disable-next-line: no-unnecessary-type-assertion\n res = reshape(res, [res.shape[1], res.shape[2], res.shape[3]]) as\n Tensor3D;\n }\n\n return {value: res, gradFunc: grad};\n });\n return customOp(x4D, $filter) as T;\n } else {\n const customOpWithBias = customGrad(\n (x4D: Tensor4D, filter: Tensor4D, bias: Tensor, save: GradSaveFunc) => {\n // tslint:disable-next-line: no-unnecessary-type-assertion\n let res: Tensor4D|Tensor3D = ENGINE.runKernel(\n FusedDepthwiseConv2D, inputs as {} as NamedTensorMap,\n attrs as {} as NamedAttrMap);\n\n save([filter, x4D, res, bias]);\n\n if (reshapedTo4D) {\n // tslint:disable-next-line: no-unnecessary-type-assertion\n res = reshape(res, [res.shape[1], res.shape[2], res.shape[3]]) as\n Tensor3D;\n }\n\n return {value: res, gradFunc: grad};\n });\n\n return customOpWithBias(x4D, $filter, $bias) as T;\n }\n}\nexport const depthwiseConv2d = op({fusedDepthwiseConv2d_});\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n
*/\n\nimport {ENGINE} from '../../engine';\nimport {customGrad} from '../../gradients';\nimport {_FusedMatMul, _FusedMatMulAttrs, _FusedMatMulInputs} from '../../kernel_names';\nimport {NamedAttrMap} from '../../kernel_registry';\nimport {Tensor, Tensor3D} from '../../tensor';\nimport {GradSaveFunc, NamedTensorMap} from '../../tensor_types';\nimport {makeTypesMatch} from '../../tensor_util';\nimport {convertToTensor} from '../../tensor_util_env';\nimport {TensorLike} from '../../types';\nimport * as util from '../../util';\n\nimport {add} from '../add';\nimport * as broadcast_util from '../broadcast_util';\nimport {Activation} from '../fused_types';\nimport {applyActivation, getFusedBiasGradient, getFusedDyActivation, shouldFuse} from '../fused_util';\nimport {matMul as unfusedMatMul} from '../mat_mul';\nimport {op} from '../operation';\nimport {reshape} from '../reshape';\n\n/**\n * Computes the dot product of two matrices with optional activation and
bias.\n *\n * ```js\n * const a = tf.tensor2d([-1, -2], [1, 2]);\n * const b = tf.tensor2d([1, 2, 3, 4], [2, 2]);\n * const bias = tf.tensor2d([1, 2], [1, 2]);\n *\n * tf.fused.matMul({a, b, bias, activation: 'relu'}).print();\n * ```\n *\n * @param obj An object with the following properties:\n * - `a` First matrix in dot product operation.\n * - `b` Second matrix in dot product operation.\n * - `transposeA` If true, `a` is transposed before multiplication.\n * - `transposeB` If true, `b` is transposed before multiplication.\n * - `bias` Matrix to be added to the result.\n * - `activation` Name of activation kernel (defaults to `linear`).\n * - `preluActivationWeights` Tensor of prelu weights.\n * - `leakyreluAlpha` Alpha of leakyrelu.\n */\nfunction fusedMatMul_<T extends Tensor>({\n a,\n b,\n transposeA = false,\n transposeB = false,\n bias,\n activation = 'linear',\n preluActivationWeights,\n leakyreluAlpha,\n}: {\n a: T|TensorLike,\n b: T|TensorLike,\n transposeA?: boolean,\n

```
 transposeB?: boolean,\n  bias?: Tensor|TensorLike,\n  activation?: Activation,\n  preluActivationWeights?:
Tensor\n  leakyreluAlpha?: number\n}): T {\n   if (shouldFuse(ENGINE.state.gradientDepth, activation) === false)
{\n     let result = unfusedMatMul(a, b, transposeA, transposeB);\n     if (bias != null) {\n       result = add(result,
bias);\n     }\n\n     return applyActivation(\n         result, activation, preluActivationWeights, leakyreluAlpha)
as\n         T;\n   }\n\n   let $a = convertToTensor(a, 'a', 'fused matMul');\n   let $b = convertToTensor(b, 'b', 'fused
matMul');\n   [$a, $b] = makeTypesMatch($a, $b);\n\n   const innerShapeA =\n       transposeA ? $a.shape[$a.rank
- 2] : $a.shape[$a.rank - 1];\n   const innerShapeB =\n       transposeB ? $b.shape[$b.rank - 1] : $b.shape[$b.rank -
2];\n\n   const outerShapeA =\n       transposeA ? $a.shape[$a.rank - 1] : $a.shape[$a.rank - 2];\n   const
outerShapeB =\n       transposeB ? $b.shape[$b.rank
 - 2] : $b.shape[$b.rank - 1];\n\n   const outerDimsA = $a.shape.slice(0, -2);\n   const outerDimsB =
$b.shape.slice(0, -2);\n   const batchDimA = util.sizeFromShape(outerDimsA);\n   const batchDimB =
util.sizeFromShape(outerDimsB);\n\n   util.assert(\n       $a.rank >= 2 && $b.rank >= 2 && $a.rank === $b.rank,\n
    () => `Error in fused matMul: inputs must have the same rank of at ` +\n         `least 2, got ranks ${$a.rank}
and ${$b.rank}.`);\n\n   util.assert(\n       util.arraysEqual(outerDimsA, outerDimsB),\n       () => `Error in fused
matMul: outer dimensions (${outerDimsA}) and (` +\n         `${outerDimsB}) of Tensors with shapes ${$a.shape}
and ` +\n         `${$b.shape} must match.`);\n\n   util.assert(\n       innerShapeA === innerShapeB,\n       () =>
`Error in fused matMul: inner shapes (${innerShapeA}) and (` +\n         `${innerShapeB}) of Tensors with shapes
${$a.shape} and ` +\n         `${$b.shape} and transposeA=${transposeA}` +\n
     ` and transposeB=${transposeB} must match.`);\n\n   const outShape = $a.shape.slice(0, -
2).concat([outerShapeA, outerShapeB]);\n\n   const a3D: Tensor3D = transposeA ?\n       reshape($a, [batchDimA,
innerShapeA, outerShapeA]) :\n       reshape($a, [batchDimA, outerShapeA, innerShapeA]);\n   const b3D:
Tensor3D = transposeB ?\n       reshape($b, [batchDimB, outerShapeB, innerShapeB]) :\n       reshape($b,
[batchDimB, innerShapeB, outerShapeB]);\n\n   let $bias: Tensor;\n   if (bias != null) {\n     $bias =
convertToTensor(bias, 'bias', 'fused matMul');\n     [$bias] = makeTypesMatch($bias, $a);\n\n
broadcast_util.assertAndGetBroadcastShape(outShape, $bias.shape);\n   }\n\n   let $preluActivationWeights:
Tensor;\n   if (preluActivationWeights != null) {\n     $preluActivationWeights = convertToTensor(\n
preluActivationWeights, 'prelu weights', 'fused matMul');\n   }\n\n   const grad = (dy: Tensor3D, saved: Tensor[])
=> {\n     const [a3D, b3D,
 y, $bias] = saved;\n     // we reshape dy because the result of the forward is not\n     // necessarily going to be a 3d
tensor due to a reshape done at the end of\n     // the customOp.\n     const dyActivation =\n
getFusedDyActivation(reshape(dy, y.shape), y, activation);\n     let aDer: Tensor;\n     let bDer: Tensor;\n\n     if
(!transposeA && !transposeB) {\n       aDer = unfusedMatMul(dyActivation, b3D, false, true);\n       bDer =
unfusedMatMul(a3D, dyActivation, true, false);\n     } else if (!transposeA && transposeB) {\n       aDer =
unfusedMatMul(dyActivation, b3D, false, false);\n       bDer = unfusedMatMul(dyActivation, a3D, true, false);\n
} else if (transposeA && !transposeB) {\n       aDer = unfusedMatMul(b3D, dyActivation, false, true);\n       bDer =
unfusedMatMul(a3D, dyActivation, false, false);\n     } else {\n       aDer = unfusedMatMul(b3D, dyActivation,
true, true);\n       bDer = unfusedMatMul(dyActivation, a3D, true, true);\n
   }\n\n     if (bias != null) {\n       const biasDer = getFusedBiasGradient($bias, dyActivation);\n       return [aDer,
bDer, biasDer];\n     } else {\n       return [aDer, bDer];\n     }\n   };\n\n   const inputs: _FusedMatMulInputs = {\n
  a: a3D,\n     b: b3D,\n     bias: $bias,\n     preluActivationWeights: $preluActivationWeights\n   };\n   const
attrs: _FusedMatMulAttrs =\n       {transposeA, transposeB, activation, leakyreluAlpha};\n\n   // Depending on the
the params passed in we will have different number of\n   // inputs and thus a a different number of elements in the
gradient.\n   if (bias == null) {\n     const customOp =\n         customGrad((a3D: Tensor3D, b3D: Tensor3D, save:
GradSaveFunc) => {\n           const res =\n               // tslint:disable-next-line: no-unnecessary-type-assertion\n
     ENGINE.runKernel(\n                 _FusedMatMul, inputs as {} as NamedTensorMap,\n                 attrs as {}
as NamedAttrMap) as
 T;\n\n           save([a3D, b3D, res]);\n\n           return {value: reshape(res, outShape), gradFunc: grad};\n         });\n
   return customOp(a3D, b3D) as T;\n   } else {\n     const customOpWithBias = customGrad(\n         (a3D:
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Tensor3D, b3D: Tensor3D, $bias: Tensor, save: GradSaveFunc) => {\n const res =\n // tslint:disable-next-line: no-unnecessary-type-assertion\n ENGINE.runKernel(\n _FusedMatMul, inputs as {} as NamedTensorMap,\n attrs as {} as NamedAttrMap) as T;\n\n save([a3D, b3D, res, $bias]);\n\n return {value: reshape(res, outShape), gradFunc: grad};\n });\n\n return customOpWithBias(a3D, b3D, $bias) as T;\n }\n }\n\n export const matMul = op({fusedMatMul_});\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==========\n */\n\nimport {conv2d} from './fused/conv2d';\nimport {depthwiseConv2d} from './fused/depthwise_conv2d';\nimport {matMul} from './fused/mat_mul';\nimport {Activation} from './fused_types';\n\nexport {Activation, conv2d, depthwiseConv2d, matMul};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==========\n */\n\nimport {Tensor1D} from '../../tensor';\nimport {op} from '../operation';\nimport {cosineWindow} from '../signal_ops_util';\n\n/**\n * Generate a hamming window.\n *\n * See: https://en.wikipedia.org/wiki/Window_function#Hann_and_Hamming_windows\n *\n * ```js\n * tf.signal.hammingWindow(10).print();\n * ```\n * @param The length of window\n *\n * @doc {heading: 'Operations', subheading: 'Signal', namespace: 'signal'}\n */\nfunction hammingWindow_(windowLength: number): Tensor1D {\n return cosineWindow(windowLength, 0.54, 0.46);\n}\nexport const hammingWindow = op({hammingWindow_});\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==========\n */\n\nimport {Tensor1D} from '../../tensor';\nimport {op} from '../operation';\nimport {cosineWindow} from '../signal_ops_util';\n\n/**\n * Generate a Hann window.\n *\n * See: https://en.wikipedia.org/wiki/Window_function#Hann_and_Hamming_windows\n *\n * ```js\n * tf.signal.hannWindow(10).print();\n * ```\n * @param The length of window\n *\n * @doc {heading: 'Operations', subheading: 'Signal', namespace: 'signal'}\n */\nfunction hannWindow_(windowLength: number): Tensor1D {\n return cosineWindow(windowLength, 0.5, 0.5);\n}\n\nexport const hannWindow = op({hannWindow_});\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed

on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions
and\n * limitations under the License.\n *
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*/\n\nimport {Tensor, Tensor1D} from '../../tensor';\nimport {concat} from '../concat';\nimport {fill} from '../fill';\nimport {op} from '../operation';\nimport {reshape} from '../reshape';\nimport {slice} from '../slice';\nimport {tensor2d} from '../tensor2d';\n\n/**\n * Expands input into frames of frameLength.\n * Slides a window size with frameStep.\n *\n * ```js\n * tf.signal.frame([1, 2, 3], 2, 1).print();\n * ```\n * @param signal The input tensor to be expanded\n * @param frameLength Length of each frame\n * @param frameStep The frame hop size in samples.\n * @param padEnd Whether to pad the end of signal with padValue.\n * @param padValue An number to use where the input signal does\n * not exist when padEnd is True.\n *\n * @doc {heading: 'Operations', subheading: 'Signal', namespace: 'signal'}\n */\nfunction frame_(\n signal: Tensor1D, frameLength:
number, frameStep: number, padEnd = false,\n padValue = 0): Tensor {\n let start = 0;\n const output: Tensor[] = [];\n while (start + frameLength <= signal.size) {\n output.push(slice(signal, start, frameLength));\n start += frameStep;\n }\n\n if (padEnd) {\n while (start < signal.size) {\n const padLen = (start + frameLength) - signal.size;\n const pad = concat([\n slice(signal, start, frameLength - padLen), fill([padLen], padValue)\n]);\n output.push(pad);\n start += frameStep;\n }\n }\n\n if (output.length === 0) {\n return tensor2d([], [0, frameLength]);\n }\n\n return reshape(concat(output), [output.length, frameLength]);\n}\nexport const frame = op({frame_});\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n *
http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n
*/\n\nimport {Tensor, Tensor1D} from '../../tensor';\nimport {concat} from '../concat';\nimport {mul} from '../mul';\nimport {op} from '../operation';\nimport {enclosingPowerOfTwo} from '../signal_ops_util';\nimport {slice} from '../slice';\nimport {rfft} from '../spectral/rfft';\n\nimport {frame} from './frame';\nimport {hannWindow} from './hann_window';\n\n/**\n * Computes the Short-time Fourier Transform of signals\n * See: https://en.wikipedia.org/wiki/Short-time_Fourier_transform\n *\n * ```js\n * const input = tf.tensor1d([1, 1,
1, 1, 1])\n * tf.signal.stft(input, 3, 1).print();\n * ```\n * @param signal 1-dimensional real value tensor.\n * @param frameLength The window length of samples.\n * @param frameStep The number of samples to step.\n * @param fftLength The size of the FFT to apply.\n * @param windowFn A callable that takes a window length and returns 1-d tensor.\n *\n * @doc {heading: 'Operations', subheading: 'Signal', namespace: 'signal'}\n */\nfunction stft_(\n signal: Tensor1D, frameLength: number, frameStep: number,\n fftLength?: number,\n windowFn: (length:
number) => Tensor1D = hannWindow): Tensor {\n if (fftLength == null) {\n fftLength =
enclosingPowerOfTwo(frameLength);\n }\n const framedSignal = frame(signal, frameLength, frameStep);\n const windowedSignal = mul(framedSignal, windowFn(frameLength));\n const output: Tensor[] = [];\n for (let i = 0; i <
framedSignal.shape[0]; i++) {\n output.push(\n rfft(slice(windowedSignal, [i, 0], [1, frameLength]),
fftLength));\n
}\n return concat(output);\n}\nexport const stft = op({stft_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n *
http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *

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==========================================================================\n
*/\n\nimport {ENGINE} from '../../engine';\nimport {CropAndResize, CropAndResizeAttrs, CropAndResizeInputs}
from '../../kernel_names';\nimport {NamedAttrMap} from '../../kernel_registry';\nimport {Tensor1D, Tensor2D,
 Tensor4D} from '../../tensor';\nimport {NamedTensorMap} from '../../tensor_types';\nimport {convertToTensor}
from '../../tensor_util_env';\nimport {TensorLike} from '../../types';\nimport * as util from '../../util';\n\nimport {op}
from '../operation';\n\n/**\n * Extracts crops from the input image tensor and resizes them using bilinear\n *
sampling or nearest neighbor sampling (possibly with aspect ratio change)\n * to a common output size specified by
cropSize.\n *\n * @param image 4d tensor of shape `[batch,imageHeight,imageWidth, depth]`,\n *     where
imageHeight and imageWidth must be positive, specifying the\n *     batch of images from which to take crops\n *
@param boxes 2d float32 tensor of shape `[numBoxes, 4]`. Each entry is\n *     `[y1, x1, y2, x2]`, where `(y1, x1)`
and `(y2, x2)` are the normalized\n *     coordinates of the box in the boxInd[i]'th image in the batch\n * @param
boxInd 1d int32 tensor of shape `[numBoxes]` with values in range\n *     `[0, batch)`
 that specifies the image that the `i`-th box refers to.\n * @param cropSize 1d int32 tensor of 2 elements
`[cropHeigh, cropWidth]`\n *     specifying the size to which all crops are resized to.\n * @param method Optional
string from `'bilinear' | 'nearest'`,\n *     defaults to bilinear, which specifies the sampling method for resizing\n *
@param extrapolationValue A threshold for deciding when to remove boxes based\n *     on score. Defaults to 0.\n *
@return A 4D tensor of the shape `[numBoxes,cropHeight,cropWidth,depth]`\n *\n * @doc {heading: 'Operations',
subheading: 'Images', namespace: 'image'}\n */\nfunction cropAndResize_(\n    image: Tensor4D|TensorLike,\n
boxes: Tensor2D|TensorLike,\n    boxInd: Tensor1D|TensorLike,\n    cropSize: [number, number],\n    method:
'bilinear'|'nearest' = 'bilinear',\n    extrapolationValue = 0,\n    ): Tensor4D {\n  const $image =
convertToTensor(image, 'image', 'cropAndResize');\n  const $boxes = convertToTensor(boxes, 'boxes',
'cropAndResize',
 'float32');\n  const $boxInd = convertToTensor(boxInd, 'boxInd', 'cropAndResize', 'int32');\n\n  const numBoxes =
$boxes.shape[0];\n\n  util.assert(\n      $image.rank === 4,\n      () => 'Error in cropAndResize: image must be rank
4,' +\n          `but got rank ${$image.rank}.`);\n  util.assert(\n      $boxes.rank === 2 && $boxes.shape[1] === 4,\n
() => `Error in cropAndResize: boxes must be have size [${numBoxes},4] ` +\n          `but had shape
${$boxes.shape}.`);\n  util.assert(\n      $boxInd.rank === 1 && $boxInd.shape[0] === numBoxes,\n      () => `Error
in cropAndResize: boxInd must be have size [${numBoxes}] ` +\n          `but had shape ${$boxes.shape}.`);\n
util.assert(\n      cropSize.length === 2,\n      () => `Error in cropAndResize: cropSize must be of length 2, but got `
+\n          `length ${cropSize.length}.`);\n  util.assert(\n      cropSize[0] >= 1 && cropSize[1] >= 1,\n      () =>
`cropSize must be atleast [1,1], but was ${cropSize}`);\n  util.assert(\n
    method === 'bilinear' || method === 'nearest',\n      () => `method must be bilinear or nearest, but was
${method}`);\n\n  const inputs:\n      CropAndResizeInputs = {image: $image, boxes: $boxes, boxInd: $boxInd};\n
const attrs: CropAndResizeAttrs = {method, extrapolationValue, cropSize};\n  const res = ENGINE.runKernel(\n
CropAndResize, inputs as {} as NamedTensorMap,\n      attrs as {} as NamedAttrMap);\n  return res as
Tensor4D;\n}\n\nexport const cropAndResize = op({cropAndResize_});\n","/**\n * @license\n * Copyright 2020
Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you
may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n *
http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing,
software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES
OR CONDITIONS OF
 ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n *
limitations under the License.\n *
==========================================================================\n
*/\n\nimport {ENGINE} from '../../engine';\nimport {FlipLeftRight, FlipLeftRightInputs} from
'../../kernel_names';\nimport {Tensor4D} from '../../tensor';\nimport {NamedTensorMap} from
'../../tensor_types';\nimport {convertToTensor} from '../../tensor_util_env';\nimport {TensorLike} from
'../../types';\nimport * as util from '../../util';\nimport {op} from '../operation';\n\n/**\n * Flips the image left to right.
```

Currently available in the CPU, WebGL, and\n * WASM backends.\n *\n * @param image 4d tensor of shape `[batch, imageHeight, imageWidth, depth]`.\n */\n/** @doc {heading: 'Operations', subheading: 'Images', namespace: 'image'} */\nfunction flipLeftRight_(image: Tensor4D|TensorLike): Tensor4D {\n const $image = convertToTensor(image, 'image', 'flipLeftRight',
'float32');\n\n util.assert(\n $image.rank === 4,\n   () => 'Error in flipLeftRight: image must be rank 4,' +\n
`but got rank ${$image.rank}.`);\n\n const inputs: FlipLeftRightInputs = {image: $image};\n const res =\n ENGINE.runKernel(FlipLeftRight, inputs as {} as NamedTensorMap, {});\n return res as Tensor4D;\n}\n\nexport const flipLeftRight = op({flipLeftRight_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions
and\n * limitations under the License.\n *
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*/\n\nimport {ENGINE} from '../../engine';\nimport {RotateWithOffset, RotateWithOffsetAttrs, RotateWithOffsetInputs} from '../../kernel_names';\nimport {NamedAttrMap} from '../../kernel_registry';\nimport {Tensor4D} from '../../tensor';\nimport {NamedTensorMap} from '../../tensor_types';\nimport {convertToTensor} from '../../tensor_util_env';\nimport {TensorLike} from '../../types';\nimport * as util from '../../util';\n\nimport {op} from '../operation';\n\n/**\n * Rotates the input image tensor counter-clockwise with an optional offset\n * center of rotation. Currently available in the CPU, WebGL, and WASM backends.\n *\n * @param image 4d tensor of shape `[batch, imageHeight, imageWidth, depth]`.\n * @param radians The amount of rotation.\n * @param fillValue The value to fill in the empty space leftover\n *   after rotation. Can be either a single grayscale
value (0-255), or an\n *   array of three numbers `[red, green, blue]` specifying the red, green,\n *   and blue channels. Defaults to `0` (black).\n * @param center The center of rotation. Can be either a single value (0-1), or\n *
an array of two numbers `[centerX, centerY]`. Defaults to `0.5` (rotates\n *   the image around its center).\n *\n * @doc {heading: 'Operations', subheading: 'Images', namespace: 'image'}\n */\nfunction rotateWithOffset_(\n image: Tensor4D|TensorLike, radians: number,\n   fillValue: number|[number, number, number] = 0,\n   center: number|[number, number] = 0.5): Tensor4D {\n const $image = convertToTensor(image, 'image', 'rotateWithOffset', 'float32');\n\n util.assert(\n $image.rank === 4,\n   () => 'Error in rotateWithOffset: image must be rank 4,' +\n   `but got rank ${$image.rank}.`);\n\n const inputs: RotateWithOffsetInputs = {image: $image};\n const attrs: RotateWithOffsetAttrs = {radians, fillValue, center};\n const
res = ENGINE.runKernel(\n   RotateWithOffset, inputs as {} as NamedTensorMap,\n   attrs as {} as NamedAttrMap);\n return res as Tensor4D;\n}\n\nexport const rotateWithOffset = op({rotateWithOffset_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
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*/\n\nimport {Tensor1D, Tensor2D} from '../tensor';\nimport * as util
from '../util';\n\nfunction nonMaxSuppSanityCheck(\n   boxes: Tensor2D, scores: Tensor1D, maxOutputSize: number,\n   iouThreshold: number, scoreThreshold: number, softNmsSigma?: number): {\n maxOutputSize: number,\n iouThreshold: number,\n scoreThreshold: number,\n softNmsSigma: number\n} {\n if (iouThreshold == null) {\n   iouThreshold = 0.5;\n }\n if (scoreThreshold == null) {\n   scoreThreshold =

Number.NEGATIVE_INFINITY;\n }\n if (softNmsSigma == null) {\n   softNmsSigma = 0.0;\n }\n\n const numBoxes = boxes.shape[0];\n maxOutputSize = Math.min(maxOutputSize, numBoxes);\n\n util.assert(\n   0 <= iouThreshold && iouThreshold <= 1,\n   () => `iouThreshold must be in [0, 1], but was '${iouThreshold}'`);\n util.assert(\n   boxes.rank === 2,\n   () => `boxes must be a 2D tensor, but was of rank '${boxes.rank}'`);\n util.assert(\n   boxes.shape[1] === 4,\n   () =>\n   `boxes must have 4 columns, but 2nd dimension was ${boxes.shape[1]}`);\n util.assert(scores.rank === 1, () => 'scores must be a 1D tensor');\n util.assert(\n   scores.shape[0] === numBoxes,\n   () => `scores has incompatible shape with boxes. Expected ${numBoxes}, ` +\n   `but was ${scores.shape[0]}`);\n util.assert(\n   0 <= softNmsSigma && softNmsSigma <= 1,\n   () => `softNmsSigma must be in [0, 1], but was '${softNmsSigma}'`);\n return {maxOutputSize, iouThreshold, scoreThreshold, softNmsSigma};\n}\n\nexport {nonMaxSuppSanityCheck};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either
 express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
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*/\n\nimport {ENGINE} from '../../engine';\nimport {NonMaxSuppressionV3} from '../../kernel_names';\nimport {Tensor1D, Tensor2D} from '../../tensor';\nimport {convertToTensor} from '../../tensor_util_env';\nimport {TensorLike} from '../../types';\n\nimport {nonMaxSuppSanityCheck} from '../nonmax_util';\nimport {op} from '../operation';\n\n/**\n * Performs non maximum suppression of bounding boxes based on\n * iou (intersection over union).\n *\n * @param boxes a 2d tensor of shape `[numBoxes, 4]`. Each entry is\n *   `[y1, x1, y2, x2]`, where `(y1, x1)` and `(y2, x2)` are the corners of\n *   the bounding box.\n * @param scores a 1d tensor providing the box scores of shape `[numBoxes]`.\n * @param maxOutputSize The maximum number of boxes to be selected.\n * @param iouThreshold
 A float representing the threshold for deciding whether\n *   boxes overlap too much with respect to IOU. Must be between [0, 1].\n *   Defaults to 0.5 (50% box overlap).\n * @param scoreThreshold A threshold for deciding when to remove boxes based\n *   on score. Defaults to -inf, which means any score is accepted.\n * @return A 1D tensor with the selected box indices.\n *\n * @doc {heading: 'Operations', subheading: 'Images', namespace: 'image'}\n */\nfunction nonMaxSuppression_(\n   boxes: Tensor2D|TensorLike, scores: Tensor1D|TensorLike,\n maxOutputSize: number, iouThreshold = 0.5,\n   scoreThreshold = Number.NEGATIVE_INFINITY): Tensor1D {\n const $boxes = convertToTensor(boxes, 'boxes', 'nonMaxSuppression');\n const $scores = convertToTensor(scores, 'scores', 'nonMaxSuppression');\n\n const inputs = nonMaxSuppSanityCheck(\n $boxes, $scores, maxOutputSize, iouThreshold, scoreThreshold);\n maxOutputSize = inputs.maxOutputSize;\n iouThreshold = inputs.iouThreshold;\n
  scoreThreshold = inputs.scoreThreshold;\n\n const attrs = {maxOutputSize, iouThreshold, scoreThreshold};\n return ENGINE.runKernel(\n   NonMaxSuppressionV3, {boxes: $boxes, scores: $scores}, attrs);\n}\n\nexport const nonMaxSuppression = op({nonMaxSuppression_});\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
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*/\n\n/**\n * Inserts a value into a sorted array. This method allows duplicate, meaning it\n * allows inserting duplicate value, in which case, the element will be inserted\n * at the lowest index of the value.\n * @param arr The array to modify.\n * @param element The element to insert.\n * @param comparator Optional. If no comparator is specified, elements are\n * compared using array_util.defaultComparator, which is suitable for Strings\n * and Numbers in ascending arrays. If the array contains multiple instances of\n * the target value, the left-most instance will be returned. To provide a\n * comparator, it should take 2 arguments to compare and return a negative,\n * zero, or a positive number.\n */\nexport function binaryInsert<T>(\n    arr: T[], element: T, comparator?: (a: T, b: T) => number) {\n  const index = binarySearch(arr, element, comparator);\n  const insertionPoint = index < 0 ? -(index + 1) : index;\n  arr.splice(insertionPoint, 0, element);\n}\n\n/**\n * Searches the array for the target using binary search, returns the index\n * of the found element, or position to insert if element not found. If no\n * comparator is specified, elements are compared using array_\n * util.defaultComparator, which is suitable for Strings and Numbers in\n * ascending arrays. If the array contains multiple instances of the target\n * value, the left-most instance will be returned.\n * @param arr The array to be searched in.\n * @param target The target to be searched for.\n * @param comparator Should take 2 arguments to compare and return a negative,\n *     zero, or a positive number.\n * @return Lowest index of the target value if found, otherwise the insertion\n *     point where the target should be inserted, in the form of\n *     (-insertionPoint - 1).\n */\nexport function binarySearch<T>(\n    arr: T[], target: T, comparator?: (a: T, b: T) => number) {\n  return binarySearch_(arr, target, comparator || defaultComparator);\n}\n\n/**\n * Compares its two arguments for order.\n * @param a The first element to be compared.\n * @param b The second element to be compared.\n * @return A negative number, zero, or a positive number as the first\n *     argument is less than, equal to, or greater than the second.\n */\nfunction defaultComparator<T>(a: T, b: T): number {\n  return a > b ? 1 : a < b ? -1 : 0;\n}\n\nfunction binarySearch_<T>(\n    arr: T[], target: T, comparator: (a: T, b: T) => number) {\n  let left = 0;\n  let right = arr.length;\n  let middle = 0;\n  let found = false;\n  while (left < right) {\n    middle = left + ((right - left) >>> 1);\n    const compareResult = comparator(target, arr[middle]);\n    if (compareResult > 0) {\n      left = middle + 1;\n    } else {\n      right = middle;\n      // If compareResult is 0, the value is found. We record it is found,\n      // and then keep looking because there may be duplicate.\n      found = !compareResult;\n    }\n  }\n\n  return found ? left : -left - 1;\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ============================================================================\n */\n\nimport {TypedArray} from '../types';\nimport {binaryInsert} from './non_max_suppression_util';\n\n/**\n * Implementation of the NonMaxSuppression kernel shared between webgl and cpu.\n */\ninterface Candidate {\n  score: number;\n  boxIndex: number;\n  suppressBeginIndex: number;\n}\n\ninterface NonMaxSuppressionResult {\n  selectedIndices: number[];\n  selectedScores?: number[];\n  validOutputs?: number;\n}\n\nexport function nonMaxSuppressionV3Impl(\n    boxes: TypedArray, scores: TypedArray, maxOutputSize: number,\n    iouThreshold: number, scoreThreshold: number): NonMaxSuppressionResult {\n  return nonMaxSuppressionImpl_(\n      boxes, scores, maxOutputSize, iouThreshold, scoreThreshold,\n      0 /* softNmsSigma */);\n}\n\nexport function nonMaxSuppressionV4Impl(\n    boxes: TypedArray, scores: TypedArray, maxOutputSize: number,\n    iouThreshold: number, scoreThreshold: number,\n    padToMaxOutputSize: boolean): NonMaxSuppressionResult {\n  return nonMaxSuppressionImpl_(\n      boxes, scores, maxOutputSize, iouThreshold, scoreThreshold,\n      0 /* softNmsSigma */, false /* returnScoresTensor */,\n      padToMaxOutputSize /* padToMaxOutputSize */, true\n      /* returnValidOutputs */);\n}\n\nexport function nonMaxSuppressionV5Impl(\n    boxes: TypedArray, scores:
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TypedArray, maxOutputSize: number,\n    iouThreshold: number, scoreThreshold: number,\n    softNmsSigma: number): NonMaxSuppressionResult {\n  return nonMaxSuppressionImpl_(\n      boxes, scores, maxOutputSize, iouThreshold, scoreThreshold, softNmsSigma,\n      true /* returnScoresTensor */);\n}\n\nfunction nonMaxSuppressionImpl_(\n    boxes: TypedArray, scores: TypedArray, maxOutputSize: number,\n    iouThreshold: number, scoreThreshold: number, softNmsSigma: number,\n    returnScoresTensor = false, padToMaxOutputSize = false,\n    returnValidOutputs = false): NonMaxSuppressionResult {\n  // The list is sorted in ascending order, so that we can always pop the\n  // candidate with the largest score in O(1) time.\n  const candidates = [];\n\n  for (let i = 0; i < scores.length; i++) {\n    if (scores[i] > scoreThreshold) {\n      candidates.push({score: scores[i], boxIndex: i, suppressBeginIndex: 0});\n    }\n  }\n\n  candidates.sort(ascendingComparator);\n\n  // If softNmsSigma is 0,
 the outcome of this algorithm is exactly same as\n  // before.\n  const scale = softNmsSigma > 0 ? (-0.5 / softNmsSigma) : 0.0;\n\n  const selectedIndices: number[] = [];\n  const selectedScores: number[] = [];\n\n  while (selectedIndices.length < maxOutputSize && candidates.length > 0) {\n    const candidate = candidates.pop();\n    const {score: originalScore, boxIndex, suppressBeginIndex} = candidate;\n\n    if (originalScore < scoreThreshold) {\n      break;\n    }\n\n    // Overlapping boxes are likely to have similar scores, therefore we\n    // iterate through the previously selected boxes backwards in order to\n    // see if candidate's score should be suppressed. We use\n    // suppressBeginIndex to track and ensure a candidate can be suppressed\n    // by a selected box no more than once. Also, if the overlap exceeds\n    // iouThreshold, we simply ignore the candidate.\n    let ignoreCandidate = false;\n    for (let j = selectedIndices.length - 1; j >= suppressBeginIndex; --j)
 {\n      const iou = intersectionOverUnion(boxes, boxIndex, selectedIndices[j]);\n\n      if (iou >= iouThreshold) {\n        ignoreCandidate = true;\n        break;\n      }\n\n      candidate.score =\n          candidate.score *
suppressWeight(iouThreshold, scale, iou);\n\n      if (candidate.score <= scoreThreshold) {\n        break;\n      }\n    }\n\n    // At this point, if `candidate.score` has not dropped below\n    // `scoreThreshold`, then we know that we went through all of the\n    // previous selections and can safely update `suppressBeginIndex` to the\n    // end of the selected array. Then we can re-insert the candidate with\n    // the updated score and suppressBeginIndex back in the candidate list.\n    // If on the other hand, `candidate.score` has dropped below the score\n    // threshold, we will not add it back to the candidates list.\n    candidate.suppressBeginIndex = selectedIndices.length;\n\n    if (!ignoreCandidate) {\n      // Candidate has passed all the
 tests, and is not suppressed, so\n      // select the candidate.\n      if (candidate.score === originalScore) {\n        selectedIndices.push(boxIndex);\n        selectedScores.push(candidate.score);\n      } else if (candidate.score > scoreThreshold) {\n        // Candidate's score is suppressed but is still high enough to be\n        // considered, so add back to the candidates list.\n        binaryInsert(candidates, candidate, ascendingComparator);\n      }\n    }\n  }\n\n  // NonMaxSuppressionV4 feature: padding output to maxOutputSize.\n  const validOutputs = selectedIndices.length;\n  const elemsToPad = maxOutputSize - validOutputs;\n\n  if (padToMaxOutputSize && elemsToPad > 0) {\n    selectedIndices.push(...new Array(elemsToPad).fill(0));\n    selectedScores.push(...new Array(elemsToPad).fill(0.0));\n  }\n\n  const result: NonMaxSuppressionResult = {selectedIndices};\n\n  if (returnScoresTensor) {\n    result['selectedScores'] = selectedScores;\n  }\n\n  if (returnValidOutputs)
 {\n    result['validOutputs'] = validOutputs;\n  }\n\n  return result;\n}\n\nfunction intersectionOverUnion(boxes: TypedArray, i: number, j: number) {\n  const iCoord = boxes.subarray(i * 4, i * 4 + 4);\n  const jCoord = boxes.subarray(j * 4, j * 4 + 4);\n  const yminI = Math.min(iCoord[0], iCoord[2]);\n  const xminI = Math.min(iCoord[1], iCoord[3]);\n  const ymaxI = Math.max(iCoord[0], iCoord[2]);\n  const xmaxI = Math.max(iCoord[1], iCoord[3]);\n  const yminJ = Math.min(jCoord[0], jCoord[2]);\n  const xminJ = Math.min(jCoord[1], jCoord[3]);\n  const ymaxJ = Math.max(jCoord[0], jCoord[2]);\n  const xmaxJ = Math.max(jCoord[1], jCoord[3]);\n  const areaI = (ymaxI - yminI) * (xmaxI - xminI);\n  const areaJ = (ymaxJ - yminJ) * (xmaxJ - xminJ);\n  if (areaI <= 0 || areaJ <= 0) {\n    return 0.0;\n  }\n  const intersectionYmin = Math.max(yminI, yminJ);\n  const intersectionXmin = Math.max(xminI, xminJ);\n  const intersectionYmax = Math.min(ymaxI, ymaxJ);\n  const intersectionXmax = Math.min(xmaxI,
```

xmaxJ);\n const intersectionArea = Math.max(intersectionYmax - intersectionYmin, 0.0) *\n Math.max(intersectionXmax - intersectionXmin, 0.0);\n return intersectionArea / (areaI + areaJ - intersectionArea);\n}\n\n// A Gaussian penalty function, this method always returns values in [0, 1].\n// The weight is a function of similarity, the more overlap two boxes are, the\n// smaller the weight is, meaning highly overlapping boxe will be significantly\n// penalized. On the other hand, a non-overlapping box will not be penalized.\nfunction suppressWeight(iouThreshold: number, scale: number, iou: number) {\n const weight = Math.exp(scale * iou * iou);\n return iou <= iouThreshold ? weight : 0.0;\n}\n\nfunction ascendingComparator(c1: Candidate, c2: Candidate) {\n // For objects with same scores, we make the object with the larger index go\n // first. In an array that pops from the end, this means that the object with\n // the smaller index will be popped first. This ensures the same output as\n // the TensorFlow python version.\n return (c1.score - c2.score) ||\n   ((c1.score === c2.score) && (c2.boxIndex - c1.boxIndex));\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {nonMaxSuppressionV3Impl} from '../../backends/non_max_suppression_impl';\nimport {Tensor1D, Tensor2D}
 from '../../tensor';\nimport {convertToTensor} from '../../tensor_util_env';\nimport {TensorLike} from '../../types';\nimport {nonMaxSuppSanityCheck} from '../nonmax_util';\nimport {tensor1d} from '../tensor1d';\n\n/**\n * Performs non maximum suppression of bounding boxes based on\n * iou (intersection over union).\n *\n * This is the async version of `nonMaxSuppression`\n *\n * @param boxes a 2d tensor of shape `[numBoxes, 4]`. Each entry is\n *   `[y1, x1, y2, x2]`, where `(y1, x1)` and `(y2, x2)` are the corners of\n *   the bounding box.\n * @param scores a 1d tensor providing the box scores of shape `[numBoxes]`.\n * @param maxOutputSize The maximum number of boxes to be selected.\n * @param iouThreshold A float representing the threshold for deciding whether\n *   boxes overlap too much with respect to IOU. Must be between [0, 1].\n *   Defaults to 0.5 (50% box overlap).\n * @param scoreThreshold A threshold for deciding when to remove boxes based\n *   on score. Defaults
 to -inf, which means any score is accepted.\n * @return A 1D tensor with the selected box indices.\n *\n * @doc {heading: 'Operations', subheading: 'Images', namespace: 'image'}\n */\nasync function nonMaxSuppressionAsync_(\n   boxes: Tensor2D|TensorLike, scores: Tensor1D|TensorLike,\n   maxOutputSize: number, iouThreshold = 0.5,\n   scoreThreshold = Number.NEGATIVE_INFINITY): Promise<Tensor1D> {\n const $boxes = convertToTensor(boxes, 'boxes', 'nonMaxSuppressionAsync');\n const $scores = convertToTensor(scores, 'scores', 'nonMaxSuppressionAsync');\n\n const inputs = nonMaxSuppSanityCheck(\n $boxes, $scores, maxOutputSize, iouThreshold, scoreThreshold);\n maxOutputSize = inputs.maxOutputSize;\n iouThreshold = inputs.iouThreshold;\n scoreThreshold = inputs.scoreThreshold;\n\n const boxesAndScores = await Promise.all([$boxes.data(), $scores.data()]);\n const boxesVals = boxesAndScores[0];\n const scoresVals = boxesAndScores[1];\n\n // We call a cpu based impl directly
 with the typedarray data here rather\n // than a kernel because all kernels are synchronous (and thus cannot await\n // .data()).\n const {selectedIndices} = nonMaxSuppressionV3Impl(\n   boxesVals, scoresVals, maxOutputSize, iouThreshold, scoreThreshold);\n if ($boxes !== boxes) {\n $boxes.dispose();\n }\n if ($scores !== scores) {\n $scores.dispose();\n }\n\n return tensor1d(selectedIndices, 'int32');\n}\n\nexport const nonMaxSuppressionAsync = nonMaxSuppressionAsync_;\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing,

software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND,
either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {ENGINE} from '../../engine';\nimport {NonMaxSuppressionV5, NonMaxSuppressionV5Attrs, NonMaxSuppressionV5Inputs} from '../../kernel_names';\nimport {NamedAttrMap} from '../../kernel_registry';\nimport {Tensor, Tensor1D, Tensor2D} from '../../tensor';\nimport {NamedTensorMap} from '../../tensor_types';\nimport {convertToTensor} from '../../tensor_util_env';\nimport {TensorLike} from '../../types';\n\nimport {nonMaxSuppSanityCheck} from '../nonmax_util';\nimport {op} from '../operation';\n\n/**\n * Performs non maximum suppression of bounding boxes based on\n * iou (intersection over union).\n *\n * This op also supports a Soft-NMS mode (c.f.\n * Bodla et al, https://arxiv.org/abs/1704.04503) where boxes reduce the score\n * of other overlapping boxes, therefore
favoring different regions of the image\n * with high scores. To enable this Soft-NMS mode, set the `softNmsSigma`\n * parameter to be larger than 0.\n *\n * @param boxes a 2d tensor of shape `[numBoxes, 4]`. Each entry is\n * `[y1, x1, y2, x2]`, where `(y1, x1)` and `(y2, x2)` are the corners of\n * the bounding box.\n * @param scores a 1d tensor providing the box scores of shape `[numBoxes]`.\n * @param maxOutputSize The maximum number of boxes to be selected.\n * @param iouThreshold A float representing the threshold for deciding whether\n * boxes overlap too much with respect to IOU. Must be between [0, 1].\n * Defaults to 0.5 (50% box overlap).\n * @param scoreThreshold A threshold for deciding when to remove boxes based\n * on score. Defaults to -inf, which means any score is accepted.\n * @param softNmsSigma A float representing the sigma parameter for Soft NMS.\n * When sigma is 0, it falls back to nonMaxSuppression.\n * @return A map with the following
properties:\n * - selectedIndices: A 1D tensor with the selected box indices.\n * - selectedScores: A 1D tensor with the corresponding scores for each\n * selected box.\n *\n * @doc {heading: 'Operations', subheading: 'Images', namespace: 'image'}\n */\nfunction nonMaxSuppressionWithScore_(\n boxes: Tensor2D|TensorLike, scores: Tensor1D|TensorLike,\n maxOutputSize: number, iouThreshold = 0.5,\n scoreThreshold = Number.NEGATIVE_INFINITY,\n softNmsSigma = 0.0): NamedTensorMap {\n const $boxes = convertToTensor(boxes, 'boxes', 'nonMaxSuppression');\n const $scores = convertToTensor(scores, 'scores', 'nonMaxSuppression');\n\n const params = nonMaxSuppSanityCheck(\n $boxes, $scores, maxOutputSize, iouThreshold, scoreThreshold,\n softNmsSigma);\n maxOutputSize = params.maxOutputSize;\n iouThreshold = params.iouThreshold;\n scoreThreshold = params.scoreThreshold;\n softNmsSigma = params.softNmsSigma;\n\n const inputs: NonMaxSuppressionV5Inputs
= {boxes: $boxes, scores: $scores};\n const attrs: NonMaxSuppressionV5Attrs =\n {maxOutputSize, iouThreshold, scoreThreshold, softNmsSigma};\n\n // tslint:disable-next-line: no-unnecessary-type-assertion\n const result = ENGINE.runKernel(\n NonMaxSuppressionV5, inputs as {} as NamedTensorMap,\n attrs as {} as NamedAttrMap) as Tensor[];\n\n return {selectedIndices: result[0], selectedScores: result[1]};\n}\n\nexport const nonMaxSuppressionWithScore = op({nonMaxSuppressionWithScore_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT
WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\nimport {nonMaxSuppressionV5Impl} from '../../backends/non_max_suppression_impl';\nimport {Tensor1D, Tensor2D} from '../../tensor';\nimport {NamedTensorMap} from '../../tensor_types';\nimport {convertToTensor}

from '../../tensor_util_env';\nimport {TensorLike} from '../../types';\nimport {nonMaxSuppSanityCheck} from '../nonmax_util';\nimport {tensor1d} from '../tensor1d';\n\n/**\n * Asynchronously performs non maximum suppression of bounding boxes based on\n * iou (intersection over union).\n *\n * This op also supports a Soft-NMS mode (c.f.\n * Bodla et al, https://arxiv.org/abs/1704.04503) where boxes reduce the score\n * of other overlapping boxes, therefore favoring different regions of the image\n * with high scores. To enable this Soft-NMS mode, set the `softNmsSigma`\n * parameter to be larger than 0.\n *\n * @param boxes a 2d tensor of shape `[numBoxes, 4]`. Each entry is\n *   `[y1, x1, y2, x2]`, where `(y1, x1)` and `(y2, x2)` are the corners of\n *   the bounding box.\n * @param scores a 1d tensor providing the box scores of shape `[numBoxes]`.\n * @param maxOutputSize The maximum number of boxes to be selected.\n * @param iouThreshold A float representing the threshold for deciding whether\n *   boxes overlap too much with respect to IOU. Must be between [0, 1].\n *   Defaults to 0.5 (50% box overlap).\n * @param scoreThreshold A threshold for deciding when to remove boxes based\n *   on score. Defaults to -inf, which means any score is accepted.\n * @param softNmsSigma A float representing the sigma parameter for Soft NMS.\n *   When sigma is 0, it falls back to nonMaxSuppression.\n * @return A map with the following properties:\n *   - selectedIndices: A 1D tensor with the selected box indices.\n *   - selectedScores: A 1D tensor with the corresponding scores for each\n *   selected box.\n *\n * @doc {heading: 'Operations', subheading: 'Images', namespace: 'image'}\n */\nasync function nonMaxSuppressionWithScoreAsync_(\n   boxes: Tensor2D|TensorLike, scores: Tensor1D|TensorLike,\n   maxOutputSize: number, iouThreshold = 0.5,\n   scoreThreshold = Number.NEGATIVE_INFINITY,\n   softNmsSigma = 0.0): Promise<NamedTensorMap> {\n const $boxes = convertToTensor(boxes, 'boxes', 'nonMaxSuppressionAsync');\n const $scores = convertToTensor(scores, 'scores', 'nonMaxSuppressionAsync');\n\n const params = nonMaxSuppSanityCheck(\n $boxes, $scores, maxOutputSize, iouThreshold, scoreThreshold,\n   softNmsSigma);\n maxOutputSize = params.maxOutputSize;\n iouThreshold = params.iouThreshold;\n scoreThreshold = params.scoreThreshold;\n softNmsSigma = params.softNmsSigma;\n\n const boxesAndScores = await Promise.all([$boxes.data(), $scores.data()]);\n const boxesVals = boxesAndScores[0];\n const scoresVals = boxesAndScores[1];\n\n // We call a cpu based impl directly with the typedarray data here rather\n // than a kernel because all kernels are synchronous (and thus cannot await\n // .data()).\n const {selectedIndices, selectedScores} = nonMaxSuppressionV5Impl(\n   boxesVals, scoresVals, maxOutputSize, iouThreshold, scoreThreshold,\n   softNmsSigma);\n\n if ($boxes !== boxes) {\n $boxes.dispose();\n }\n if ($scores !== scores) {\n $scores.dispose();\n }\n\n return {\n   selectedIndices: tensor1d(selectedIndices, 'int32'),\n   selectedScores: tensor1d(selectedScores)\n };\n}\n\nexport const nonMaxSuppressionWithScoreAsync = nonMaxSuppressionWithScoreAsync_;\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n * ==\n */\n\nimport {ENGINE} from '../../engine';\nimport {NonMaxSuppressionV4, NonMaxSuppressionV4Attrs, NonMaxSuppressionV4Inputs} from '../../kernel_names';\nimport {NamedAttrMap} from '../../kernel_registry';\nimport {Tensor, Tensor1D, Tensor2D} from '../../tensor';\nimport {NamedTensorMap} from '../../tensor_types';\nimport {convertToTensor} from '../../tensor_util_env';\nimport {TensorLike} from '../../types';\n\nimport {nonMaxSuppSanityCheck} from '../nonmax_util';\nimport {op} from '../operation';\n\n/**\n * Asynchronously performs non maximum suppression of bounding boxes based on\n * iou (intersection over union), with an option to pad results.\n *\n * @param boxes a 2d tensor of shape `[numBoxes, 4]`. Each entry is\n *   `[y1, x1, y2, x2]`, where `(y1, x1)` and `(y2, x2)` are the corners of\n *   the bounding box.\n * @param scores a 1d tensor providing the box scores of shape `[numBoxes]`.\n * @param maxOutputSize The maximum number of boxes to be selected.\n *

@param iouThreshold A float representing the threshold for deciding whether\n * boxes overlap too much with respect to IOU. Must be between [0, 1].\n * Defaults to 0.5 (50% box overlap).\n * @param scoreThreshold A threshold for deciding when to remove boxes based\n * on score. Defaults to -inf, which means any score is accepted.\n * @param padToMaxOutputSize Defalts to false. If true, size of output\n * `selectedIndices` is padded to maxOutputSize.\n * @return A map with the following properties:\n * - selectedIndices: A 1D tensor with the selected box indices.\n * - validOutputs: A scalar denoting how many elements in `selectedIndices`\n * are valid. Valid elements occur first, then padding.\n *\n * @doc {heading: 'Operations', subheading: 'Images', namespace: 'image'}\n */\nfunction nonMaxSuppressionPadded_(\n boxes: Tensor2D|TensorLike, scores: Tensor1D|TensorLike,\n maxOutputSize: number, iouThreshold = 0.5,\n scoreThreshold = Number.NEGATIVE_INFINITY,\n padToMaxOutputSize = false): NamedTensorMap {\n const $boxes = convertToTensor(boxes, 'boxes', 'nonMaxSuppression');\n const $scores = convertToTensor(scores, 'scores', 'nonMaxSuppression');\n\n const params = nonMaxSuppSanityCheck(\n $boxes, $scores, maxOutputSize, iouThreshold, scoreThreshold,\n null /* softNmsSigma */);\n const $maxOutputSize = params.maxOutputSize;\n const $iouThreshold = params.iouThreshold;\n const $scoreThreshold = params.scoreThreshold;\n\n const inputs: NonMaxSuppressionV4Inputs = {boxes: $boxes, scores: $scores};\n const attrs: NonMaxSuppressionV4Attrs = {\n maxOutputSize: $maxOutputSize,\n iouThreshold: $iouThreshold,\n scoreThreshold: $scoreThreshold,\n padToMaxOutputSize\n };\n\n // tslint:disable-next-line: no-unnecessary-type-assertion\n const result = ENGINE.runKernel(\n NonMaxSuppressionV4, inputs as {} as NamedTensorMap,\n attrs as {} as NamedAttrMap) as Tensor[];\n\n return {selectedIndices: result[0], validOutputs: result[1]};\n}\n\nexport const nonMaxSuppressionPadded = op({nonMaxSuppressionPadded_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n * ==\n */\nimport {nonMaxSuppressionV4Impl} from '../../backends/non_max_suppression_impl';\nimport {Tensor1D, Tensor2D} from '../../tensor';\nimport {NamedTensorMap} from '../../tensor_types';\nimport {convertToTensor} from '../../tensor_util_env';\nimport {TensorLike} from '../../types';\nimport {nonMaxSuppSanityCheck} from '../nonmax_util';\nimport {scalar} from '../scalar';\nimport {tensor1d} from '../tensor1d';\n\n/**\n * Asynchronously performs non maximum suppression of bounding boxes based on\n * iou (intersection over union), with an option to pad results.\n *\n * @param boxes a 2d tensor of shape `[numBoxes, 4]`. Each entry is\n * `[y1, x1, y2, x2]`, where `(y1, x1)` and `(y2, x2)` are the corners of\n * the bounding box.\n * @param scores a 1d tensor providing the box scores of shape `[numBoxes]`.\n * @param maxOutputSize The maximum number of boxes to be selected.\n * @param iouThreshold A float representing the threshold for deciding whether\n * boxes overlap too much with respect to IOU. Must be between [0, 1].\n * Defaults to 0.5 (50% box overlap).\n * @param scoreThreshold A threshold for deciding when to remove boxes based\n * on score. Defaults to -inf, which means any score is accepted.\n * @param padToMaxOutputSize Defalts to false. If true, size of output\n * `selectedIndices` is padded to maxOutputSize.\n * @return A map with the following properties:\n * - selectedIndices: A 1D tensor with the selected box indices.\n * - validOutputs: A scalar denoting how many elements in `selectedIndices`\n * are valid. Valid elements occur first, then padding.\n *\n * @doc {heading: 'Operations', subheading: 'Images', namespace: 'image'}\n */\nasync function nonMaxSuppressionPaddedAsync_(\n boxes: Tensor2D|TensorLike, scores: Tensor1D|TensorLike,\n maxOutputSize: number, iouThreshold = 0.5,\n scoreThreshold = Number.NEGATIVE_INFINITY,\n padToMaxOutputSize = false): Promise<NamedTensorMap> {\n const

$boxes = convertToTensor(boxes, 'boxes', 'nonMaxSuppressionAsync');\n const $scores = convertToTensor(scores, 'scores', 'nonMaxSuppressionAsync');\n\n const params = nonMaxSuppSanityCheck(\n $boxes, $scores, maxOutputSize, iouThreshold, scoreThreshold,\n   null /* softNmsSigma */);\n const $maxOutputSize = params.maxOutputSize;\n const $iouThreshold = params.iouThreshold;\n const $scoreThreshold = params.scoreThreshold;\n\n const [boxesVals, scoresVals] =\n   await Promise.all([$boxes.data(), $scores.data()]);\n\n // We call a cpu based impl directly with the typedarray data here rather\n // than a kernel because all kernels are synchronous (and thus cannot await\n // .data()).\n const {selectedIndices, validOutputs} = nonMaxSuppressionV4Impl(\n   boxesVals, scoresVals, $maxOutputSize, $iouThreshold, $scoreThreshold,\n   padToMaxOutputSize);\n\n if ($boxes !== boxes) {\n $boxes.dispose();\n }\n if ($scores !== scores) {\n $scores.dispose();\n }\n\n return {\n   selectedIndices: tensor1d(selectedIndices, 'int32'),\n   validOutputs: scalar(validOutputs, 'int32')\n };\n}\n\nexport const nonMaxSuppressionPaddedAsync = nonMaxSuppressionPaddedAsync_;\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS
 OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n */\n\nimport {ENGINE} from '../../engine';\nimport {ResizeBilinear, ResizeBilinearAttrs, ResizeBilinearInputs} from '../../kernel_names';\nimport {NamedAttrMap} from '../../kernel_registry';\nimport {Tensor3D, Tensor4D} from '../../tensor';\nimport {NamedTensorMap} from '../../tensor_types';\nimport {convertToTensor} from '../../tensor_util_env';\nimport {TensorLike} from '../../types';\nimport * as util from '../../util';\n\nimport {op} from '../operation';\nimport {reshape} from '../reshape';\n\n/**\n * Bilinear resize a single 3D image or a batch of 3D images to a new shape.\n *\n * @param images The images, of rank 4 or rank 3, of shape\n *   `[batch, height, width, inChannels]`. If rank 3, batch of 1 is assumed.\n * @param size The new shape `[newHeight, newWidth]` to resize the\n *   images to. Each channel is resized individually.\n * @param alignCorners Defaults to `false`. If true, rescale\n *   input by `(new_height - 1) / (height - 1)`, which exactly aligns the 4\n *   corners of images and resized images. If false, rescale by\n *   `new_height / height`. Treat similarly the width dimension.\n * @param halfPixelCenters Defaults to `false`. Whether to assume pixel centers\n *   are at 0.5, which would make the floating point coordinates of the top\n *   left pixel 0.5, 0.5.\n *\n * @doc {heading: 'Operations', subheading: 'Images', namespace: 'image'}\n */\nfunction resizeBilinear_<T extends Tensor3D|Tensor4D>(\n   images: T|TensorLike, size: [number, number], alignCorners = false,\n   halfPixelCenters = false): T {\n const $images = convertToTensor(images, 'images', 'resizeBilinear');\n\n util.assert(\n $images.rank === 3 || $images.rank === 4,\n   () => `Error in resizeBilinear: x must be rank 3 or 4,
 but got ` +\n          `rank ${$images.rank}.`);\n  util.assert(\n      size.length === 2,\n      () => `Error in resizeBilinear: new shape must 2D, but got shape ` +\n          `${size}.`);\n  util.assert(\n      halfPixelCenters === false || alignCorners === false,\n      () => `Error in resizeBilinear: If halfPixelCenters is true, ` +\n          `alignCorners must be false.`);\n\n let batchImages = $images as Tensor4D;\n let reshapedTo4D = false;\n if ($images.rank === 3) {\n   reshapedTo4D = true;\n   batchImages = reshape(\n $images, [1, $images.shape[0], $images.shape[1], $images.shape[2]]);\n }\n\n const [] = size;\n\n const inputs: ResizeBilinearInputs = {images: batchImages};\n const attrs: ResizeBilinearAttrs = {alignCorners, halfPixelCenters, size};\n\n // tslint:disable-next-line: no-unnecessary-type-assertion\n const res = ENGINE.runKernel(\n   ResizeBilinear, inputs as {} as NamedTensorMap,\n   attrs as {} as NamedAttrMap) as
 T;\n\n if (reshapedTo4D) {\n   return reshape(res, [res.shape[1], res.shape[2], res.shape[3]]) as T;\n }\n return res;\n}\n\nexport const resizeBilinear = op({resizeBilinear_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not

use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {ENGINE} from '../../engine';\nimport {ResizeNearestNeighbor, ResizeNearestNeighborAttrs, ResizeNearestNeighborInputs} from '../../kernel_names';\nimport {NamedAttrMap} from '../../kernel_registry';\nimport {Tensor3D, Tensor4D} from '../../tensor';\nimport {NamedTensorMap} from '../../tensor_types';\nimport {convertToTensor} from '../../tensor_util_env';\nimport {TensorLike} from '../../types';\nimport * as util from '../../util';\n\nimport {op} from '../operation';\nimport {reshape} from '../reshape';\n\n/**\n * NearestNeighbor resize a batch of 3D images to a new shape.\n *\n * @param images The images, of rank 4 or rank 3, of shape\n *   `[batch, height, width, inChannels]`. If rank 3, batch of 1 is assumed.\n * @param size The new shape `[newHeight, newWidth]` to resize the\n *   images to. Each channel is resized individually.\n * @param alignCorners Defaults to False. If true, rescale\n *   input by `(new_height - 1) / (height - 1)`, which exactly aligns the 4\n *   corners of images and resized images. If false, rescale by\n *   `new_height / height`.
 Treat similarly the width dimension.\n * @param halfPixelCenters Defaults to `false`. Whether to assumes pixels are of\n *   half the actual dimensions, and yields more accurate resizes. This flag\n *   would also make the floating point coordinates of the top left pixel\n *   0.5, 0.5.\n *\n * @doc {heading: 'Operations', subheading: 'Images', namespace: 'image'}\n */\nfunction resizeNearestNeighbor_<T extends Tensor3D|Tensor4D>(\n   images: T|TensorLike, size: [number, number], alignCorners = false,\n   halfPixelCenters = false): T {\n const $images = convertToTensor(images, 'images', 'resizeNearestNeighbor');\n\n util.assert(\n $images.rank === 3 || $images.rank === 4,\n   () => `Error in resizeNearestNeighbor: x must be rank 3 or 4, but got ` +\n   `rank ${$images.rank}.`);\n util.assert(\n   size.length === 2,\n   () =>\n   `Error in resizeNearestNeighbor: new shape must 2D, but got shape ` +\n   `${size}.`);\n util.assert(\n $images.dtype === 'float32' || $images.dtype === 'int32',\n   () => '`images` must have `int32` or `float32` as dtype');\n util.assert(\n   halfPixelCenters === false || alignCorners === false,\n   () => `Error in resizeNearestNeighbor: If halfPixelCenters is true, ` +\n   `alignCorners must be false.`);\n let batchImages = $images as Tensor4D;\n let reshapedTo4D = false;\n if ($images.rank === 3) {\n   reshapedTo4D = true;\n   batchImages = reshape(\n $images, [1, $images.shape[0], $images.shape[1], $images.shape[2]]);\n }\n const [] = size;\n\n const inputs: ResizeNearestNeighborInputs = {images: batchImages};\n const attrs:\n   ResizeNearestNeighborAttrs = {alignCorners, halfPixelCenters, size};\n\n // tslint:disable-next-line: no-unnecessary-type-assertion\n const res = ENGINE.runKernel(\n   ResizeNearestNeighbor, inputs as {} as NamedTensorMap,\n   attrs as {} as NamedAttrMap) as T;\n\n if (reshapedTo4D) {\n   return reshape(res, [res.shape[1], res.shape[2], res.shape[3]]) as T;\n }\n return res;\n}\n\nexport const resizeNearestNeighbor = op({resizeNearestNeighbor_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {Tensor} from '../../tensor';\nimport {convertToTensor} from '../../tensor_util_env';\nimport {TensorLike}
 from '../../types';\nimport {assert} from '../../util';\n\nimport {greaterEqual} from '../greater_equal';\nimport {lessEqual} from '../less_equal';\nimport {logicalAnd} from '../logical_and';\nimport {op} from

'../operation';\nimport {range} from '../range';\nimport {reshape} from '../reshape';\nimport {scalar} from '../scalar';\nimport {stack} from '../stack';\nimport {sub} from '../sub';\nimport {unstack} from '../unstack';\nimport {where} from '../where';\nimport {zeros} from '../zeros';\n\n/**\n * Copy a tensor setting everything outside a central band in each innermost\n * matrix to zero.\n *\n * The band part is computed as follows: Assume input has `k` dimensions\n * `[I, J, K, ..., M, N]`, then the output is a tensor with the same shape where\n * `band[i, j, k, ..., m, n] = in_band(m, n) * input[i, j, k, ..., m, n]`.\n * The indicator function\n * `in_band(m, n) = (num_lower < 0 || (m-n) <= num_lower))`\n * `&& (num_upper < 0 || (n-m) <= num_upper)`\n *\n * ```js\n *
const x = tf.tensor2d([[0, 1, 2, 3],\n *   [-1, 0, 1, 2],\n *   [-2, -1, 0, 1],\n *
[-3, -2, -1, 0]]);\n * let y = tf.linalg.bandPart(x, 1, -1);\n * y.print(); // [[0, 1, 2, 3],\n *   // [-1, 0, 1, 2],\n *
// [0, -1, 0, 1],\n *   // [0, 0 , -1, 0]]\n * let z = tf.linalg.bandPart(x, 2, 1);\n * z.print(); // [[0, 1, 0, 0],\n
*   // [-1, 0, 1, 0],\n *   // [-2, -1, 0, 1],\n *   // [0, -2, -1, 0]]\n * ```\n *\n * @param x Rank `k` tensor\n * @param numLower Number of subdiagonals to keep.\n *   If negative, keep entire lower triangle.\n * @param numUpper Number of subdiagonals to keep.\n *   If negative, keep entire upper triangle.\n * @returns Rank `k` tensor of the same shape as input.\n *   The extracted banded tensor.\n *\n * @doc {heading:'Operations', subheading:'Linear Algebra', namespace:'linalg'}\n */\nfunction bandPart_<T extends Tensor>(\n
a: T|TensorLike, numLower: number, numUpper: number): T {\n assert(\n   numLower % 1 === 0,\n   () => `bandPart(): numLower must be an integer, got ${numLower}.`);\n assert(\n   numUpper % 1 === 0,\n   () => `bandPart(): numUpper must be an integer, got ${numUpper}.`);\n\n const $a = convertToTensor(a, 'a', 'bandPart');\n\n assert(\n $a.rank >= 2,\n   () => `bandPart(): Rank must be at least 2, got ${$a.rank}.`);\n\n const shape = $a.shape;\n const [M, N] = $a.shape.slice(-2);\n\n if (!(numLower <= M)) {\n   throw new Error(\n
`bandPart(): numLower (${numLower})` +\n   ` must not be greater than the number of rows (${M}).`);\n }\n if (!(numUpper <= N)) {\n   throw new Error(\n   `bandPart(): numUpper (${numUpper})` +\n   ` must not be greater than the number of columns (${N}).`);\n }\n\n if (numLower < 0) {\n   numLower = M;\n }\n if (numUpper < 0) {\n   numUpper = N;\n }\n\n const i = reshape(range(0, M, 1, 'int32'),
[-1, 1]);\n const j = range(0, N, 1, 'int32');\n const ij = sub(i, j);\n\n const inBand = logicalAnd(\n   lessEqual(ij, scalar(+numLower, 'int32')),\n   greaterEqual(ij, scalar(-numUpper, 'int32')));\n\n const zero = zeros([M, N], $a.dtype);\n\n return reshape(\n   stack(unstack(reshape($a, [-1, M, N]))\n   .map(mat => where(inBand, mat, zero))),\n   shape) as T;\n}\n\nexport const bandPart = op({bandPart_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n
* See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {ENGINE} from '../../engine';\nimport {Tensor1D, Tensor2D} from '../../tensor';\nimport {assert} from '../../util';\n\nimport {div} from '../div';\nimport {mul} from '../mul';\nimport {norm} from '../norm';\nimport {op} from '../operation';\nimport {split} from '../split';\nimport {squeeze} from '../squeeze';\nimport {stack} from '../stack';\nimport {sub} from '../sub';\nimport {sum} from '../sum';\n\n/**\n * Gram-Schmidt orthogonalization.\n *\n * ```js\n * const x = tf.tensor2d([[1, 2], [3, 4]]);\n * let y = tf.linalg.gramSchmidt(x);\n * y.print();\n * console.log('Othogonalized:');\n * y.dot(y.transpose()).print(); // should be nearly the identity matrix.\n * console.log('First row direction maintained:');\n * const data = await y.array();\n * console.log(data[0][1] / data[0][0]);
// should be nearly 2.\n * ```\n *\n * @param xs The vectors to be orthogonalized, in one of the two following\n * formats:\n *   - An Array of `tf.Tensor1D`.\n *   - A `tf.Tensor2D`, i.e., a matrix, in which case the vectors are the rows\n *   of `xs`.\n *   In each case, all the vectors must have the same length and the length\n *   must be greater than or equal to the number of vectors.\n * @returns The orthogonalized and normalized vectors or matrix.\n * Orthogonalization means that the vectors or the rows of the matrix\n *   are orthogonal (zero inner products).

```
Normalization means that each\n *    vector or each row of the matrix has an L2 norm that equals `1`.\n *\n * @doc
{heading:'Operations', subheading:'Linear Algebra', namespace:'linalg'}\n */\nfunction gramSchmidt_(xs:
Tensor1D[]|Tensor2D): Tensor1D[]|Tensor2D {\n  let inputIsTensor2D: boolean;\n  if (Array.isArray(xs)) {\n
inputIsTensor2D = false;\n    assert(\n        xs != null && xs.length > 0,\n        () => 'Gram-Schmidt
 process: input must not be null, undefined, or ' +\n            'empty');\n    const dim = xs[0].shape[0];\n    for (let i = 1;
i < xs.length; ++i) {\n      assert(\n          xs[i].shape[0] === dim,\n          () =>\n              'Gram-Schmidt: Non-unique
lengths found in the input vectors: ' +\n              `(${(xs as Tensor1D[])[i].shape[0]} vs. ${dim})`);\n    }\n  } else {\n
  inputIsTensor2D = true;\n    xs = split(xs, xs.shape[0], 0).map(x => squeeze(x, [0]));\n  }\n\n  assert(\n      xs.length
<= xs[0].shape[0],\n      () => `Gram-Schmidt: Number of vectors (${\n              (xs as Tensor1D[]).length})
exceeds ` +\n          `number of dimensions (${(xs as Tensor1D[])[0].shape[0]}).`);\n\n  const ys: Tensor1D[] = [];\n
const xs1d = xs;\n  for (let i = 0; i < xs.length; ++i) {\n    ys.push(ENGINE.tidy(() => {\n      let x = xs1d[i];\n      if
(i > 0) {\n        for (let j = 0; j < i; ++j) {\n          const proj = mul(sum(mul(ys[j], x)), ys[j]);\n          x
 = sub(x, proj);\n        }\n      }\n      return div(x, norm(x, 'euclidean'));\n    }));\n  }\n\n  if (inputIsTensor2D) {\n
return stack(ys, 0) as Tensor2D;\n  } else {\n    return ys;\n  }\n}\n\nexport const gramSchmidt =
op({gramSchmidt_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed
under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the
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on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or
implied.\n * See the License for the specific language governing permissions and\n * limitations under the
License.\n *
==========================================================================\n
*/\nimport {ENGINE} from '../../engine';\nimport
 {dispose} from '../../globals';\nimport {Tensor, Tensor2D} from '../../tensor';\nimport {assert} from
'../../util';\n\nimport {clone} from '../clone';\nimport {concat} from '../concat';\nimport {div} from '../div';\nimport
{eye} from '../eye';\nimport {greater} from '../greater';\nimport {matMul} from '../mat_mul';\nimport {mul} from
'../mul';\nimport {neg} from '../neg';\nimport {norm} from '../norm';\nimport {op} from '../operation';\nimport
{reshape} from '../reshape';\nimport {slice} from '../slice';\nimport {stack} from '../stack';\nimport {sub} from
'../sub';\nimport {tensor2d} from '../tensor2d';\nimport {transpose} from '../transpose';\nimport {unstack} from
'../unstack';\nimport {where} from '../where';\n\n/**\n * Compute QR decomposition of m-by-n matrix using
Householder transformation.\n *\n * Implementation based on\n *
[http://www.cs.cornell.edu/~bindel/class/cs6210-f09/lec18.pdf]\n *
(http://www.cs.cornell.edu/~bindel/class/cs6210-f09/lec18.pdf)\n *\n
 * ```js\n * const a = tf.tensor2d([[1, 2], [3, 4]]);\n * let [q, r] = tf.linalg.qr(a);\n * console.log('Q');\n * q.print();\n *
console.log('R');\n * r.print();\n * console.log('Orthogonalized');\n * q.dot(q.transpose()).print()  // should be nearly
the identity matrix.\n * console.log('Reconstructed');\n * q.dot(r).print(); // should be nearly [[1, 2], [3, 4]];\n * ```\n
*\n * @param x The `tf.Tensor` to be QR-decomposed. Must have rank >= 2. Suppose\n *    it has the shape `[..., M,
N]`.\n * @param fullMatrices An optional boolean parameter. Defaults to `false`.\n *    If `true`, compute full-sized
`Q`. If `false` (the default),\n *    compute only the leading N columns of `Q` and `R`.\n * @returns An `Array` of
two `tf.Tensor`s: `[Q, R]`. `Q` is a unitary matrix,\n *    i.e., its columns all have unit norm and are mutually
orthogonal.\n *    If `M >= N`,\n *      If `fullMatrices` is `false` (default),\n *        - `Q` has a shape of `[..., M, N]`,\n *
    - `R` has a shape of `[..., N,
 N]`.\n *      If `fullMatrices` is `true` (default),\n *        - `Q` has a shape of `[..., M, M]`,\n *        - `R` has a shape of
`[..., M, N]`.\n *    If `M < N`,\n *      - `Q` has a shape of `[..., M, M]`,\n *      - `R` has a shape of `[..., M, N]`.\n *
@throws If the rank of `x` is less than 2.\n *\n * @doc {heading:'Operations',\n *        subheading:'Linear Algebra',\n
*        namespace:'linalg'}\n */\nfunction qr_(x: Tensor, fullMatrices = false): [Tensor, Tensor] {\n  assert(\n
x.rank >= 2,\n      () => `qr() requires input tensor to have a rank >= 2, but got rank ${\n          x.rank}`);\n\n  if
(x.rank === 2) {\n    return qr2d(x as Tensor2D, fullMatrices);\n  } else {\n    // Rank > 2.\n    // TODO(cais): Below
```

```
we split the input into individual 2D tensors,\n  // perform QR decomposition on them and then stack the results back\n  // together. We should explore whether this can be parallelized.\n  const outerDimsProd = x.shape.slice(0, x.shape.length - 2)\n
.reduce((value, prev) => value * prev);\n  const x2ds = unstack(\n  reshape(\n  x,\n  [\n  outerDimsProd, x.shape[x.shape.length - 2],\n  x.shape[x.shape.length - 1]\n  ]),\n  0);\n  const q2ds: Tensor2D[] = [];\n  const r2ds: Tensor2D[] = [];\n  x2ds.forEach(x2d => {\n  const [q2d, r2d] = qr2d(x2d as Tensor2D, fullMatrices);\n  q2ds.push(q2d);\n  r2ds.push(r2d);\n  });\n  const q = reshape(stack(q2ds, 0), x.shape);\n  const r = reshape(stack(r2ds, 0), x.shape);\n  return [q, r];\n  }\n}\n\nfunction qr2d(x: Tensor2D, fullMatrices = false): [Tensor2D, Tensor2D] {\n  return ENGINE.tidy(() => {\n  assert(\n  x.shape.length === 2,\n  () => `qr2d() requires a 2D Tensor, but got a ${\n  x.shape.length}D Tensor.`);\n\n  const m = x.shape[0];\n  const n = x.shape[1];\n\n  let q = eye(m);  // Orthogonal transform so far.\n  let r = clone(x);  //
 Transformed matrix so far.\n\n  const one2D = tensor2d([[1]], [1, 1]);\n  let w: Tensor2D = clone(one2D);\n\n  const iters = m >= n ? n : m;\n  for (let j = 0; j < iters; ++j) {\n  // This tidy within the for-loop ensures we clean up temporary\n  // tensors as soon as they are no longer needed.\n  const rTemp = r;\n  const wTemp = w;\n  const qTemp = q;\n  [w, r, q] = ENGINE.tidy((): [Tensor2D, Tensor2D, Tensor2D] => {\n  // Find H = I - tau * w * w', to put zeros below R(j, j).\n  const rjEnd1 = slice(r, [j, j], [m - j, 1]);\n  const normX = norm(rjEnd1);\n  const rjj = slice(r, [j, j], [1, 1]);\n\n  // The sign() function returns 0 on 0, which causes division by zero.\n  const s = where(greater(rjj, 0), tensor2d([[-1]]), tensor2d([[1]]));\n\n  const u1 = sub(rjj, mul(s, normX));\n  const wPre = div(rjEnd1, u1);\n  if (wPre.shape[0] === 1) {\n  w = clone(one2D);\n  } else {\n
 w = concat(\n  [\n  one2D,\n  slice(wPre, [1, 0], [wPre.shape[0] - 1, wPre.shape[1]]) as\n  Tensor2D\n  ],\n  0);\n  }\n  const tau = neg(div(matMul(s, u1), normX)) as Tensor2D;\n\n  // -- R := HR, Q := QH.\n  const rjEndAll = slice(r, [j, 0], [m - j, n]);\n  const tauTimesW: Tensor2D = mul(tau, w);\n  const wT: Tensor2D = transpose(w);\n  if (j === 0) {\n  r = sub(rjEndAll, matMul(tauTimesW, matMul(wT, rjEndAll)));\n  } else {\n  const rTimesTau: Tensor2D =\n  sub(rjEndAll, matMul(tauTimesW, matMul(wT, rjEndAll)));\n  r = concat([slice(r, [0, 0], [j, n]), rTimesTau], 0);\n  }\n  const tawTimesWT: Tensor2D = transpose(tauTimesW);\n  const qAllJEnd = slice(q, [0, j], [m, q.shape[1] - j]);\n  if (j === 0) {\n  q = sub(qAllJEnd, matMul(matMul(qAllJEnd, w), tawTimesWT));\n  } else {\n
  const qTimesTau: Tensor2D =\n  sub(qAllJEnd, matMul(matMul(qAllJEnd, w), tawTimesWT));\n  q = concat([slice(q, [0, 0], [m, j]), qTimesTau], 1);\n  }\n  return [w, r, q];\n  });\n  dispose([rTemp, wTemp, qTemp]);\n  }\n\n  if (!fullMatrices && m > n) {\n  q = slice(q, [0, 0], [m, n]);\n  r = slice(r, [0, 0], [n, n]);\n  }\n\n  return [q, r];\n  }) as [Tensor2D, Tensor2D];\n}\n\nexport const qr = op({qr_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n
 * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========================================================================\n
*/\n\nexport enum Reduction {\n  NONE,\n  MEAN,\n  SUM,\n  SUM_BY_NONZERO_WEIGHTS\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
```

```
==========================================================================\n
 */\nimport {Tensor} from '../../tensor';\nimport {convertToTensor} from '../../tensor_util_env';\nimport
{TensorLike} from '../../types';\n\nimport {cast} from '../cast';\nimport {div} from '../div';\nimport {Reduction} from
'../loss_ops_utils';\nimport {mean} from '../mean';\nimport {mul} from '../mul';\nimport {notEqual} from
'../not_equal';\nimport {ones} from '../ones';\nimport {op} from '../operation';\nimport {scalar} from
'../scalar';\nimport {sum} from '../sum';\n\n/**\n * Computes the weighted loss between two tensors.\n *\n *
@param losses Tensor of shape `[batch_size, d1, ... dN]`.\n * @param weights Tensor whose rank is either 0, or the
same rank as\n *    `losses`, and must be broadcastable to `losses` (i.e., all\n *    dimensions must be either `1`, or the
same as the corresponding\n *    `losses` dimension).\n *\n * @doc {heading: 'Training', subheading: 'Losses',
namespace: 'losses'}\n */\nfunction computeWeightedLoss_<T extends Tensor, O extends Tensor>(\n    losses:
 T|TensorLike, weights?: Tensor|TensorLike,\n    reduction = Reduction.SUM_BY_NONZERO_WEIGHTS): O {\n
const $losses = convertToTensor(losses, 'losses', 'computeWeightedLoss');\n  let $weights: Tensor = null;\n  if
(weights != null) {\n    $weights = convertToTensor(weights, 'weights', 'computeWeightedLoss');\n  }\n\n  const
weightedLoss = ($weights == null) ? $losses : mul($losses, $weights);\n\n  if (reduction === Reduction.NONE) {\n
 return weightedLoss as O;\n  }\n  if (reduction === Reduction.SUM) {\n    return sum(weightedLoss);\n  }\n  if
(reduction === Reduction.MEAN) {\n    if ($weights == null) {\n      return mean(weightedLoss);\n    } else {\n
const broadcastFactor = $losses.size / $weights.size;\n      const result = div(sum(weightedLoss), sum($weights));\n
  return broadcastFactor > 1 ? div(result, scalar(broadcastFactor)) :\n                                result as O;\n    }\n  }\n  if
(reduction === Reduction.SUM_BY_NONZERO_WEIGHTS) {\n    if ($weights == null)
 {\n      return div(sum(weightedLoss), scalar($losses.size));\n    } else {\n      const broadcastedWeights =
mul($weights, ones($losses.shape));\n\n      const numNonZeros =\n          cast(sum(notEqual(broadcastedWeights,
scalar(0))), 'float32');\n      return div(sum(weightedLoss), numNonZeros);\n    }\n  }\n\n  throw Error(`Unknown
reduction: ${reduction}`);\n}\nexport const computeWeightedLoss = op({computeWeightedLoss_});\n","/**\n *
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2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a
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WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for
the specific
 language governing permissions and\n * limitations under the License.\n *
==========================================================================\n
*/\n\nimport {Tensor} from '../../tensor';\nimport {convertToTensor} from '../../tensor_util_env';\nimport
{TensorLike} from '../../types';\nimport {assertShapesMatch} from '../../util';\nimport {abs} from '../abs';\nimport
{Reduction} from '../loss_ops_utils';\nimport {op} from '../operation';\nimport {sub} from '../sub';\n\nimport
{computeWeightedLoss} from './compute_weighted_loss';\n\n/**\n * Computes the absolute difference loss
between two tensors.\n *\n * @param labels The ground truth output tensor, same dimensions as\n *
'predictions'.\n * @param predictions The predicted outputs.\n * @param weights Tensor whose rank is either 0, or
the same rank as\n *    `labels`, and must be broadcastable to `labels` (i.e., all dimensions\n *    must be either `1`, or
the same as the corresponding `losses`\n *    dimension).\n * @param
 reduction Type of reduction to apply to loss. Should be of type\n *    `Reduction`\n *\n * @doc {heading:
'Training', subheading: 'Losses', namespace: 'losses'}\n */\nfunction absoluteDifference_<T extends Tensor, O
extends Tensor>(\n    labels: T|TensorLike, predictions: T|TensorLike,\n    weights?: Tensor|TensorLike,\n
reduction = Reduction.SUM_BY_NONZERO_WEIGHTS): O {\n  const $labels = convertToTensor(labels, 'labels',
'absoluteDifference');\n  const $predictions =\n      convertToTensor(predictions, 'predictions',
'absoluteDifference');\n  let $weights: Tensor = null;\n  if (weights != null) {\n    $weights =
convertToTensor(weights, 'weights', 'absoluteDifference');\n  }\n  assertShapesMatch(\n      $labels.shape,
$predictions.shape, 'Error in absoluteDifference: ');\n\n  const losses = abs(sub($labels, $predictions));\n  return
computeWeightedLoss(losses, $weights, reduction);\n}\n\nexport const absoluteDifference =
```

op({absoluteDifference_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n*/\nimport {Tensor} from '../../tensor';\nimport {convertToTensor} from '../../tensor_util_env';\nimport {TensorLike} from '../../types';\nimport {assertShapesMatch} from '../../util';\nimport {Reduction} from '../loss_ops_utils';\nimport {mul} from '../mul';\nimport {op} from '../operation';\nimport {scalar} from '../scalar';\nimport {sub} from '../sub';\nimport {sum} from '../sum';\n\nimport {computeWeightedLoss} from './compute_weighted_loss';\n\n/**\n * Computes the cosine distance loss between two tensors.\n *\n * @param labels The ground truth output tensor, same dimensions as\n *   'predictions'.\n * @param predictions The predicted outputs.\n * @param axis The dimension along which the cosine distance is computed.\n * @param weights Tensor whose rank is either 0, or the same rank as\n *   `labels`, and must be broadcastable to `labels` (i.e., all dimensions\n *   must be either `1`, or the same as the corresponding `losses`\n *   dimension).\n * @param reduction Type of reduction to apply to loss. Should be of type\n *   `Reduction`\n *\n * @doc {heading: 'Training', subheading: 'Losses', namespace: 'losses'}\n */\nfunction cosineDistance_<T extends Tensor, O extends Tensor>(\n   labels: T|TensorLike, predictions: T|TensorLike, axis: number,\n   weights?: Tensor|TensorLike,\n   reduction = Reduction.SUM_BY_NONZERO_WEIGHTS): O {\n const $labels = convertToTensor(labels, 'labels', 'cosineDistance');\n const $predictions =\n   convertToTensor(predictions, 'predictions', 'cosineDistance');\n let $weights: Tensor = null;\n if (weights != null) {\n $weights = convertToTensor(weights, 'weights', 'cosineDistance');\n }\n assertShapesMatch(\n $labels.shape, $predictions.shape, 'Error in cosineDistance: ');\n\n const one = scalar(1);\n const losses = sub(one, sum(mul($labels, $predictions), axis, true));\n return computeWeightedLoss(losses, $weights, reduction);\n}\nexport const cosineDistance = op({cosineDistance_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n*/\nimport {Tensor} from '../../tensor';\nimport {convertToTensor} from '../../tensor_util_env';\nimport {TensorLike} from '../../types';\nimport {assertShapesMatch} from '../../util';\nimport {Reduction} from '../loss_ops_utils';\nimport {mul} from '../mul';\nimport {op} from '../operation';\nimport {relu} from '../relu';\nimport {scalar} from '../scalar';\nimport {sub} from '../sub';\n\nimport {computeWeightedLoss} from './compute_weighted_loss';\n\n/**\n * Computes the Hinge loss between two tensors.\n *\n * @param labels The ground truth output tensor, same dimensions as\n *   'predictions'.\n * @param predictions The predicted outputs.\n * @param weights Tensor whose rank is either 0, or the same rank as\n *   `labels`, and must be broadcastable to `labels` (i.e., all dimensions\n *   must be either `1`, or the same as the corresponding `losses`\n *   dimension).\n * @param reduction Type of reduction to apply to loss. Should be of type\n *   `Reduction`\n *\n * @doc {heading: 'Training', subheading: 'Losses', namespace: 'losses'}\n */\nfunction hingeLoss_<T extends Tensor, O extends Tensor>(\n   labels: T|TensorLike, predictions: T|TensorLike,\n   weights?: Tensor|TensorLike,\n   reduction = Reduction.SUM_BY_NONZERO_WEIGHTS): O {\n let $labels = convertToTensor(labels, 'labels', 'hingeLoss');\n const $predictions = convertToTensor(predictions, 'predictions', 'hingeLoss');\n let $weights: Tensor = null;\n if (weights != null) {\n $weights = convertToTensor(weights,

'weights', 'hingeLoss');\n }\n assertShapesMatch($labels.shape, $predictions.shape, 'Error
 in hingeLoss: ');\n\n const one = scalar(1);\n // Convert binary labels to (-1, 1)\n $labels = sub(mul(scalar(2),
$labels), one);\n const losses = relu(sub(one, mul($labels, $predictions)));\n return computeWeightedLoss(losses,
$weights, reduction);\n}\nexport const hingeLoss = op({hingeLoss_});\n","/**\n * @license\n * Copyright 2020
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http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing,
software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES
OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language
governing permissions and\n * limitations under the License.\n *
==\n
 */\n\nimport {Tensor} from '../../tensor';\nimport {convertToTensor} from '../../tensor_util_env';\nimport
{TensorLike} from '../../types';\nimport {assertShapesMatch} from '../../util';\nimport {abs} from '../abs';\nimport
{add} from '../add';\nimport {Reduction} from '../loss_ops_utils';\nimport {minimum} from '../minimum';\nimport
{mul} from '../mul';\nimport {op} from '../operation';\nimport {scalar} from '../scalar';\nimport {square} from
'../square';\nimport {sub} from '../sub';\n\nimport {computeWeightedLoss} from
'./compute_weighted_loss';\n\n/**\n * Computes the huber loss between two tensors.\n *\n * @param labels The
ground truth output tensor, same dimensions as\n *   'predictions'.\n * @param predictions The predicted outputs.\n
* @param weights Tensor whose rank is either 0, or the same rank as\n *   `labels`, and must be broadcastable to
`labels` (i.e., all dimensions\n *   must be either `1`, or the same as the corresponding `losses`\n *   dimension).\n
 * @param delta Point where huber loss changes from quadratic to linear.\n * @param reduction Type of reduction
to apply to loss. Should be of type\n *   `Reduction`.\n *\n * @doc {heading: 'Training', subheading: 'Losses',
namespace: 'losses'}\n */\nfunction huberLoss_<T extends Tensor, O extends Tensor>(\n   labels: T|TensorLike,
predictions: T|TensorLike,\n   weights?: Tensor|TensorLike, delta = 1.0,\n   reduction =
Reduction.SUM_BY_NONZERO_WEIGHTS): O {\n const $labels = convertToTensor(labels, 'labels',
'huberLoss');\n const $predictions = convertToTensor(predictions, 'predictions', 'huberLoss');\n let $weights:
Tensor = null;\n if (weights != null) {\n $weights = convertToTensor(weights, 'weights', 'huberLoss');\n }\n
assertShapesMatch($labels.shape, $predictions.shape, 'Error in huberLoss: ');\n\n const deltaScalar =
scalar(delta);\n const error = abs(sub($predictions, $labels));\n const quadratic = minimum(error, deltaScalar);\n
const linear = sub(error,
 quadratic);\n\n const losses =\n   add(mul(scalar(0.5), square(quadratic)), mul(deltaScalar, linear));\n return
computeWeightedLoss(losses, $weights, reduction);\n}\nexport const huberLoss = op({huberLoss_});\n","/**\n *
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WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for
the specific language governing permissions and\n * limitations under the License.\n *
==\n
*/\n\nimport {Tensor} from '../../tensor';\nimport {convertToTensor}
 from '../../tensor_util_env';\nimport {TensorLike} from '../../types';\nimport {assertShapesMatch} from
'../../util';\nimport {add} from '../add';\nimport {log} from '../log';\nimport {Reduction} from
'../loss_ops_utils';\nimport {mul} from '../mul';\nimport {neg} from '../neg';\nimport {op} from
'../operation';\nimport {scalar} from '../scalar';\nimport {sub} from '../sub';\n\nimport {computeWeightedLoss} from
'./compute_weighted_loss';\n\n/**\n * Computes the log loss between two tensors.\n *\n * @param labels The
ground truth output tensor, same dimensions as\n *   'predictions'.\n * @param predictions The predicted outputs.\n
* @param weights Tensor whose rank is either 0, or the same rank as\n *   `labels`, and must be broadcastable to
`labels` (i.e., all dimensions\n *   must be either `1`, or the same as the corresponding `losses`\n *   dimension).\n *

@param epsilon A small increment to avoid taking log of zero\n * @param reduction Type of reduction to apply to loss. Should be of type\n * `Reduction`\n *\n * @doc {heading: 'Training', subheading: 'Losses', namespace: 'losses'}\n */\nfunction logLoss_<T extends Tensor, O extends Tensor>(\n labels: T|TensorLike, predictions: T|TensorLike,\n weights?: Tensor|TensorLike, epsilon = 1e-7,\n reduction = Reduction.SUM_BY_NONZERO_WEIGHTS): O {\n const $labels = convertToTensor(labels, 'labels', 'logLoss');\n const $predictions = convertToTensor(predictions, 'predictions', 'logLoss');\n let $weights: Tensor = null;\n if (weights != null) {\n $weights = convertToTensor(weights, 'weights', 'logLoss');\n }\n assertShapesMatch($labels.shape, $predictions.shape, 'Error in logLoss: ');\n\n const one = scalar(1);\n const epsilonScalar = scalar(epsilon);\n\n const l1 = neg(mul($labels, log(add($predictions, epsilonScalar))));\n const l2 =\n mul(sub(one, $labels), log(add(sub(one, $predictions), epsilonScalar)));\n const losses = sub(l1, l2);\n return computeWeightedLoss(losses,
$weights, reduction);\n}\nexport const logLoss = op({logLoss_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {Tensor} from '../../tensor';\nimport {convertToTensor} from '../../tensor_util_env';\nimport {TensorLike} from '../../types';\nimport {assertShapesMatch} from '../../util';\nimport {Reduction} from '../loss_ops_utils';\nimport {op} from '../operation';\nimport {squaredDifference} from '../squared_difference';\n\nimport {computeWeightedLoss} from './compute_weighted_loss';\n\n/**\n * Computes the mean squared error between two tensors.\n *\n * @param labels The ground truth output tensor, same dimensions as\n * 'predictions'.\n * @param predictions The predicted outputs.\n * @param weights Tensor whose rank is either 0, or the same rank as\n * `labels`, and must be broadcastable to `labels` (i.e., all dimensions\n * must be either `1`, or the same as the corresponding `losses`\n * dimension).\n * @param reduction Type of reduction to apply to loss. Should be of type\n * `Reduction`\n *\n * @doc {heading: 'Training', subheading: 'Losses', namespace: 'losses'}\n */\nfunction meanSquaredError_<T extends Tensor, O extends Tensor>(\n labels: T|TensorLike, predictions: T|TensorLike,\n weights?: Tensor|TensorLike,\n reduction = Reduction.SUM_BY_NONZERO_WEIGHTS): O
{\n const $labels = convertToTensor(labels, 'labels', 'meanSquaredError');\n const $predictions =\n convertToTensor(predictions, 'predictions', 'meanSquaredError');\n let $weights: Tensor = null;\n if (weights != null) {\n $weights = convertToTensor(weights, 'weights', 'meanSquaredError');\n }\n assertShapesMatch(\n $labels.shape, $predictions.shape, 'Error in meanSquaredError: ');\n\n const losses = squaredDifference($labels, $predictions);\n return computeWeightedLoss(losses, $weights, reduction);\n}\nexport const meanSquaredError = op({meanSquaredError_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License
is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {Tensor} from '../../tensor';\nimport {convertToTensor} from '../../tensor_util_env';\nimport {TensorLike} from '../../types';\nimport {assertShapesMatch} from '../../util';\nimport {abs} from '../abs';\nimport {add} from '../add';\nimport {exp} from '../exp';\nimport {log1p} from '../log1p';\nimport {Reduction} from

'../loss_ops_utils';\nimport {mul} from '../mul';\nimport {neg} from '../neg';\nimport {op} from '../operation';\nimport {relu} from '../relu';\nimport {scalar} from '../scalar';\nimport {sub} from '../sub';\n\nimport {computeWeightedLoss} from './compute_weighted_loss';\n\nfunction sigmoidCrossEntropyWithLogits_<T extends Tensor, O extends Tensor>(\n labels: T|TensorLike, logits: T|TensorLike): O {\n const $labels =\n convertToTensor(labels, 'labels', 'sigmoidCrossEntropyWithLogits');\n const $logits =\n convertToTensor(logits, 'logits', 'sigmoidCrossEntropyWithLogits');\n assertShapesMatch(\n $labels.shape, $logits.shape, 'Error in sigmoidCrossEntropyWithLogits: ');\n\n /**\n * Implementation Details:\n *\n * For brevity, let `x = logits`, `z = labels`. The logistic loss is\n * z * -log(sigmoid(x)) + (1 - z) * -log(1 - sigmoid(x))\n * = z * -log(1 / (1 + exp(-x))) + (1 - z) * -log(exp(-x) / (1 + exp(-x)))\n * = z * log(1 + exp(-x)) + (1 - z) * (-log(exp(-x)) + log(1 + exp(-x)))\n * = z * log(1 + exp(-x)) + (1 - z) * (x + log(1 + exp(-x))\n * = (1 - z) * x + log(1 + exp(-x))\n * = x - x * z + log(1 + exp(-x))\n *\n * For x < 0, to avoid overflow in exp(-x), we reformulate the above\n * x - x * z + log(1 + exp(-x))\n * = log(exp(x)) - x * z + log(1 + exp(-x))\n *
= - x * z + log(1 + exp(x))\n *\n * Hence, to ensure stability and avoid overflow, the implementation uses\n * this equivalent formulation:\n * max(x, 0) - x * z + log(1 + exp(-abs(x)))\n */\n const maxOutput = relu($logits);\n const outputXTarget = mul($logits, $labels);\n const sigmoidOutput = log1p(exp(neg(abs($logits))));\n\n return add(sub(maxOutput, outputXTarget), sigmoidOutput);\n}\n\n/**\n * Computes the sigmoid cross entropy loss between two tensors.\n *\n * If labelSmoothing is nonzero, smooth the labels towards 1/2:\n *\n * newMulticlassLabels = multiclassLabels * (1 - labelSmoothing)\n * + 0.5 * labelSmoothing\n *\n * @param multiClassLabels The ground truth output tensor of shape\n * [batch_size, num_classes], same dimensions as 'predictions'.\n * @param logits The predicted outputs.\n * @param weights Tensor whose rank is either 0, or the same rank as\n * `labels`, and must be broadcastable to `labels` (i.e., all dimensions\n
* must be either `1`, or the same as the corresponding `losses`\n * dimension).\n * @param labelSmoothing If greater than 0, then smooth the labels.\n * @param reduction Type of reduction to apply to loss. Should be of type\n * `Reduction`\n *\n * @doc { heading: 'Training', subheading: 'Losses', namespace: 'losses' }\n */\nfunction sigmoidCrossEntropy_<T extends Tensor, O extends Tensor>(\n multiClassLabels: T|TensorLike, logits: T|TensorLike,\n weights?: Tensor|TensorLike, labelSmoothing = 0,\n reduction = Reduction.SUM_BY_NONZERO_WEIGHTS): O {\n let $multiClassLabels = convertToTensor(\n multiClassLabels, 'multiClassLabels', 'sigmoidCrossEntropy');\n const $logits = convertToTensor(logits, 'logits', 'sigmoidCrossEntropy');\n let $weights: Tensor = null;\n if (weights != null) {\n $weights = convertToTensor(weights, 'weights', 'sigmoidCrossEntropy');\n }\n assertShapesMatch(\n $multiClassLabels.shape, $logits.shape, 'Error in sigmoidCrossEntropy: ');\n\n if (labelSmoothing > 0) {\n const labelSmoothingScalar = scalar(labelSmoothing);\n const one = scalar(1);\n const half = scalar(0.5);\n\n $multiClassLabels =\n add(mul($multiClassLabels, sub(one, labelSmoothingScalar)),\n mul(half, labelSmoothingScalar));\n }\n const losses = sigmoidCrossEntropyWithLogits_($multiClassLabels, $logits);\n\n return computeWeightedLoss(losses, $weights, reduction);\n}\n\nexport const sigmoidCrossEntropy = op({sigmoidCrossEntropy_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS
OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n */\nimport {customGrad} from '../../gradients';\nimport {Tensor} from '../../tensor';\nimport {GradSaveFunc} from '../../tensor_types';\nimport {convertToTensor} from '../../tensor_util_env';\nimport {TensorLike} from

'../../types';\nimport {assertShapesMatch} from '../../util';\nimport {add} from '../add';\nimport {expandShapeToKeepDim} from '../axis_util';\nimport {cast} from '../cast';\nimport {div} from '../div';\nimport {exp} from '../exp';\nimport {logSumExp} from '../log_sum_exp';\nimport {Reduction} from '../loss_ops_utils';\nimport {mul} from '../mul';\nimport {neg} from '../neg';\nimport {op} from '../operation';\nimport {reshape} from '../reshape';\nimport {scalar} from '../scalar';\nimport {sub} from '../sub';\nimport {sum} from '../sum';\n\nimport {computeWeightedLoss} from './compute_weighted_loss';\n\n/**\n * Computes softmax cross entropy between logits and labels.\n *\n * Measures the probability error in discrete classification tasks in which\n * the classes are mutually exclusive (each entry is in exactly one class).\n * For example, each CIFAR-10 image is labeled with one and only one label: an\n * image can be a dog or a truck, but not both.\n *\n * `NOTE`: While the classes are mutually exclusive, their probabilities need\n * not be. All that is required is that each row of labels is a valid\n * probability distribution. If they are not, the computation of the gradient\n * will be incorrect.\n *\n * `WARNING`: This op expects unscaled logits, since it performs a softmax on\n * logits internally for efficiency. Do not call this op with the output of\n * softmax, as it will produce incorrect results.\n *\n * logits and labels must have the same shape, e.g. [batch_size, num_classes]\n * and the same dtype.\n * @param labels The labels array.\n * @param logits The logits array.\n * @param dim The dimension softmax would be performed on. Defaults to `-1`\n *   which indicates the last dimension.\n */\nfunction softmaxCrossEntropyWithLogits_<T extends Tensor, O extends Tensor>(\n   labels: T, logits: T, dim = -1): O {\n if (dim === -1) {\n   dim = logits.rank - 1;\n }\n\n if (dim !== logits.rank - 1) {\n   throw Error(\n   `Softmax cross entropy along a non-last dimension is not yet ` +\n   `supported. Labels / logits was rank ${logits.rank} ` +\n   `and dim was ${dim}`);\n }\n // Use a custom gradient for numerical stability.\n const customOp =\n   customGrad((labels: Tensor, logits: Tensor, save: GradSaveFunc) => {\n   // Reference:\n   //   1. http://cs231n.github.io/linear-classify/#softmax\n   //   2. https://blog.feedly.com/tricks-of-the-trade-logsumexp/\n   const keepDims = true;\n   const lse = logSumExp(logits, [dim], keepDims);\n   const logResult = sub(cast(logits, 'float32'), lse);\n   save([labels, logResult]);\n\n   const costVector = neg(mul(logResult, labels));\n   const value: O = sum(costVector, [dim]);\n\n   const gradFunc = (dy: O, saved: Tensor[]) => {\n   const [labels, logResult] = saved;\n   const dyShape = expandShapeToKeepDim(dy.shape, [dim]);\n   return [\n   mul(reshape(dy, dyShape),\n   sub(cast(labels, 'float32'), exp(logResult))),\n   mul(reshape(dy, dyShape),\n   sub(exp(logResult), cast(labels, 'float32'))),\n   ];\n   };\n   return {value, gradFunc};\n   });\n\n return customOp(labels, logits);\n}\n\n/**\n * Computes the softmax cross entropy loss between two tensors.\n *\n * If labelSmoothing is nonzero, smooth the labels towards 1/2:\n *\n *   newOnehotLabels = onehotLabels * (1 - labelSmoothing)\n *   + labelSmoothing / numClasses\n *\n * @param onehotLabels One hot encoded labels\n *   [batch_size, num_classes], same dimensions as 'predictions'.\n * @param logits The predicted outputs.\n * @param weights Tensor whose rank is either 0, or 1, and must be\n *   broadcastable to `loss` of shape [batch_size]\n * @param labelSmoothing If greater than 0, then smooth the labels.\n * @param reduction Type of reduction to apply to loss. Should be of type\n *   `Reduction`\n *\n * @doc { heading: 'Training', subheading: 'Losses', namespace: 'losses' }\n */\nfunction softmaxCrossEntropy_<T extends Tensor, O extends Tensor>(\n   onehotLabels: T|TensorLike, logits: T|TensorLike,\n   weights?: Tensor|TensorLike, labelSmoothing = 0,\n   reduction = Reduction.SUM_BY_NONZERO_WEIGHTS): O {\n let $onehotLabels =\n   convertToTensor(onehotLabels, 'onehotLabels', 'softmaxCrossEntropy');\n const $logits = convertToTensor(logits, 'logits', 'softmaxCrossEntropy');\n let $weights: Tensor = null;\n\n if (weights != null) {\n $weights = convertToTensor(weights,\n   'weights', 'softmaxCrossEntropy');\n }\n\n assertShapesMatch(\n $onehotLabels.shape, $logits.shape, 'Error in softmaxCrossEntropy: ');\n\n if (labelSmoothing > 0) {\n   const labelSmoothingScalar = scalar(labelSmoothing);\n   const one = scalar(1);\n   const numClasses = scalar($onehotLabels.shape[1]);\n\n $onehotLabels =\n   add(mul($onehotLabels, sub(one, labelSmoothingScalar)),\n   div(labelSmoothingScalar, numClasses));\n }\n\n const losses = softmaxCrossEntropyWithLogits_($onehotLabels, $logits);\n\n return

computeWeightedLoss(losses, $weights, reduction);\n}\n\nexport const softmaxCrossEntropy = op({softmaxCrossEntropy_});\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless
 required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\n// Modularized ops.\nexport {abs} from './abs';\nexport {acos} from './acos';\nexport {acosh} from './acosh';\nexport {add} from './add';\nexport {addN} from './add_n';\nexport {all} from './all';\nexport {any} from './any';\nexport {argMax} from './arg_max';\nexport {argMin} from './arg_min';\nexport {asin} from './asin';\nexport {asinh} from './asinh';\nexport {atan} from './atan';\nexport {atan2} from './atan2';\nexport {atanh} from './atanh';\nexport {avgPool} from './avg_pool';\nexport {avgPool3d} from './avg_pool_3d';\nexport {basicLSTMCell} from './basic_lstm_cell';\nexport {batchToSpaceND}
 from './batch_to_space_nd';\nexport {batchNorm} from './batchnorm';\nexport {batchNorm2d} from './batchnorm2d';\nexport {batchNorm3d} from './batchnorm3d';\nexport {batchNorm4d} from './batchnorm4d';\nexport {bincount} from './bincount';\nexport {broadcastTo} from './broadcast_to';\nexport {buffer} from './buffer';\nexport {cast} from './cast';\nexport {ceil} from './ceil';\nexport {clipByValue} from './clip_by_value';\nexport {clone} from './clone';\nexport {complex} from './complex';\nexport {concat} from './concat';\nexport {concat1d} from './concat_1d';\nexport {concat2d} from './concat_2d';\nexport {concat3d} from './concat_3d';\nexport {concat4d} from './concat_4d';\nexport {conv1d} from './conv1d';\nexport {conv2d} from './conv2d';\nexport {conv2dTranspose} from './conv2d_transpose';\nexport {conv3d} from './conv3d';\nexport {conv3dTranspose} from './conv3d_transpose';\nexport {cos} from './cos';\nexport {cosh} from './cosh';\nexport {cumsum} from './cumsum';\nexport
 {denseBincount} from './dense_bincount';\nexport {depthToSpace} from './depth_to_space';\nexport {depthwiseConv2d} from './depthwise_conv2d';\nexport {diag} from './diag';\nexport {dilation2d} from './dilation2d';\nexport {div} from './div';\nexport {divNoNan} from './div_no_nan';\nexport {dot} from './dot';\nexport {elu} from './elu';\nexport {equal} from './equal';\nexport {erf} from './erf';\nexport {exp} from './exp';\nexport {expandDims} from './expand_dims';\nexport {expm1} from './expm1';\nexport {eye} from './eye';\nexport {fill} from './fill';\nexport {floor} from './floor';\nexport {floorDiv} from './floorDiv';\nexport {gather} from './gather';\nexport {greater} from './greater';\nexport {greaterEqual} from './greater_equal';\nexport {imag} from './imag';\nexport {isFinite} from './is_finite';\nexport {isInf} from './is_inf';\nexport {isNaN} from './is_nan';\nexport {leakyRelu} from './leaky_relu';\nexport {less} from './less';\nexport {lessEqual} from './less_equal';\nexport
 {linspace} from './linspace';\nexport {localResponseNormalization} from './local_response_normalization';\nexport {log} from './log';\nexport {log1p} from './log1p';\nexport {logSigmoid} from './log_sigmoid';\nexport {logSoftmax} from './log_softmax';\nexport {logSumExp} from './log_sum_exp';\nexport {logicalAnd} from './logical_and';\nexport {logicalNot} from './logical_not';\nexport {logicalOr} from './logical_or';\nexport {logicalXor} from './logical_xor';\nexport {matMul} from './mat_mul';\nexport {max} from './max';\nexport {maxPool} from './max_pool';\nexport {maxPool3d} from './max_pool_3d';\nexport {maxPoolWithArgmax} from './max_pool_with_argmax';\nexport {maximum} from './maximum';\nexport {mean} from './mean';\nexport {min} from './min';\nexport {minimum} from './minimum';\nexport {mirrorPad} from './mirror_pad';\nexport {mod} from './mod';\nexport {moments} from './moments';\nexport {mul} from './mul';\nexport {LSTMCellFunc, multiRNNCell} from './multi_rnn_cell';\nexport
 {multinomial} from './multinomial';\nexport {neg} from './neg';\nexport {notEqual} from './not_equal';\nexport {oneHot} from './one_hot';\nexport {ones} from './ones';\nexport {onesLike} from './ones_like';\nexport {outerProduct} from './outer_product';\nexport {pad} from './pad';\nexport {pad1d} from './pad1d';\nexport {pad2d}

from './pad2d';\nexport {pad3d} from './pad3d';\nexport {pad4d} from './pad4d';\nexport {pool} from './pool';\nexport {pow} from './pow';\nexport {prelu} from './prelu';\nexport {print} from './print';\nexport {prod} from './prod';\nexport {rand} from './rand';\nexport {randomGamma} from './random_gamma';\nexport {randomNormal} from './random_normal';\nexport {randomUniform} from './random_uniform';\nexport {range} from './range';\nexport {real} from './real';\nexport {reciprocal} from './reciprocal';\nexport {relu} from './relu';\nexport {relu6} from './relu6';\nexport {reshape} from './reshape';\nexport {reverse} from './reverse';\nexport {reverse1d} from './reverse_1d';\nexport
{reverse2d} from './reverse_2d';\nexport {reverse3d} from './reverse_3d';\nexport {reverse4d} from './reverse_4d';\nexport {round} from './round';\nexport {rsqrt} from './rsqrt';\nexport {scalar} from './scalar';\nexport {selu} from './selu';\nexport {separableConv2d} from './separable_conv2d';\nexport {setdiff1dAsync} from './setdiff1d_async';\nexport {sigmoid} from './sigmoid';\nexport {sign} from './sign';\nexport {sin} from './sin';\nexport {sinh} from './sinh';\nexport {slice} from './slice';\nexport {slice1d} from './slice1d';\nexport {slice2d} from './slice2d';\nexport {slice3d} from './slice3d';\nexport {slice4d} from './slice4d';\nexport {softmax} from './softmax';\nexport {softplus} from './softplus';\nexport {spaceToBatchND} from './space_to_batch_nd';\nexport {fft} from './spectral/fft';\nexport {ifft} from './spectral/ifft';\nexport {irfft} from './spectral/irfft';\nexport {rfft} from './spectral/rfft';\nexport {split} from './split';\nexport {sqrt} from
'./sqrt';\nexport {square} from './square';\nexport {squaredDifference} from './squared_difference';\nexport {squeeze} from './squeeze';\nexport {stack} from './stack';\nexport {step} from './step';\nexport {stridedSlice} from './strided_slice';\nexport {sub} from './sub';\nexport {sum} from './sum';\nexport {tan} from './tan';\nexport {tanh} from './tanh';\nexport {tensor} from './tensor';\nexport {tensor1d} from './tensor1d';\nexport {tensor2d} from './tensor2d';\nexport {tensor3d} from './tensor3d';\nexport {tensor4d} from './tensor4d';\nexport {tensor5d} from './tensor5d';\nexport {tensor6d} from './tensor6d';\nexport {tile} from './tile';\nexport {topk} from './topk';\nexport {truncatedNormal} from './truncated_normal';\nexport {unique} from './unique';\nexport {unsortedSegmentSum} from './unsorted_segment_sum';\nexport {unstack} from './unstack';\nexport {variable} from './variable';\nexport {where} from './where';\nexport {whereAsync} from './where_async';\nexport {zeros} from
'./zeros';\nexport {zerosLike} from './zeros_like';\n\nexport * from './boolean_mask';\nexport * from './transpose';\nexport * from './norm';\nexport * from './moving_average';\nexport * from './scatter_nd';\nexport * from './sparse_to_dense';\nexport * from './gather_nd';\nexport * from './dropout';\nexport * from './signal_ops_util';\nexport * from './in_top_k';\n\nexport {op, OP_SCOPE_SUFFIX} from './operation';\n\nimport {rfft} from './spectral/rfft';\nimport {fft} from './spectral/fft';\nimport {ifft} from './spectral/ifft';\nimport {irfft} from './spectral/irfft';\nconst spectral = {\n fft,\n ifft,\n rfft,\n irfft\n};\n\nimport * as fused from './fused_ops';\n\nimport {hammingWindow} from './signal/hamming_window';\nimport {hannWindow} from
'./signal/hann_window';\nimport {frame} from './signal/frame';\nimport {stft} from './signal/stft';\nconst signal = {\n hammingWindow,\n hannWindow,\n frame,\n stft,\n};\n\n// Image Ops namespace\nimport {cropAndResize} from './image/crop_and_resize';\nimport
{flipLeftRight} from './image/flip_left_right';\nimport {rotateWithOffset} from
'./image/rotate_with_offset';\nimport {nonMaxSuppression} from './image/non_max_suppression';\nimport {nonMaxSuppressionAsync} from './image/non_max_suppression_async';\nimport {nonMaxSuppressionWithScore} from './image/non_max_suppression_with_score';\nimport {nonMaxSuppressionWithScoreAsync} from './image/non_max_suppression_with_score_async';\nimport {nonMaxSuppressionPadded} from './image/non_max_suppression_padded';\nimport {nonMaxSuppressionPaddedAsync} from './image/non_max_suppression_padded_async';\nimport {resizeBilinear} from './image/resize_bilinear';\nimport {resizeNearestNeighbor} from './image/resize_nearest_neighbor';\nconst image = {\n flipLeftRight,\n resizeNearestNeighbor,\n resizeBilinear,\n rotateWithOffset,\n cropAndResize,\n nonMaxSuppression,\n nonMaxSuppressionAsync,\n nonMaxSuppressionWithScore,\n nonMaxSuppressionWithScoreAsync,\n nonMaxSuppressionPadded,\n
nonMaxSuppressionPaddedAsync\n};\n\n// linalg namespace\nimport {bandPart} from
'./linalg/band_part';\nimport {gramSchmidt} from './linalg/gram_schmidt';\nimport {qr} from './linalg/qr';\nconst

linalg = {\n bandPart,\n gramSchmidt,\n qr\n};\n\n// losses namespace;\nimport {absoluteDifference} from './losses/absolute_difference';\nimport {computeWeightedLoss} from './losses/compute_weighted_loss';\nimport {cosineDistance} from './losses/cosine_distance';\nimport {hingeLoss} from './losses/hinge_loss';\nimport {huberLoss} from './losses/huber_loss';\nimport {logLoss} from './losses/log_loss';\nimport {meanSquaredError} from './losses/mean_squared_error';\nimport {sigmoidCrossEntropy} from './losses/sigmoid_cross_entropy';\nimport {softmaxCrossEntropy} from './losses/softmax_cross_entropy';\nconst losses = {\n absoluteDifference,\n computeWeightedLoss,\n cosineDistance,\n hingeLoss,\n huberLoss,\n logLoss,\n meanSquaredError,\n sigmoidCrossEntropy,\n softmaxCrossEntropy\n};\n\n//
 Second level exports.\nexport {image, linalg, losses, spectral, fused, signal};\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {dispose} from '../globals';\nimport {variableGrads} from '../gradients';\nimport {scalar} from '../ops/ops';\nimport {Serializable} from '../serialization';\nimport
 {Scalar, Variable} from '../tensor';\nimport {NamedTensor, NamedTensorMap} from '../tensor_types';\n\n/**\n * A variable that belongs to an optimizer.\n *\n * The `originalName` field is required for keeping track of the canonical\n * name of the variable, which is usually the name of the model weight that\n * the variable is related to plus a suffix, e.g., 'dense1/kernel/momentum'.\n * The name of the `Variable` object itself cannot be used directly due to\n * possible deduplication: Every `Variable` must have a unique name but more\n * than one optimizer objects of the same type may be created for the same model\n * or the same `Variable`.\n */\nexport interface OptimizerVariable {\n originalName: string;\n variable: Variable;\n}\n\n/** @doc {heading: 'Training', subheading: 'Classes', namespace: 'train'} */\nexport abstract class Optimizer extends Serializable {\n protected iterations_: number;\n\n /**\n   * Executes `f()` and minimizes the scalar output of `f()` by computing\n   * gradients of y with respect to the list of trainable variables provided by\n   * `varList`. If no list is provided, it defaults to all trainable variables.\n   *\n   * @param f The function to execute and whose output to minimize.\n   * @param returnCost Whether to return the scalar cost value produced by\n   * executing `f()`.\n   * @param varList An optional list of variables to update. If specified, only\n   * the trainable variables in varList will be updated by minimize. Defaults to\n   * all trainable variables.\n   *\n   * @doc {heading: 'Training', subheading: 'Optimizers'}\n   */\n minimize(f: () => Scalar, returnCost = false, varList?: Variable[]): Scalar\n |null {\n   const {value, grads} = this.computeGradients(f, varList);\n\n   if (varList != null) {\n   const gradArray: NamedTensor[] =\n varList.map(v => ({name: v.name, tensor: grads[v.name]}));\n   this.applyGradients(gradArray);\n   } else {\n this.applyGradients(grads);\n   }\n\n
  // Dispose gradients.\n   dispose(grads);\n\n   if (returnCost) {\n   return value;\n   } else {\n value.dispose();\n   return null;\n   }\n }\n\n /**\n   * The number of iterations that this optimizer instance has been invoked for.\n   */\n get iterations(): number {\n   if (this.iterations_ == null) {\n   this.iterations_ = 0;\n   }\n   return this.iterations_;\n }\n\n protected incrementIterations() {\n   this.iterations_ = this.iterations + 1;\n }\n\n /**\n   * Executes f() and computes the gradient of the scalar output of f() with\n   * respect to the list of trainable variables provided by `varList`. If no\n   * list is provided, it defaults to all trainable variables.\n   *\n   * @param f The function to execute and whose output to use for computing\n   * gradients with respect to variables.\n   * @param varList An optional list of variables to compute gradients with\n   * respect to. If specified, only the trainable variables in varList will have\n
  * gradients computed with respect to. Defaults to all trainable variables.\n   *\n   * @doc {heading: 'Training', subheading: 'Optimizers'}\n   */\n computeGradients(f: () => Scalar, varList?: Variable[]):\n   {value: Scalar, grads: NamedTensorMap} {\n   return variableGrads(f, varList);\n }\n\n /**\n   * Updates variables by using the

computed gradients.\n *\n * @param variableGradients A mapping of variable name to its gradient value.\n *\n * @doc {heading: 'Training', subheading: 'Optimizers'}\n */\n abstract applyGradients(variableGradients: NamedTensorMap|\n NamedTensor[]): void;\n\n /**\n * Dispose the variables (if any) owned by this optimizer instance.\n */\n dispose(): void {\n if (this.iterations_ != null) {\n dispose(this.iterations_);\n }\n }\n\n async saveIterations(): Promise<NamedTensor> {\n if (this.iterations_ == null) {\n this.iterations_ = 0;\n }\n return {\n name: 'iter', // Named for
 Python compatibility.\n // TODO(cais): Use 'int64' type when available.\n tensor: scalar(this.iterations_, 'int32')\n };\n }\n\n async getWeights(): Promise<NamedTensor[]> {\n throw new Error('getWeights() is not implemented for this optimizer yet.');\n }\n\n async setWeights(weightValues: NamedTensor[]): Promise<void> {\n throw new Error(\n `setWeights() is not implemented for this optimizer class ` +\n `${this.getClassName()}`);\n }\n\n /**\n * Extract the first element of the weight values and set it\n * as the iterations counter variable of this instance of optimizer.\n *\n * @param weightValues\n * @returns Weight values with the first element consumed and excluded.\n */\n protected async extractIterations(weightValues: NamedTensor[]):\n Promise<NamedTensor[]> {\n this.iterations_ = (await weightValues[0].tensor.data())[0];\n return weightValues.slice(1);\n }\n}\n\nObject.defineProperty(Optimizer, Symbol.hasInstance,
 {\n value: (instance: Optimizer) => {\n return instance.minimize != null && instance.computeGradients != null &&\n instance.applyGradients != null;\n }\n});\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
 ==\n
 */\n\nimport {ENGINE} from '../engine';\nimport {dispose, tidy} from '../globals';\nimport {add} from '../ops/add';\nimport
 {div} from '../ops/div';\nimport {mul} from '../ops/mul';\nimport {sqrt} from '../ops/ops';\nimport {square} from '../ops/square';\nimport {zerosLike} from '../ops/zeros_like';\nimport {ConfigDict, registerClass, Serializable, SerializableConstructor} from '../serialization';\nimport {NamedTensor, NamedVariableMap} from '../tensor_types';\n\nimport {Optimizer, OptimizerVariable} from './optimizer';\n\n/** @doclink Optimizer */\nexport class AdadeltaOptimizer extends Optimizer {\n /** @nocollapse */\n static className = 'Adadelta'; // Name matters for Python compatibility.\n private accumulatedGrads: OptimizerVariable[] = [];\n private accumulatedUpdates: OptimizerVariable[] = [];\n\n constructor(\n protected learningRate: number, protected rho: number,\n protected epsilon: number = null) {\n super();\n\n if (epsilon == null) {\n this.epsilon = ENGINE.backend.epsilon();\n }\n }\n\n applyGradients(variableGradients: NamedVariableMap|NamedTensor[])
 {\n const variableNames = Array.isArray(variableGradients) ?\n variableGradients.map(item => item.name) :\n Object.keys(variableGradients);\n\n variableNames.forEach((name, i) => {\n const value = ENGINE.registeredVariables[name];\n const trainable = false;\n if (this.accumulatedGrads[i] == null) {\n this.accumulatedGrads[i] = {\n originalName: `${name}/accum_grad`,\n variable: tidy(() => zerosLike(value).variable(trainable))\n };\n }\n if (this.accumulatedUpdates[i] == null) {\n this.accumulatedUpdates[i] = {\n originalName: `${name}/accum_var`,\n variable: tidy(() => zerosLike(value).variable(trainable))\n };\n }\n\n const gradient = Array.isArray(variableGradients) ?\n variableGradients[i].tensor :\n variableGradients[name];\n if (gradient == null) {\n return;\n }\n\n const accumulatedGrad = this.accumulatedGrads[i].variable;\n
  const accumulatedUpdate = this.accumulatedUpdates[i].variable;\n\n tidy(() => {\n const newAccumulatedGrad =\n add(mul(accumulatedGrad, this.rho),\n mul(square(gradient), 1 - this.rho));\n\n const updates =\n mul(div(sqrt(add(accumulatedUpdate, this.epsilon)),\n sqrt(add(accumulatedGrad, this.epsilon))),\n gradient);\n\n const newAccumulatedUpdate =\n

add(mul(accumulatedUpdate, this.rho),\n mul(square(updates), 1 - this.rho));\n\n accumulatedGrad.assign(newAccumulatedGrad);\n accumulatedUpdate.assign(newAccumulatedUpdate);\n\n const newValue = add(mul(updates, -this.learningRate), value);\n value.assign(newValue);\n });\n });\n this.incrementIterations();\n }\n\n dispose(): void {\n if (this.accumulatedUpdates != null) {\n dispose(this.accumulatedGrads.map(v => v.variable));\n dispose(this.accumulatedUpdates.map(v => v.variable));\n }\n }\n\n async getWeights(): Promise<NamedTensor[]> {\n // Order matters for Python compatibility.\n const variables: OptimizerVariable[] =\n [...this.accumulatedGrads, ...this.accumulatedUpdates];\n return [await this.saveIterations()].concat(\n variables.map(v => ({name: v.originalName, tensor: v.variable})));\n }\n\n async setWeights(weightValues: NamedTensor[]): Promise<void> {\n weightValues = await this.extractIterations(weightValues);\n const variableCount = weightValues.length / 2;\n const trainable = false;\n this.accumulatedGrads =\n weightValues.slice(0, variableCount).map(v => ({\n originalName: v.name,\n variable: v.tensor.variable(\n trainable)\n }));\n this.accumulatedUpdates =\n weightValues.slice(variableCount, variableCount * 2)\n .map(v => ({\n originalName: v.name,\n variable: v.tensor.variable(trainable)\n }));\n }\n\n getConfig(): ConfigDict {\n return {\n 'learningRate': this.learningRate,\n 'rho': this.rho,\n 'epsilon': this.epsilon\n };\n }\n\n /** @nocollapse */\n static fromConfig<T extends Serializable>(\n cls: SerializableConstructor<T>, config: ConfigDict): T {\n return new cls(config['learningRate'], config['rho'], config['epsilon']);\n }\n}\nregisterClass(AdadeltaOptimizer);\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n*/\n\nimport {ENGINE} from '../engine';\nimport {dispose, tidy} from '../globals';\nimport {add} from '../ops/add';\nimport {div} from '../ops/div';\nimport {fill} from '../ops/fill';\nimport {mul} from '../ops/mul';\nimport {sqrt} from '../ops/sqrt';\nimport {square} from '../ops/square';\nimport {ConfigDict, registerClass, Serializable, SerializableConstructor} from '../serialization';\nimport {NamedTensor, NamedVariableMap} from '../tensor_types';\n\nimport {Optimizer, OptimizerVariable} from './optimizer';\n\n/** @doclink Optimizer */\nexport class AdagradOptimizer extends Optimizer {\n /** @nocollapse */\n static className = 'Adagrad';\n // Note: Name matters for Python compatibility.\n\n private accumulatedGrads: OptimizerVariable[] = [];\n\n constructor(\n protected learningRate: number, private initialAccumulatorValue = 0.1) {\n super();\n }\n\n applyGradients(variableGradients: NamedVariableMap|NamedTensor[]) {\n const variableNames = Array.isArray(variableGradients) ?\n variableGradients.map(item => item.name) :\n Object.keys(variableGradients);\n\n variableNames.forEach((name, i) => {\n const value = ENGINE.registeredVariables[name];\n if (this.accumulatedGrads[i] == null) {\n const trainable = false;\n this.accumulatedGrads[i] = {\n originalName: `${name}/accumulator`,\n variable: tidy(\n () => fill(value.shape, this.initialAccumulatorValue)\n .variable(trainable))\n };\n }\n\n const gradient = Array.isArray(variableGradients) ?\n variableGradients[i].tensor :\n variableGradients[name];\n\n if (gradient == null) {\n return;\n }\n\n const accumulatedGrad = this.accumulatedGrads[i].variable;\n\n tidy(() => {\n const newAccumulatedGrad = add(accumulatedGrad, square(gradient));\n accumulatedGrad.assign(newAccumulatedGrad);\n\n const newValue = add(\n mul(div(gradient,\n sqrt(add(newAccumulatedGrad, ENGINE.backend.epsilon()))),\n -this.learningRate),\n value);\n value.assign(newValue);\n });\n });\n this.incrementIterations();\n

```
}\n\n  dispose(): void {\n    if (this.accumulatedGrads != null) {\n      dispose(this.accumulatedGrads.map(v =>
v.variable));\n    }\n  }\n\n  async getWeights(): Promise<NamedTensor[]> {\n    // Order matters for Python
compatibility.\n    return [await this.saveIterations()].concat(this.accumulatedGrads.map(\n        v => ({name:
v.originalName, tensor: v.variable})));\n  }\n\n  async setWeights(weightValues:
 NamedTensor[]): Promise<void> {\n    weightValues = await this.extractIterations(weightValues);\n    const
trainable = false;\n    this.accumulatedGrads = weightValues.map(\n        v => ({originalName: v.name, variable:
v.tensor.variable(trainable)}));\n  }\n\n  getConfig(): ConfigDict {\n    return {\n      'learningRate':
this.learningRate,\n      'initialAccumulatorValue': this.initialAccumulatorValue,\n    };\n  }\n\n  /** @nocollapse
*/\n  static fromConfig<T extends Serializable>(\n      cls: SerializableConstructor<T>, config: ConfigDict): T {\n
return new cls(config['learningRate'], config['initialAccumulatorValue']);\n
}\n}\nregisterClass(AdagradOptimizer);\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights
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except in compliance with the License.\n * You may obtain a copy of the License at\n *\n *
http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless
 required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an
\"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n
* See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========================================================================\n
*/\n\nimport {ENGINE} from '../engine';\nimport {dispose, tidy} from '../globals';\nimport {add} from
'../ops/add';\nimport {div} from '../ops/div';\nimport {mul} from '../ops/mul';\nimport {pow} from
'../ops/pow';\nimport {scalar} from '../ops/scalar';\nimport {sqrt} from '../ops/sqrt';\nimport {square} from
'../ops/square';\nimport {sub} from '../ops/sub';\nimport {zerosLike} from '../ops/zeros_like';\nimport {ConfigDict,
registerClass, Serializable, SerializableConstructor} from '../serialization';\nimport {Variable} from
'../tensor';\nimport {NamedTensor, NamedVariableMap} from '../tensor_types';\n\nimport
 {Optimizer, OptimizerVariable} from './optimizer';\n\nexport class AdamOptimizer extends Optimizer {\n  /**
@nocollapse */\n  static className = 'Adam';  // Note: Name matters for Python compatibility.\n  private accBeta1:
Variable;\n  private accBeta2: Variable;\n\n  private accumulatedFirstMoment: OptimizerVariable[] = [];\n  private
accumulatedSecondMoment: OptimizerVariable[] = [];\n\n  constructor(\n      protected learningRate: number,
protected beta1: number,\n      protected beta2: number, protected epsilon: number = null) {\n    super();\n    tidy(()
=> {\n      // accB* will be updated by batch.\n      this.accBeta1 = scalar(beta1).variable();\n      this.accBeta2 =
scalar(beta2).variable();\n    });\n\n    if (epsilon == null) {\n      this.epsilon = ENGINE.backend.epsilon();\n    }\n
}\n\n  applyGradients(variableGradients: NamedVariableMap|NamedTensor[]) {\n    const varNames =
Array.isArray(variableGradients) ?\n        variableGradients.map(v => v.name)
 :\n        Object.keys(variableGradients);\n    tidy(() => {\n      const oneMinusAccBeta1 = sub(1, this.accBeta1);\n
const oneMinusAccBeta2 = sub(1, this.accBeta2);\n\n      varNames.forEach((name, i) => {\n        const value =
ENGINE.registeredVariables[name];\n        const trainable = false;\n        if (this.accumulatedFirstMoment[i] ==
null) {\n          this.accumulatedFirstMoment[i] = {\n            originalName: `${name}/m`,\n            variable: tidy(()
=> zerosLike(value).variable(trainable))\n          };\n        }\n        if (this.accumulatedSecondMoment[i] == null) {\n
          this.accumulatedSecondMoment[i] = {\n            originalName: `${name}/v`,\n            variable: tidy(() =>
zerosLike(value).variable(trainable))\n          };\n        }\n\n        const gradient = Array.isArray(variableGradients)
?\n            variableGradients[i].tensor :\n            variableGradients[name];\n        if (gradient == null) {\n
return;\n        }\n\n
        const firstMoment = this.accumulatedFirstMoment[i].variable;\n        const secondMoment =
this.accumulatedSecondMoment[i].variable;\n\n        const newFirstMoment =\n            add(mul(firstMoment,
this.beta1), mul(gradient, 1 - this.beta1));\n        const newSecondMoment =\n            add(mul(secondMoment,
this.beta2),\n                mul(square(gradient), 1 - this.beta2));\n\n        const biasCorrectedFirstMoment =
div(newFirstMoment, oneMinusAccBeta1);\n        const biasCorrectedSecondMoment =\n
div(newSecondMoment, oneMinusAccBeta2);\n\n        firstMoment.assign(newFirstMoment);\n
```

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secondMoment.assign(newSecondMoment);\n\n        const newValue =\n
add(mul(div(biasCorrectedFirstMoment,\n                    add(sqrt(biasCorrectedSecondMoment), this.epsilon)),\n
            -this.learningRate),\n                value);\n        value.assign(newValue);\n      });\n\n
this.accBeta1.assign(mul(this.accBeta1, this.beta1));\n
  this.accBeta2.assign(mul(this.accBeta2, this.beta2));\n    });\n    this.incrementIterations();\n  }\n\n  dispose(): void
{\n    this.accBeta1.dispose();\n    this.accBeta2.dispose();\n\n    if (this.accumulatedFirstMoment != null) {\n
dispose(this.accumulatedFirstMoment.map(v => v.variable));\n    }\n    if (this.accumulatedSecondMoment != null)
{\n      dispose(this.accumulatedSecondMoment.map(v => v.variable));\n    }\n  }\n\n  async getWeights():
Promise<NamedTensor[]> {\n    // Order matters for Python compatibility.\n    const variables: OptimizerVariable[]
=\n        [...this.accumulatedFirstMoment, ...this.accumulatedSecondMoment];\n    return [await
this.saveIterations()].concat(\n        variables.map(v => ({name: v.originalName, tensor: v.variable})));\n  }\n\n
async setWeights(weightValues: NamedTensor[]): Promise<void> {\n    weightValues = await
this.extractIterations(weightValues);\n    tidy(() => {\n      this.accBeta1.assign(pow(this.beta1, this.iterations_ +
1));\n
    this.accBeta2.assign(pow(this.beta2, this.iterations_ + 1));\n    });\n\n    const variableCount =
weightValues.length / 2;\n    const trainable = false;\n    this.accumulatedFirstMoment =\n        weightValues.slice(0,
variableCount).map(v => ({\n                                originalName: v.name,\n
 variable: v.tensor.variable(\n                                trainable)\n                                }));\n
this.accumulatedSecondMoment =\n        weightValues.slice(variableCount, variableCount * 2)\n            .map(v =>
({\n                originalName: v.name,\n                variable: v.tensor.variable(trainable)\n                }));\n  }\n\n
getConfig(): ConfigDict {\n    return {\n      'learningRate': this.learningRate,\n      'beta1': this.beta1,\n      'beta2':
this.beta2,\n      'epsilon': this.epsilon,\n    };\n  }\n\n  /** @nocollapse */\n
  static fromConfig<T extends Serializable>(\n      cls: SerializableConstructor<T>, config: ConfigDict): T {\n
return new cls(\n        config['learningRate'], config['beta1'], config['beta2'],\n        config['epsilon']);\n
}\n}\nregisterClass(AdamOptimizer);\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n
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compliance with the License.\n * You may obtain a copy of the License at\n *\n *
http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing,
software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES
OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language
governing permissions and\n * limitations under the License.\n *
==========================================================================\n
*/\n\nimport
 {ENGINE} from '../engine';\nimport {dispose, tidy} from '../globals';\nimport {abs} from '../ops/abs';\nimport
{add} from '../ops/add';\nimport {div} from '../ops/div';\nimport {maximum} from '../ops/maximum';\nimport {mul}
from '../ops/mul';\nimport {scalar} from '../ops/scalar';\nimport {sub} from '../ops/sub';\nimport {zerosLike} from
'../ops/zeros_like';\nimport {ConfigDict, registerClass, Serializable, SerializableConstructor} from
'../serialization';\nimport {Variable} from '../tensor';\nimport {NamedTensor, NamedVariableMap} from
'../tensor_types';\n\nimport {Optimizer, OptimizerVariable} from './optimizer';\n\nexport class AdamaxOptimizer
extends Optimizer {\n  /** @nocollapse */\n  static className = 'Adamax';  // Note: Name matters for Python
compatbility.\n  private accBeta1: Variable;\n  private iteration: Variable;\n\n  private accumulatedFirstMoment:
OptimizerVariable[] = [];\n  private accumulatedWeightedInfNorm: OptimizerVariable[] = [];\n\n  constructor(\n
protected
 learningRate: number, protected beta1: number,\n      protected beta2: number, protected epsilon: number = null,\n
 protected decay = 0.0) {\n    super();\n\n    tidy(() => {\n      this.iteration = scalar(0).variable();\n      this.accBeta1 =
scalar(beta1).variable();\n    });\n\n    if (epsilon == null) {\n      this.epsilon = ENGINE.backend.epsilon();\n    }\n
}\n\n  applyGradients(variableGradients: NamedVariableMap|NamedTensor[]) {\n    const variableNames =
Array.isArray(variableGradients) ?\n        variableGradients.map(item => item.name) :\n
```

```
Object.keys(variableGradients);\n\n    tidy(() => {\n      const oneMinusAccBeta1 = sub(1, this.accBeta1);\n      const lr =\n          div(-this.learningRate, add(mul(this.iteration, this.decay), 1));\n\n      variableNames.forEach((name, i) => {\n        const value = ENGINE.registeredVariables[name];\n        const trainable = false;\n        if (this.accumulatedFirstMoment[i] == null) {\n          this.accumulatedFirstMoment[i] = {\n            originalName: `${name}/m`,\n            variable: zerosLike(value).variable(trainable)\n          };\n        }\n        if (this.accumulatedWeightedInfNorm[i] == null) {\n          this.accumulatedWeightedInfNorm[i] = {\n            originalName: `${name}/v`,\n            variable: zerosLike(value).variable(trainable)\n          };\n        }\n\n        const gradient = Array.isArray(variableGradients) ?\n            variableGradients[i].tensor :\n            variableGradients[name];\n        if (gradient == null) {\n          return;\n        }\n\n        const firstMoment = this.accumulatedFirstMoment[i].variable;\n        const weightedInfNorm = this.accumulatedWeightedInfNorm[i].variable;\n\n        const newFirstMoment =\n            add(mul(firstMoment, this.beta1), mul(gradient, 1 - this.beta1));\n\n        const ut0 = mul(weightedInfNorm, this.beta2);\n        const ut1 = abs(gradient);\n\n        const newWeightedInfNorm = maximum(ut0, ut1);\n\n        firstMoment.assign(newFirstMoment);\n        weightedInfNorm.assign(newWeightedInfNorm);\n\n        const newValue =\n            add(mul(div(lr, oneMinusAccBeta1),\n                    div(newFirstMoment, add(newWeightedInfNorm, this.epsilon))),\n                value);\n\n        value.assign(newValue);\n      });\n\n      this.iteration.assign(add(this.iteration, 1));\n      this.accBeta1.assign(mul(this.accBeta1, this.beta1));\n    });\n    this.incrementIterations();\n  }\n\n  dispose(): void {\n    this.accBeta1.dispose();\n    this.iteration.dispose();\n\n    if (this.accumulatedFirstMoment != null) {\n      dispose(this.accumulatedFirstMoment.map(v => v.variable));\n    }\n    if (this.accumulatedWeightedInfNorm != null) {\n      dispose(this.accumulatedWeightedInfNorm.map(v => v.variable));\n    }\n  }\n\n  async getWeights(): Promise<NamedTensor[]> {\n    throw new Error('getWeights() is not implemented for Adamax yet.');\n  }\n\n  async setWeights(weightValues: NamedTensor[]): Promise<void> {\n    throw new Error('setWeights() is not implemented for Adamax yet.');\n  }\n\n  getConfig(): ConfigDict {\n    return {\n      'learningRate': this.learningRate,\n      'beta1': this.beta1,\n      'beta2': this.beta2,\n      'epsilon': this.epsilon,\n      'decay': this.decay\n    };\n  }\n\n  /** @nocollapse */\n  static fromConfig<T extends Serializable>(\n      cls: SerializableConstructor<T>, config: ConfigDict): T {\n    return new cls(\n        config['learningRate'], config['beta1'], config['beta2'],\n        config['epsilon'], config['decay']);\n  }\n}\nregisterClass(AdamaxOptimizer);\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
=============================================================================\n */\n\nimport {ENGINE} from '../engine';\nimport {keep, tidy} from '../globals';\nimport {add} from '../ops/add';\nimport {mul} from '../ops/mul';\nimport {scalar} from '../ops/scalar';\nimport {ConfigDict, registerClass, Serializable, SerializableConstructor} from '../serialization';\nimport {Scalar} from '../tensor';\nimport {NamedTensor, NamedTensorMap} from '../tensor_types';\n\nimport {Optimizer} from './optimizer';\n\n/** @doclink Optimizer */\nexport class SGDOptimizer extends Optimizer {\n  /** @nocollapse */\n  static className = 'SGD';  // Note: Name matters for Python compatibility.\n  protected c: Scalar;\n\n  constructor(protected learningRate: number) {\n    super();\n    this.setLearningRate(learningRate);\n  }\n\n  applyGradients(variableGradients: NamedTensorMap|NamedTensor[]) {\n    const varNames = Array.isArray(variableGradients) ?\n        variableGradients.map(v => v.name) :\n        Object.keys(variableGradients);\n    varNames.forEach((name, i) => {\n      const gradient = Array.isArray(variableGradients) ?\n          variableGradients[i].tensor :\n          variableGradients[name];\n      if (gradient == null) {\n        return;\n      }\n      const value = ENGINE.registeredVariables[name];\n      tidy(() => {\n        const newValue = add(mul(this.c, gradient), value);\n        value.assign(newValue);\n      });\n    });\n
```

this.incrementIterations();\n }\n\n /**\n   * Sets the learning rate of the optimizer.\n   */\n setLearningRate(learningRate: number) {\n   this.learningRate = learningRate;\n   if (this.c != null) {\n   this.c.dispose();\n   }\n   this.c = keep(scalar(-learningRate));\n }\n\n dispose() {\n   this.c.dispose();\n }\n\n async getWeights(): Promise<NamedTensor[]> {\n   return [await this.saveIterations()];\n }\n\n async setWeights(weightValues: NamedTensor[]): Promise<void> {\n   weightValues = await this.extractIterations(weightValues);\n   if (weightValues.length !== 0) {\n   throw new Error('SGD optimizer does not have settable weights.');\n   }\n }\n\n getConfig(): ConfigDict {\n   return {'learningRate': this.learningRate};\n }\n\n /** @nocollapse */\n static fromConfig<T extends Serializable>(\n   cls: SerializableConstructor<T>, config: ConfigDict): T {\n   return new cls(config['learningRate']);\n }\n}\nregisterClass(SGDOptimizer);\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n * ===\n */\n\nimport {ENGINE} from '../engine';\nimport {dispose, tidy} from '../globals';\nimport {add} from '../ops/add';\nimport {mul} from '../ops/mul';\nimport {scalar} from '../ops/scalar';\nimport {zerosLike} from '../ops/zeros_like';\nimport {ConfigDict, registerClass, Serializable, SerializableConstructor} from '../serialization';\nimport {Scalar, Tensor} from '../tensor';\nimport {NamedTensor, NamedVariableMap} from '../tensor_types';\n\nimport {OptimizerVariable} from './optimizer';\nimport {SGDOptimizer} from './sgd_optimizer';\n\n/** @doclink Optimizer */\nexport class MomentumOptimizer extends SGDOptimizer {\n /** @nocollapse */\n static className = 'Momentum'; // Name matters for Python compatibility.\n private m: Scalar;\n private accumulations: OptimizerVariable[] = [];\n\n constructor(\n   protected learningRate: number, private momentum: number,\n   private useNesterov = false) {\n   super(learningRate);\n   this.m = scalar(this.momentum);\n }\n\n applyGradients(variableGradients: NamedVariableMap|NamedTensor[]) {\n   const variableNames = Array.isArray(variableGradients) ?\n   variableGradients.map(item => item.name) :\n   Object.keys(variableGradients);\n\n   variableNames.forEach((name, i) => {\n   const value = ENGINE.registeredVariables[name];\n   if (this.accumulations[i] == null) {\n   const trainable = false;\n   this.accumulations[i] = {\n   originalName: `${name}/momentum`,\n   variable: tidy(() => zerosLike(value).variable(trainable))\n   };\n   }\n   const accumulation = this.accumulations[i].variable;\n   const gradient = Array.isArray(variableGradients) ?\n   variableGradients[i].tensor :\n   variableGradients[name];\n   if (gradient == null) {\n   return;\n   }\n   tidy(() => {\n   let newValue: Tensor;\n   const newAccumulation = add(mul(this.m, accumulation), gradient);\n   if (this.useNesterov) {\n   newValue = add(\n   mul(this.c, add(gradient, mul(newAccumulation, this.m))), value);\n   } else {\n   newValue = add(mul(this.c, newAccumulation), value);\n   }\n   accumulation.assign(newAccumulation);\n   value.assign(newValue);\n   });\n   });\n   this.incrementIterations();\n }\n\n dispose(): void {\n   this.m.dispose();\n   if (this.accumulations != null) {\n   dispose(this.accumulations.map(v => v.variable));\n   }\n }\n\n /**\n   * Sets the momentum of the optimizer.\n   *\n   * @param momentum\n   */\n setMomentum(momentum:\n number) {\n   this.momentum = momentum;\n }\n\n async getWeights(): Promise<NamedTensor[]> {\n   // Order matters for Python compatibility.\n   return [await this.saveIterations()].concat(this.accumulations.map(\n   v => ({name: v.originalName, tensor: v.variable})));\n }\n\n async setWeights(weightValues: NamedTensor[]):\n Promise<void> {\n   weightValues = await this.extractIterations(weightValues);\n   const trainable = false;\n   this.accumulations = weightValues.map(\n   v => ({originalName: v.name, variable:\n   v.tensor.variable(trainable)}));\n }\n\n getConfig(): ConfigDict {\n   return {\n   'learningRate':

```
this.learningRate,\n      'momentum': this.momentum,\n      'useNesterov': this.useNesterov\n    };\n  }\n\n  /** @nocollapse */\n  static fromConfig<T extends Serializable>(\n      cls: SerializableConstructor<T>, config: ConfigDict): T {\n    return new cls(\n        config['learningRate'], config['momentum'], config['useNesterov']);\n  }\n}\nregisterClass(MomentumOptimizer);\n","/**\n
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=============================================================================\n
*/\n\nimport {ENGINE} from '../engine';\nimport {dispose, tidy} from '../globals';\nimport {add} from '../ops/add';\nimport {div} from '../ops/div';\nimport {mul} from '../ops/mul';\nimport {sqrt} from '../ops/sqrt';\nimport {square} from
 '../ops/square';\nimport {sub} from '../ops/sub';\nimport {zerosLike} from '../ops/zeros_like';\nimport {ConfigDict, registerClass, Serializable, SerializableConstructor} from '../serialization';\nimport {NamedTensor, NamedTensorMap} from '../tensor_types';\n\nimport {Optimizer, OptimizerVariable} from './optimizer';\n\n/** @doclink Optimizer */\nexport class RMSPropOptimizer extends Optimizer {\n  /** @nocollapse */\n  static className = 'RMSProp';  // Note: Name matters for Python compatibility.\n  private centered: boolean;\n\n  private accumulatedMeanSquares: OptimizerVariable[] = [];\n  private accumulatedMoments: OptimizerVariable[] = [];\n  private accumulatedMeanGrads: OptimizerVariable[] = [];\n\n  constructor(\n      protected learningRate: number, protected decay = 0.9,\n      protected momentum = 0.0, protected epsilon: number = null,\n      centered = false) {\n    super();\n\n    this.centered = centered;\n\n    if (epsilon == null) {\n      this.epsilon = ENGINE.backend.epsilon();\n    }\n    if (learningRate == null) {\n      throw new Error(`learningRate for RMSPropOptimizer must be defined.`);\n    }\n  }\n\n  applyGradients(variableGradients: NamedTensorMap|NamedTensor[]) {\n    const variableNames = Array.isArray(variableGradients) ?\n        variableGradients.map(item => item.name) :\n        Object.keys(variableGradients);\n\n    variableNames.forEach((name, i) => {\n      const value = ENGINE.registeredVariables[name];\n      const trainable = false;\n      if (this.accumulatedMeanSquares[i] == null) {\n        this.accumulatedMeanSquares[i] = {\n          originalName: `${name}/rms`,\n          variable: tidy(() => zerosLike(value).variable(trainable))\n        };\n      }\n      if (this.accumulatedMoments[i] == null) {\n        this.accumulatedMoments[i] = {\n          originalName: `${name}/momentum`,\n          variable: tidy(() => zerosLike(value).variable(trainable))\n        };\n      }\n      if (this.accumulatedMeanGrads[i] == null &&
 this.centered) {\n        this.accumulatedMeanGrads[i] = {\n          originalName: `${name}/mg`,\n          variable: tidy(() => zerosLike(value).variable(trainable))\n        };\n      }\n\n      const gradient =
 Array.isArray(variableGradients) ?\n          variableGradients[i].tensor :\n          variableGradients[name];\n      if (gradient == null) {\n        return;\n      }\n\n      const accumulatedMeanSquare =
 this.accumulatedMeanSquares[i].variable;\n      const accumulatedMoments =
 this.accumulatedMoments[i].variable;\n      tidy(() => {\n        const newAccumulatedMeanSquare =\n
 add(mul(accumulatedMeanSquare, this.decay),\n                mul(square(gradient), 1 - this.decay));\n\n        if (this.centered) {\n          const accumulatedMeanGrad = this.accumulatedMeanGrads[i].variable;\n          // Centered gradient\n          const newAccumulatedMeanGrad =\n              add(mul(accumulatedMeanGrad, this.decay),\n
      mul(gradient, 1 - this.decay));\n\n
          const gradContribution =\n              div(mul(gradient, this.learningRate),\n                  sqrt(\n
 sub(newAccumulatedMeanSquare,\n                      add(square(newAccumulatedMeanGrad), this.epsilon))));\n
  const newAccumulatedMoments =\n              add(mul(accumulatedMoments, this.momentum),
 gradContribution);\n\n          accumulatedMeanSquare.assign(newAccumulatedMeanSquare);\n
 accumulatedMeanGrad.assign(newAccumulatedMeanGrad);\n
 accumulatedMoments.assign(newAccumulatedMoments);\n\n          const newValue = sub(value,
```

newAccumulatedMoments);\n value.assign(newValue);\n } else {\n // Plain gradient\n const newAccumulatedMeanSquare =\n add(mul(accumulatedMeanSquare, this.decay),\n mul(square(gradient), 1 - this.decay));\n\n const newAccumulatedMoments =\n add(mul(accumulatedMoments, this.momentum),\n div(mul(gradient,\n this.learningRate),\n sqrt(add(newAccumulatedMeanSquare, this.epsilon))));\n\n accumulatedMeanSquare.assign(newAccumulatedMeanSquare);\n accumulatedMoments.assign(newAccumulatedMoments);\n\n const newValue = sub(value,\n newAccumulatedMoments);\n value.assign(newValue);\n }\n });\n });\n this.incrementIterations();\n }\n\n dispose(): void {\n if (this.accumulatedMeanSquares != null) {\n dispose(this.accumulatedMeanSquares.map(v => v.variable));\n }\n if (this.accumulatedMeanGrads != null && this.centered) {\n dispose(this.accumulatedMeanGrads.map(v => v.variable));\n }\n if (this.accumulatedMoments != null) {\n dispose(this.accumulatedMoments.map(v => v.variable));\n }\n }\n\n async getWeights(): Promise<NamedTensor[]> {\n // Order matters for Python compatibility.\n const variables: OptimizerVariable[] =\n [...this.accumulatedMeanSquares, ...this.accumulatedMoments];\n if (this.centered) {\n variables.push(...this.accumulatedMeanGrads);\n }\n return [await this.saveIterations()].concat(\n variables.map(v => ({name: v.originalName, tensor: v.variable})));\n }\n\n async setWeights(weightValues: NamedTensor[]): Promise<void> {\n weightValues = await this.extractIterations(weightValues);\n const variableCount =\n this.centered ? weightValues.length / 3 : weightValues.length / 2;\n const trainable = false;\n this.accumulatedMeanSquares =\n weightValues.slice(0, variableCount).map(v => ({\n originalName: v.name,\n variable: v.tensor.variable(\n trainable)\n }));\n this.accumulatedMoments =\n weightValues.slice(variableCount, variableCount * 2)\n .map(v => ({\n originalName: v.name,\n variable: v.tensor.variable(trainable)\n }));\n if (this.centered) {\n this.accumulatedMeanGrads =\n weightValues.slice(variableCount * 2, variableCount * 3)\n .map(v => ({\n originalName: v.name,\n variable: v.tensor.variable(trainable)\n }));\n }\n }\n\n getConfig(): ConfigDict {\n return {\n 'learningRate': this.learningRate,\n 'decay': this.decay,\n 'momentum': this.momentum,\n 'epsilon': this.epsilon,\n 'centered': this.centered\n };\n }\n\n /** @nocollapse */\n static fromConfig<T extends Serializable>(\n cls: SerializableConstructor<T>, config: ConfigDict): T {\n return new cls(\n config['learningRate'], config['decay'], config['momentum'],\n config['epsilon'], config['centered']);\n }\n}\nregisterClass(RMSPropOptimizer);\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ===\n */\n\nimport {AdadeltaOptimizer} from './adadelta_optimizer';\nimport {AdagradOptimizer} from './adagrad_optimizer';\nimport {AdamOptimizer} from './adam_optimizer';\nimport {AdamaxOptimizer} from './adamax_optimizer';\nimport {MomentumOptimizer} from './momentum_optimizer';\nimport {RMSPropOptimizer} from './rmsprop_optimizer';\nimport {SGDOptimizer} from './sgd_optimizer';\n\nexport class OptimizerConstructors {\n /**\n * Constructs a `tf.SGDOptimizer` that uses stochastic gradient descent.\n *\n * ```js\n * // Fit a quadratic function by learning the coefficients a, b, c.\n * const xs = tf.tensor1d([0, 1, 2, 3]);\n * const ys = tf.tensor1d([1.1, 5.9, 16.8, 33.9]);\n *\n * const a = tf.scalar(Math.random()).variable();\n * const b = tf.scalar(Math.random()).variable();\n * const c = tf.scalar(Math.random()).variable();\n *\n * // y = a * x^2 + b * x + c.\n * const f = x =>

a.mul(x.square()).add(b.mul(x)).add(c);\n * const loss = (pred, label) => pred.sub(label).square().mean();\n *\n * const learningRate = 0.01;\n * const optimizer = tf.train.sgd(learningRate);\n *\n * // Train the model.\n * for (let i = 0; i < 10; i++) {\n * optimizer.minimize(() => loss(f(xs), ys));\n * }\n *\n * // Make predictions.\n * console.log(\n * `a: ${a.dataSync()},
b: ${b.dataSync()}, c: ${c.dataSync()}`);\n * const preds = f(xs).dataSync();\n * preds.forEach((pred, i) => {\n * console.log(`x: ${i}, pred: ${pred}`);\n * });\n * ```\n *\n * @param learningRate The learning rate to use for the SGD algorithm.\n *\n * @doc {heading: 'Training', subheading: 'Optimizers', namespace: 'train'}\n */\n static sgd(learningRate: number): SGDOptimizer {\n return new SGDOptimizer(learningRate);\n }\n\n /**\n * Constructs a `tf.MomentumOptimizer` that uses momentum gradient\n * descent.\n *\n * See\n * [http://proceedings.mlr.press/v28/sutskever13.pdf](\n * http://proceedings.mlr.press/v28/sutskever13.pdf)\n *\n * @param learningRate The learning rate to use for the Momentum gradient\n * descent algorithm.\n * @param momentum The momentum to use for the momentum gradient descent\n * algorithm.\n *\n * @doc {heading: 'Training', subheading: 'Optimizers', namespace: 'train'}\n */\n static momentum(learningRate:
number, momentum: number, useNesterov = false):\n MomentumOptimizer {\n return new MomentumOptimizer(learningRate, momentum, useNesterov);\n }\n\n /**\n * Constructs a `tf.RMSPropOptimizer` that uses RMSProp gradient\n * descent. This implementation uses plain momentum and is not centered\n * version of RMSProp.\n *\n * See\n * [http://www.cs.toronto.edu/~tijmen/csc321/slides/lecture_slides_lec6.pdf](\n * http://www.cs.toronto.edu/~tijmen/csc321/slides/lecture_slides_lec6.pdf)\n *\n * @param learningRate The learning rate to use for the RMSProp gradient\n * descent algorithm.\n * @param decay The discounting factor for the history/coming gradient.\n * @param momentum The momentum to use for the RMSProp gradient descent\n * algorithm.\n * @param epsilon Small value to avoid zero denominator.\n * @param centered If true, gradients are normalized by the estimated\n * variance of the gradient.\n *\n * @doc {heading: 'Training', subheading:
'Optimizers', namespace: 'train'}\n */\n static rmsprop(\n learningRate: number, decay = .9, momentum = 0.0, epsilon: number = null,\n centered = false): RMSPropOptimizer {\n return new RMSPropOptimizer(\n learningRate, decay, momentum, epsilon, centered);\n }\n\n /**\n * Constructs a `tf.AdamOptimizer` that uses the Adam algorithm.\n * See https://arxiv.org/abs/1412.6980\n *\n * @param learningRate The learning rate to use for the Adam gradient\n * descent algorithm.\n * @param beta1 The exponential decay rate for the 1st moment estimates.\n * @param beta2 The exponential decay rate for the 2nd moment estimates.\n * @param epsilon A small constant for numerical stability.\n *\n * @doc {heading: 'Training', subheading: 'Optimizers', namespace: 'train'}\n */\n static adam(\n learningRate = 0.001, beta1 = 0.9, beta2 = 0.999,\n epsilon: number = null): AdamOptimizer {\n return new AdamOptimizer(learningRate,
beta1, beta2, epsilon);\n }\n\n /**\n * Constructs a `tf.AdadeltaOptimizer` that uses the Adadelta algorithm.\n * See https://arxiv.org/abs/1212.5701\n *\n * @param learningRate The learning rate to use for the Adadelta gradient\n * descent algorithm.\n * @param rho The learning rate decay over each update.\n * @param epsilon A constant epsilon used to better condition the grad\n * update.\n *\n * @doc {heading: 'Training', subheading: 'Optimizers', namespace: 'train'}\n */\n static adadelta(learningRate = .001, rho = .95, epsilon: number = null):\n AdadeltaOptimizer {\n return new AdadeltaOptimizer(learningRate, rho, epsilon);\n }\n\n /**\n * Constructs a `tf.AdamaxOptimizer` that uses the Adamax algorithm.\n * See https://arxiv.org/abs/1412.6980\n *\n * @param learningRate The learning rate to use for the Adamax gradient\n * descent algorithm.\n *
@param beta1 The exponential decay rate for the 1st moment estimates.\n * @param beta2 The exponential decay rate for the 2nd moment estimates.\n * @param epsilon A small constant for numerical stability.\n * @param decay The learning rate decay over each update.\n *\n * @doc {heading: 'Training', subheading: 'Optimizers', namespace: 'train'}\n */\n static adamax(\n learningRate = 0.002, beta1 = 0.9, beta2 = 0.999, epsilon: number = null,\n decay = 0.0): AdamaxOptimizer {\n return new AdamaxOptimizer(learningRate, beta1, beta2, epsilon, decay);\n }\n\n /**\n * Constructs a `tf.AdagradOptimizer` that uses the Adagrad algorithm.\n * See\n *

[http://www.jmlr.org/papers/volume12/duchi11a/duchi11a.pdf](\n * http://www.jmlr.org/papers/volume12/duchi11a/duchi11a.pdf)\n * or\n * [http://ruder.io/optimizing-gradient-descent/index.html#adagrad](\n * http://ruder.io/optimizing-gradient-descent/index.html#adagrad)\n *\n * @param learningRate The learning
rate to use for the Adagrad gradient\n * descent algorithm.\n * @param initialAccumulatorValue Starting value for the accumulators, must be\n * positive.\n *\n * @doc {heading: 'Training', subheading: 'Optimizers', namespace: 'train'}\n */\n static adagrad(learningRate: number, initialAccumulatorValue = 0.1):\n AdagradOptimizer {\n return new AdagradOptimizer(learningRate, initialAccumulatorValue);\n }\n}\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific
language governing permissions and\n * limitations under the License.\n *
==========\n */\n\n// So typings can propagate.\nimport {AdadeltaOptimizer} from './optimizers/adadelta_optimizer';\nimport {AdagradOptimizer} from './optimizers/adagrad_optimizer';\nimport {AdamOptimizer} from './optimizers/adam_optimizer';\nimport {AdamaxOptimizer} from './optimizers/adamax_optimizer';\nimport {MomentumOptimizer} from './optimizers/momentum_optimizer';\nimport {OptimizerConstructors} from './optimizers/optimizer_constructors';\nimport {RMSPropOptimizer} from './optimizers/rmsprop_optimizer';\nimport {SGDOptimizer} from './optimizers/sgd_optimizer';\n\n// tslint:disable-next-line:no-unused-expression\n[MomentumOptimizer, SGDOptimizer, AdadeltaOptimizer, AdagradOptimizer,\n RMSPropOptimizer, AdamaxOptimizer, AdamOptimizer];\n\nexport const train = {\n sgd: OptimizerConstructors.sgd,\n momentum: OptimizerConstructors.momentum,\n
adadelta: OptimizerConstructors.adadelta,\n adagrad: OptimizerConstructors.adagrad,\n rmsprop: OptimizerConstructors.rmsprop,\n adamax: OptimizerConstructors.adamax,\n adam: OptimizerConstructors.adam\n};\n","/**\n * @license\n * Copyright 2017 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nconst delayCallback: Function = (() => {\n if (typeof requestAnimationFrame
!== 'undefined') {\n return requestAnimationFrame;\n } else if (typeof setImmediate !== 'undefined') {\n return setImmediate;\n }\n return (f: Function) => f(); // no delays\n})();\n\n/**\n * Returns a promise that resolve when a requestAnimationFrame has completed.\n *\n * On Node.js this uses setImmediate instead of requestAnimationFrame.\n *\n * This is simply a sugar method so that users can do the following:\n * `await tf.nextFrame();`\n *\n * @doc {heading: 'Performance', subheading: 'Timing'}\n */\nfunction nextFrame(): Promise<void> {\n return new Promise<void>(resolve => delayCallback(() => resolve()));\n}\n\nexport {nextFrame};\n","/**\n * @license\n * Copyright 2017 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required
by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the

License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport * as util from '../util';\n\nexport function assertParamsConsistent(shapes: number[][], axis: number) {\n const rank = shapes[0].length;\n shapes.forEach((shape, i) => {\n util.assert(\n shape.length === rank,\n () =>\n `Error in concat${rank}D: rank of tensors[${i}] must be the same ` +\n `as the rank of the rest (${rank})`);\n });\n\n util.assert(\n axis >= 0 && axis < rank,\n () => `Error in concat${rank}D: axis must be between 0 and ${rank - 1}.`);\n\n const firstShape = shapes[0];\n shapes.forEach((shape, i) => {\n for (let r = 0; r < rank; r++) {\n util.assert(\n (r === axis) || (shape[r] === firstShape[r]),\n () => `Error in concat${rank}D: Shape of tensors[${i}] (${shape}) ` +\n `does not match the shape of the rest (${firstShape}) ` +\n `along the non-concatenated axis ${i}.`);\n }\n });\n}\n\nexport function computeOutShape(shapes: number[][], axis: number): number[] {\n const outputShape = shapes[0].slice();\n for (let i = 1; i < shapes.length; i++) {\n outputShape[axis] += shapes[i][axis];\n }\n return outputShape;\n}\n","/**\n * @license\n * Copyright 2017 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\n/**\n * Inputs of size above this threshold will be parallelized by calling multiple\n * shader programs.\n */\nimport {nearestDivisor} from '../util';\n\nexport const PARALLELIZE_THRESHOLD = 30;\n\nexport interface ReduceInfo {\n windowSize: number;\n batchSize: number;\n inSize: number;\n outSize: number;\n}\n\nexport function computeOptimalWindowSize(inSize: number): number {\n if (inSize <= PARALLELIZE_THRESHOLD) {\n return inSize;\n }\n return nearestDivisor(inSize, Math.floor(Math.sqrt(inSize)));\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\n// Returns the image center in pixels.\nexport function getImageCenter(\n center: number|[number, number], imageHeight: number,\n imageWidth: number): [number, number] {\n const centerX =\n imageWidth * (typeof center === 'number' ? center : center[0]);\n const centerY =\n imageHeight * (typeof center === 'number' ? center : center[1]);\n return [centerX, centerY];\n}\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\n/**\n * Gets the new shape of the input Tensor after it's been reshaped\n * to:\n * [blockShape[0], ..., blockShape[M-1], batch / prod(blockShape),\n * inputShape[1], ..., inputShape[N-1]]\n *\n * See step 1: https://www.tensorflow.org/api_docs/python/tf/batch_to_space_nd\n */\nexport function getReshaped(\n

inputShape:
number[], blockShape: number[], prod: number,\n batchToSpace = true): number[] {\n let reshaped: number[] = [];\n if (batchToSpace) {\n reshaped = reshaped.concat(blockShape.slice(0));\n reshaped.push(inputShape[0] / prod);\n reshaped = reshaped.concat(inputShape.slice(1));\n } else {\n reshaped = reshaped.concat(inputShape[0]);\n const spatialLength = blockShape.length;\n for (let i = 0; i < spatialLength; ++i) {\n reshaped =\n reshaped.concat([inputShape[i + 1] / blockShape[i], blockShape[i]]);\n }\n reshaped = reshaped.concat(inputShape.slice(spatialLength + 1));\n }\n return reshaped;\n}\n\n/**\n * Gets the permutation that will transpose the dimensions of the\n * reshaped tensor to shape:\n *\n * [batch / prod(block_shape),inputShape[1], blockShape[0], ...,\n * inputShape[M], blockShape[M-1],inputShape[M+1], ..., inputShape[N-1]]\n *\n * see step 2: https://www.tensorflow.org/api_docs/python/tf/batch_to_space_nd\n */\nexport function getPermuted(\n reshapedRank: number, blockShapeRank: number,\n batchToSpace = true): number[] {\n const permuted = [];\n if (batchToSpace) {\n permuted.push(blockShapeRank);\n for (let i = blockShapeRank + 1; i < reshapedRank; ++i) {\n if (i <= 2 * blockShapeRank) {\n permuted.push(i);\n permuted.push(i - (blockShapeRank + 1));\n } else {\n permuted.push(i);\n }\n }\n } else {\n const permutedBeforeBatch = [];\n const permutedAfterBatch = [];\n for (let i = 1; i < reshapedRank; ++i) {\n if (i >= blockShapeRank * 2 + 1 || i % 2 === 1) {\n permutedAfterBatch.push(i);\n } else {\n permutedBeforeBatch.push(i);\n }\n }\n permuted.push(...permutedBeforeBatch);\n permuted.push(0);\n permuted.push(...permutedAfterBatch);\n }\n return permuted;\n}\n\n/**\n * Gets the shape of the reshaped and permuted input Tensor before any cropping\n * is applied. The new shape will be:\n *\n * [batch / prod(blockShape),inputShape[1]
* blockShape[0], ...,\n * inputShape[M] * blockShape[M-1],inputShape[M+1], ..., inputShape[N-1]]\n *\n * See step 3: https://www.tensorflow.org/api_docs/python/tf/batch_to_space_nd\n */\nexport function getReshapedPermuted(\n inputShape: number[], blockShape: number[], prod: number,\n batchToSpace = true): number[] {\n const reshapedPermuted = [];\n\n if (batchToSpace) {\n reshapedPermuted.push(inputShape[0] / prod);\n } else {\n reshapedPermuted.push(inputShape[0] * prod);\n }\n\n for (let i = 1; i < inputShape.length; ++i) {\n if (i <= blockShape.length) {\n if (batchToSpace) {\n reshapedPermuted.push(blockShape[i - 1] * inputShape[i]);\n } else {\n reshapedPermuted.push(inputShape[i] / blockShape[i - 1]);\n }\n } else {\n reshapedPermuted.push(inputShape[i]);\n }\n }\n\n return reshapedPermuted;\n}\n\n/**\n * Converts the crops argument into the beginning coordinates of a slice\n * operation.\n
*/\nexport function getSliceBeginCoords(\n crops: number[][], blockShape: number): number[] {\n const sliceBeginCoords = [0];\n for (let i = 0; i < blockShape; ++i) {\n sliceBeginCoords.push(crops[i][0]);\n }\n return sliceBeginCoords;\n}\n\n/**\n * Converts the crops argument into the size of a slice operation. When\n * combined with getSliceBeginCoords this function allows the reshaped and\n * permuted Tensor to be cropped to its final output shape of:\n *\n * inputShape[1] * blockShape[0] - crops[0,0] - crops[0,1], ...,\n * inputShape[M] * blockShape[M-1] -crops[M-1,0] -\n * crops[M-1,1],inputShape[M+1], ..., inputShape[N-1]]\n *\n * See step 4: https://www.tensorflow.org/api_docs/python/tf/batch_to_space_nd\n */\nexport function getSliceSize(\n uncroppedShape: number[], crops: number[][], blockShape: number): number[] {\n const sliceSize = uncroppedShape.slice(0, 1);\n for (let i = 0; i < blockShape; ++i) {\n sliceSize.push(uncroppedShape[i + 1] - crops[i][0]
- crops[i][1]);\n }\n\n return sliceSize;\n}\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
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*/\n\nexport const SELU_SCALEALPHA = 1.7580993408473768599402175208123;\nexport const SELU_SCALE = 1.0507009873554804934193349852946;\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the
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==========\n*/\n\nexport const ERF_P = 0.3275911;\nexport const ERF_A1 = 0.254829592;\nexport const ERF_A2 = -0.284496736;\nexport const ERF_A3 = 1.421413741;\nexport const ERF_A4 = -1.453152027;\nexport const ERF_A5 = 1.061405429;\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may
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==========\n*/\n\nimport {env} from './environment';\n\nexport function warn(...msg: Array<{}>): void {\n if (!env().getBool('IS_TEST')) {\n console.warn(...msg);\n }\n}\n\nexport function log(...msg: Array<{}>): void {\n if (!env().getBool('IS_TEST')) {\n console.log(...msg);\n }\n}\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n *
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==========\n*/\n\nimport {TypedArray} from '../types';\n/**\n * Merges real and imaginary Float32Arrays into a single complex Float32Array.\n *\n * The memory layout is interleaved as follows:\n * real: [r0, r1, r2]\n * imag: [i0, i1, i2]\n * complex: [r0, i0, r1, i1, r2, i2]\n *\n * This is the inverse of splitRealAndImagArrays.\n *\n * @param real The real values of the complex tensor values.\n * @param imag The imag values of the
complex tensor values.\n * @returns A complex tensor as a Float32Array with merged values.\n */\nexport function mergeRealAndImagArrays(\n real: Float32Array, imag: Float32Array): Float32Array {\n if (real.length !== imag.length) {\n throw new Error(\n `Cannot merge real and imag arrays of different lengths. real:` +\n `${real.length}, imag: ${imag.length}.`);\n }\n const result = new Float32Array(real.length * 2);\n for (let i = 0; i < result.length; i += 2) {\n result[i] = real[i / 2];\n result[i + 1] = imag[i / 2];\n }\n return result;\n}\n\n/**\n * Splits a complex Float32Array into real and imag parts.\n *\n * The memory layout is interleaved as follows:\n * complex: [r0, i0, r1, i1, r2, i2]\n * real: [r0, r1, r2]\n * imag: [i0, i1, i2]\n *\n * This is the inverse of mergeRealAndImagArrays.\n *\n * @param complex The complex tensor values.\n * @returns An object with real and imag Float32Array components of the complex\n * tensor.\n */\nexport
function splitRealAndImagArrays(complex: Float32Array):\n {real: Float32Array, imag: Float32Array} {\n const real = new Float32Array(complex.length / 2);\n const imag = new Float32Array(complex.length / 2);\n for (let i = 0; i < complex.length; i += 2) {\n real[i / 2] = complex[i];\n imag[i / 2] = complex[i + 1];\n }\n return {real, imag};\n}\n\n/**\n * Extracts even indexed complex values in the given array.\n * @param complex The complex tensor values\n */\nexport function complexWithEvenIndex(complex: Float32Array):\n {real:

Float32Array, imag: Float32Array} {\n const len = Math.ceil(complex.length / 4);\n const real = new Float32Array(len);\n const imag = new Float32Array(len);\n for (let i = 0; i < complex.length; i += 4) {\n real[Math.floor(i / 4)] = complex[i];\n   imag[Math.floor(i / 4)] = complex[i + 1];\n }\n return {real, imag};\n}\n\n/**\n * Extracts odd indexed comple values in the given array.\n * @param complex The complex tensor values\n */\nexport
 function complexWithOddIndex(complex: Float32Array):\n   {real: Float32Array, imag: Float32Array} {\n const len = Math.floor(complex.length / 4);\n const real = new Float32Array(len);\n const imag = new Float32Array(len);\n for (let i = 2; i < complex.length; i += 4) {\n   real[Math.floor(i / 4)] = complex[i];\n imag[Math.floor(i / 4)] = complex[i + 1];\n }\n return {real, imag};\n}\n\n/**\n * Get the map representing a complex value in the given array.\n * @param complex The complex tensor values.\n * @param index An index of the target complex value.\n */\nexport function getComplexWithIndex(\n   complex: Float32Array, index: number): {real: number, imag: number} {\n const real = complex[index * 2];\n const imag = complex[index * 2 + 1];\n return {real, imag};\n}\n\n/**\n * Insert a given complex value into the TypedArray.\n * @param data The array in which the complex value is inserted.\n * @param c The complex value to be inserted.\n * @param index An index of
 the target complex value.\n */\nexport function assignToTypedArray(\n   data: TypedArray, real: number, imag: number, index: number) {\n data[index * 2] = real;\n data[index * 2 + 1] = imag;\n}\n\n/**\n * Make the list of exponent terms used by FFT.\n */\nexport function exponents(\n   n: number, inverse: boolean): {real: Float32Array, imag: Float32Array} {\n const real = new Float32Array(n / 2);\n const imag = new Float32Array(n / 2);\n for (let i = 0; i < Math.ceil(n / 2); i++) {\n   const x = (inverse ? 2 : -2) * Math.PI * (i / n);\n   real[i] = Math.cos(x);\n   imag[i] = Math.sin(x);\n }\n return {real, imag};\n}\n\n/**\n * Make the exponent term used by FFT.\n */\nexport function exponent(\n   k: number, n: number, inverse: boolean): {real: number, imag: number} {\n const x = (inverse ? 2 : -2) * Math.PI * (k / n);\n const real = Math.cos(x);\n const imag = Math.sin(x);\n return {real, imag};\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n
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==\n
*/\nimport {TensorInfo} from '../kernel_registry';\nimport {Tensor} from '../tensor';\nimport {assert} from '../util';\n\n/**\n * Prepare the split size array. When the input is a number, the axis is evenly\n * divided among the split size. When the input contains the negative value, the\n * rest of the axis is allocated toward that.\n */\nexport
 function prepareSplitSize(\n   x: Tensor|TensorInfo, numOrSizeSplits: number[]|number,\n   axis = 0): number[] {\n let splitSizes = [];\n if (typeof (numOrSizeSplits) === 'number') {\n   assert(\n   x.shape[axis] % numOrSizeSplits === 0,\n   () => 'Number of splits must evenly divide the axis.');\n   splitSizes =\n   new Array(numOrSizeSplits).fill(x.shape[axis] / numOrSizeSplits);\n } else {\n   const numOfNegs = numOrSizeSplits.reduce((count, value) => {\n   if (value === -1) {\n   count += 1;\n   }\n   return count;\n   }, 0);\n   assert(\n   numOfNegs <= 1,\n   () => 'There should be only one negative value in split array.');\n   const negIndex = numOrSizeSplits.indexOf(-1);\n   // Allow the number of split array to be -1, which indicates the rest\n   // of dimension is allocated to that split.\n   if (negIndex !== -1) {\n   const total = numOrSizeSplits.reduce((a, b) => b > 0 ? a + b : a);\n   numOrSizeSplits[negIndex]
 = x.shape[axis] - total;\n   }\n   assert(\n   x.shape[axis] === numOrSizeSplits.reduce((a, b) => a + b),\n   () => 'The sum of sizes must match the size of the axis dimension.');\n   splitSizes = numOrSizeSplits;\n }\n\n return splitSizes;\n}\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n *

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==========\n */\n\nimport {TensorInfo} from '../kernel_registry';\nimport {nearestDivisor} from '../util';\n\nimport {PARALLELIZE_THRESHOLD} from './reduce_util';\n\nexport interface SegOpInfo {\n windowSize: number;\n batchSize: number;\n inSize: number;\n numSegments: number;\n}\n\nexport function segOpComputeOptimalWindowSize(\n inSize: number, numSegments: number): number {\n let done = false;\n let res;\n\n if (inSize <= PARALLELIZE_THRESHOLD) {\n res = inSize;\n done = true;\n } else {\n res = nearestDivisor(inSize, Math.floor(Math.sqrt(inSize)));\n }\n\n while (!done) {\n if (res > numSegments || res === inSize) {\n done = true;\n } else {\n res = nearestDivisor(inSize, res + 1);\n }\n }\n return res;\n}\n\nexport function computeOutShape(\n aShape: number[], axis: number, numSegments: number): number[] {\n const outShape = [];\n const rank = aShape.length;\n for (let dim = 0; dim < rank; dim++) {\n if (dim !== axis) {\n outShape.push(aShape[dim]);\n

} else {\n outShape.push(numSegments);\n }\n }\n return outShape;\n}\n\nexport interface GatherOpShapeInfo {\n batchSize: number;\n sliceSize: number;\n outerSize: number;\n dimSize: number;\n outputShape: number[];\n}\n\nexport function collectGatherOpShapeInfo(\n x: TensorInfo, indices: TensorInfo, axis: number,\n batchDims: number): GatherOpShapeInfo {\n const indicesRank = indices.shape.length;\n const xRank = x.shape.length;\n\n if (batchDims !== 0) {\n if (batchDims < -indicesRank || batchDims > indicesRank) {\n throw new Error(`Expect batchDims in the range of [-${indicesRank}, ${\n indicesRank}], but got ${batchDims}`);\n }\n\n if (batchDims < 0) {\n batchDims += indicesRank;\n }\n\n if (batchDims > xRank) {\n throw new Error(`batchDims (${batchDims}) must be less than rank(x) (\n ${xRank}).`);\n }\n\n if (axis < batchDims) {\n throw new Error(`batchDims (${\n batchDims}) must be less than or equal to axis (${axis}).`);\n }\n\n for (let i = 0; i < batchDims; ++i) {\n if (x.shape[i] !== indices.shape[i]) {\n throw new Error(\n `x.shape[${i}]: ${x.shape[i]} should be equal to indices.shape[${\n i}]: ${indices.shape[i]}.`);\n }\n }\n const dimSize = x.shape[axis];\n\n const outputShape: number[] = [];\n let batchSize = 1;\n let outerSize = 1;\n let sliceSize = 1;\n\n for (let i = 0; i < batchDims; ++i) {\n outputShape.push(x.shape[i]);\n batchSize *= x.shape[i];\n }\n\n for (let i = batchDims; i < axis; i++) {\n outputShape.push(x.shape[i]);\n outerSize *= x.shape[i];\n }\n\n for (let i = batchDims; i < indicesRank; i++) {\n outputShape.push(indices.shape[i]);\n }\n\n for (let i = axis + 1; i < xRank; i++) {\n outputShape.push(x.shape[i]);\n sliceSize *= x.shape[i];\n }\n\n return {batchSize, sliceSize, outerSize, dimSize, outputShape};\n}\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {decodeString, encodeString} from '../util';\n\n// Utilities needed by backend consumers of tf-core.\nexport * from '../ops/axis_util';\nexport * from '../ops/broadcast_util';\nexport * from '../ops/concat_util';\nexport * from '../ops/conv_util';\nexport * from '../ops/fused_util';\nexport * from '../ops/fused_types';\nexport * from '../ops/reduce_util';\n\nimport * as slice_util from '../ops/slice_util';\nexport {slice_util};\n\nexport {BackendValues, TypedArray, upcastType, PixelData} from '../types';\nexport {MemoryInfo, TimingInfo} from '../engine';\nexport * from '../ops/rotate_util';\nexport * from '../ops/array_ops_util';\nexport * from '../ops/gather_nd_util';\nexport * from

'../ops/scatter_nd_util';\nexport * from '../ops/selu_util';\nexport * from '../ops/fused_util';\nexport * from '../ops/erf_util';\nexport * from '../log';\nexport * from '../backends/complex_util';\nexport * from '../ops/split_util';\n\nimport * as segment_util from '../ops/segment_util';\nexport {segment_util};\n\nexport function fromUint8ToStringArray(vals: Uint8Array[]) {\n try {\n   // Decode the bytes into string.\n   return vals.map(val => decodeString(val));\n } catch (err) {\n   throw new Error(\n   `Failed to decode encoded string bytes into utf-8, error: ${err}`);\n }\n}\n\nexport function fromStringArrayToUint8(strings: string[]) {\n return strings.map(s => encodeString(s));\n}\n\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n * ==\n */\n\nexport {nonMaxSuppressionV3Impl, nonMaxSuppressionV4Impl, nonMaxSuppressionV5Impl} from './non_max_suppression_impl';\nexport {whereImpl} from './where_impl';\n","/**\n * @license\n * Copyright 2020 Google Inc. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n * ==\n */\n\n// base.ts is tfjs-core without auto registration of things like flags,\n// gradients, chained ops or the opHandler. See base_side_effects.ts for parts\n// tfjs core that are required side effects.\n\n/**\n * @fileoverview\n * @suppress {partialAlias} Optimization disabled due to passing the module\n * object into a function below:\n *\n *   import * as ops from './ops/ops';\n *   setOpHandler(ops);\n */\n\n// Serialization.\nimport * as io from './io/io';\nimport * as math from './math';\nimport * as browser from './ops/browser';\nimport * as gather_util from './ops/gather_nd_util';\nimport * as scatter_util from './ops/scatter_nd_util';\nimport * as slice_util from './ops/slice_util';\nimport * as serialization from './serialization';\nimport * as tensor_util from './tensor_util';\nimport * as test_util from './test_util';\nimport * as util from './util';\nimport {version} from './version';\n\nexport {InferenceModel, MetaGraph, MetaGraphInfo, ModelPredictConfig, ModelTensorInfo, SavedModelTensorInfo, SignatureDef, SignatureDefEntry, SignatureDefInfo} from './model_types';\n// Optimizers.\nexport {AdadeltaOptimizer} from './optimizers/adadelta_optimizer';\nexport {AdagradOptimizer} from './optimizers/adagrad_optimizer';\nexport {AdamOptimizer} from './optimizers/adam_optimizer';\nexport {AdamaxOptimizer} from './optimizers/adamax_optimizer';\nexport {MomentumOptimizer} from './optimizers/momentum_optimizer';\nexport {Optimizer} from './optimizers/optimizer';\nexport {RMSPropOptimizer} from './optimizers/rmsprop_optimizer';\nexport {SGDOptimizer} from './optimizers/sgd_optimizer';\nexport {Scalar, Tensor, Tensor1D, Tensor2D, Tensor3D, Tensor4D, Tensor5D, TensorBuffer, Variable} from './tensor';\nexport {GradSaveFunc, NamedTensorMap, TensorContainer, TensorContainerArray, TensorContainerObject} from './tensor_types';\nexport {BackendValues, DataType, DataTypeMap, DataValues, NumericDataType, PixelData, Rank, RecursiveArray, ScalarLike, ShapeMap, sumOutType, TensorLike, TypedArray, upcastType} from './types';\n\nexport * from './ops/ops';\nexport {Reduction} from './ops/loss_ops_utils';\n\nexport * from './train';\nexport * from './globals';\nexport * from './kernel_registry';\nexport {customGrad, grad, grads, valueAndGrad, valueAndGrads, variableGrads} from './gradients';\n\nexport {TimingInfo,

MemoryInfo, ForwardFunc} from './engine';\nexport {Environment, env, ENV} from './environment';\nexport {Platform} from './platforms/platform';\n\nexport {version as version_core};\n\n// Top-level method exports.\nexport {nextFrame} from './browser_util';\n\n// Second level exports.\nimport * as backend_util from './backends/backend_util';\nimport * as device_util from './device_util';\nexport {\n browser,\n io,\n math,\n serialization,\n test_util,\n util,\n backend_util,\n tensor_util,\n slice_util,\n gather_util,\n scatter_util,\n device_util\n};\n\nimport * as kernel_impls from './backends/kernel_impls';\nexport {kernel_impls};\n// Backend specific.\nexport {KernelBackend, BackendTimingInfo, DataMover, DataStorage} from './backends/backend';\n\n// Export all kernel names / info.\nexport * from './kernel_names';\n","/**\n * @license\n * Copyright 2017 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ===\n */\n\n// Required side effectful code.\nimport './base_side_effects';\n// All exports from this package should be in base.\nexport * from './base';\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ===\n */\n\nconst contexts: {[key: string]: WebGLRenderingContext} = {};\n\nconst WEBGL_ATTRIBUTES: WebGLContextAttributes = {\n alpha: false,\n antialias: false,\n premultipliedAlpha: false,\n preserveDrawingBuffer: false,\n depth: false,\n stencil: false,\n failIfMajorPerformanceCaveat: true\n};\n\nexport function clearWebGLContext(webGLVersion: number) {\n delete contexts[webGLVersion];\n}\n\nexport function setWebGLContext(\n webGLVersion: number, gl: WebGLRenderingContext) {\n contexts[webGLVersion] = gl;\n}\n\nexport function getWebGLContext(webGLVersion:\n number): WebGLRenderingContext {\n if (!(webGLVersion in contexts)) {\n const newCtx = getWebGLRenderingContext(webGLVersion);\n if (newCtx !== null) {\n contexts[webGLVersion] = newCtx;\n } else {\n console.log('Could not get context for WebGL version', webGLVersion);\n return null;\n }\n }\n const gl = contexts[webGLVersion];\n if (gl.isContextLost()) {\n delete contexts[webGLVersion];\n return getWebGLContext(webGLVersion);\n }\n\n gl.disable(gl.DEPTH_TEST);\n gl.disable(gl.STENCIL_TEST);\n gl.disable(gl.BLEND);\n gl.disable(gl.DITHER);\n gl.disable(gl.POLYGON_OFFSET_FILL);\n gl.disable(gl.SAMPLE_COVERAGE);\n gl.enable(gl.SCISSOR_TEST);\n gl.enable(gl.CULL_FACE);\n gl.cullFace(gl.BACK);\n\n return contexts[webGLVersion];\n}\n\nfunction createCanvas(webGLVersion: number) {\n if (typeof OffscreenCanvas !== 'undefined' && webGLVersion === 2) {\n return new OffscreenCanvas(300, 150);\n } else if (typeof document !==\n 'undefined') {\n return document.createElement('canvas');\n } else {\n throw new Error('Cannot create a canvas in this context');\n }\n}\n\nfunction getWebGLRenderingContext(webGLVersion: number): WebGLRenderingContext {\n if (webGLVersion !== 1 && webGLVersion !== 2) {\n throw new Error('Cannot get WebGL rendering context, WebGL is disabled.');\n }\n const canvas = createCanvas(webGLVersion);\n\n canvas.addEventListener('webglcontextlost', (ev: Event) => {\n ev.preventDefault();\n delete contexts[webGLVersion];\n }, false);\n if (webGLVersion === 1) {\n return (canvas.getContext('webgl',

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WEBGL_ATTRIBUTES) ||\n            canvas.getContext('experimental-webgl', WEBGL_ATTRIBUTES)) as\n WebGLRenderingContext;\n  }\n  return canvas.getContext('webgl2', WEBGL_ATTRIBUTES) as\n WebGLRenderingContext;\n}\n","/**\n * @license\n * Copyright 2017 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not\n  use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==========================================================================\n */\n\nimport {backend_util, DataId, DataType, env, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nexport enum PackingScheme {\n  /**\n   * All values in a single texel are densely packed without any constraints.\n   *\n   * This is how the shader encodes a tensor with shape = [2, 3, 4]\n   * (indices are [batch, row, col]).\n   *\n   * 000|001   010|011   020|021\n   * -------   -------   -------\n   * 002|003   012|013   022|023\n
   *\n   * 100|101   110|111   120|121\n   * -------   -------   -------\n   * 102|103   112|113   122|123\n   *\n   */\n DENSE,\n\n  /**\n   * Single texels contain only values from the same batch, and from adjacent\n   * rows and columns.\n   *\n   * This is how the shader encodes a tensor with shape = [2, 3, 5]\n   * (indices are [batch, row, col]).\n   *\n   * 000|001   002|003   004|xxx   020|021   022|023   024|xxx\n   * -------   -------   -------   -------   -------   -------\n   * 010|011   012|013   014|xxx   xxx|xxx   xxx|xxx   xxx|xxx\n   *\n   * 100|101   102|103   104|xxx   120|121   122|123   124|xxx\n   * -------   -------   -------   -------   -------   -------\n   * 110|111   112|113   114|xxx   xxx|xxx   xxx|xxx   xxx|xxx\n   *\n   */\n  SHARED_BATCH\n}\n\nexport enum TextureUsage {\n  RENDER,\n  UPLOAD,\n  PIXELS,\n  DOWNLOAD\n}\n\nexport enum PhysicalTextureType {\n  UNPACKED_FLOAT16,\n  UNPACKED_FLOAT32,\n  PACKED_4X1_UNSIGNED_BYTE,\n  PACKED_2X2_FLOAT32,\n  PACKED_2X2_FLOAT16\n}\n\nexport
 interface TextureData {\n  // Required.\n  shape: number[];\n  dtype: DataType;\n\n  // Optional.\n  values?: backend_util.BackendValues;\n  texture?: WebGLTexture;\n  // For complex numbers, the real and imaginary parts are stored as their own\n  // individual tensorInfos, with a parent joining the two with the\n  // complexTensors field. When this is defined, texture will be null.\n  complexTensorInfos?: {real: TensorInfo, imag: TensorInfo};\n  /** [rows, columns] shape of the texture. */\n  texShape?: [number, number];\n  usage?: TextureUsage;\n  isPacked?: boolean;\n\n  refCount: number;\n\n  // Available when the tensor has been sliced.\n  slice?: {\n    // Offset in the 'flat index' space.\n    flatOffset: number;\n    // Used for counting how many sliced tensors point to the same texture.\n    origDataId: DataId;\n  };\n}\n\nexport function getUnpackedMatrixTextureShapeWidthHeight(\n    rows: number, columns: number): [number, number] {\n  return [columns,
 rows];\n}\n\nexport function getUnpackedArraySizeFromMatrixSize(\n    matrixSize: number, channelsPerTexture: number): number {\n  return matrixSize * channelsPerTexture;\n}\n\nexport function getColorMatrixTextureShapeWidthHeight(\n    rows: number, columns: number): [number, number] {\n  return [columns * 4, rows];\n}\n\n/**\n * Get shape for densely packed RGBA texture.\n */\nexport function getDenseTexShape(shape: number[]): [number, number] {\n  const size = util.sizeFromShape(shape);\n  const texelsNeeded = Math.ceil(size / 4);\n  return util.sizeToSquarishShape(texelsNeeded);\n}\n\nexport function getMatrixSizeFromUnpackedArraySize(\n    unpackedSize: number, channelsPerTexture: number): number {\n  if (unpackedSize % channelsPerTexture !== 0) {\n    throw new Error(\n        `unpackedSize (${unpackedSize}) must be a multiple of ` +\n        `${channelsPerTexture}`);\n  }\n  return unpackedSize / channelsPerTexture;\n}\n\nexport function decodeMatrixFromUnpackedColorRGBAArray(\n
   unpackedArray: Float32Array, matrix: Float32Array, channels: number) {\n  const requiredSize = unpackedArray.length * channels / 4;\n  if (matrix.length < requiredSize) {\n    throw new Error(\n        `matrix length (${matrix.length}) must be >= ${requiredSize}`);\n  }\n  let dst = 0;\n  for (let src = 0; src < unpackedArray.length; src += 4) {\n    for (let c = 0; c < channels; c++) {\n      matrix[dst++] = unpackedArray[src + c];\n    }\n  }\n}\n\nexport function getPackedMatrixTextureShapeWidthHeight(\n    rows: number, columns:
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number): [number, number] {\n return [\n   Math.max(1, Math.ceil(columns / 2)), Math.max(1, Math.ceil(rows / 2))\n];\n}\n\nexport function getPackedRGBAArraySizeFromMatrixShape(\n   rows: number, columns: number): number {\n const [w, h] = getPackedMatrixTextureShapeWidthHeight(rows, columns);\n return w * h * 4;\n}\n\nexport interface TextureConfig {\n internalFormatFloat: number;\n textureFormatFloat: number;\n internalFormatPackedHalfFloat:
 number;\n internalFormatHalfFloat: number;\n internalFormatPackedFloat: number;\n\n // The format to use during a gl.readPixels call.\n downloadTextureFormat: number;\n // How many channels need to be unpacked after a gl.readPixels call.\n downloadUnpackNumChannels: number;\n\n defaultNumChannels: number;\n textureTypeHalfFloat: number;\n textureTypeFloat: number;\n}\n\nexport function getTextureConfig(\n   // tslint:disable-next-line:no-any\n   gl: WebGLRenderingContext, textureHalfFloatExtension?: any): TextureConfig {\n // tslint:disable-next-line:no-any\n const glany = gl as any;\n\n let internalFormatFloat: number;\n let internalFormatHalfFloat: number;\n let internalFormatPackedHalfFloat: number;\n let internalFormatPackedFloat: number;\n let textureFormatFloat: number;\n\n let downloadTextureFormat: number;\n let downloadUnpackNumChannels: number;\n\n let defaultNumChannels: number;\n let textureTypeHalfFloat: number;\n let textureTypeFloat: number;\n\n
  if (env().getNumber('WEBGL_VERSION') === 2) {\n   internalFormatFloat = glany.R32F;\n
internalFormatHalfFloat = glany.R16F;\n   internalFormatPackedHalfFloat = glany.RGBA16F;\n
internalFormatPackedFloat = glany.RGBA32F;\n   textureFormatFloat = glany.RED;\n
downloadUnpackNumChannels = 4;\n   defaultNumChannels = 1;\n   textureTypeHalfFloat =
glany.HALF_FLOAT;\n   textureTypeFloat = glany.FLOAT;\n } else {\n   internalFormatFloat = gl.RGBA;\n
internalFormatHalfFloat = gl.RGBA;\n   internalFormatPackedHalfFloat = gl.RGBA;\n
internalFormatPackedFloat = glany.RGBA;\n   textureFormatFloat = gl.RGBA;\n   downloadUnpackNumChannels
= 4;\n   defaultNumChannels = 4;\n   textureTypeHalfFloat = textureHalfFloatExtension != null ?\n
textureHalfFloatExtension.HALF_FLOAT_OES :\n   null;\n   textureTypeFloat = gl.FLOAT;\n }\n
downloadTextureFormat = gl.RGBA;\n\n return {\n   internalFormatFloat,\n   internalFormatHalfFloat,\n
internalFormatPackedHalfFloat,\n
    internalFormatPackedFloat,\n   textureFormatFloat,\n   downloadTextureFormat,\n
downloadUnpackNumChannels,\n   defaultNumChannels,\n   textureTypeHalfFloat,\n   textureTypeFloat\n
};\n}\n","/**\n * @license\n * Copyright 2017 Google LLC. All Rights Reserved.\n * Licensed under the Apache
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BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the
License for the specific language governing permissions and\n * limitations under the License.\n *
==\n
*/\n\nimport {env, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport
 {getWebGLContext} from './canvas_util';\nimport {getTextureConfig} from './tex_util';\n\nexport function
callAndCheck<T>(gl: WebGLRenderingContext, func: () => T): T {\n const returnValue = func();\n if
(env().getBool('DEBUG')) {\n   checkWebGLError(gl);\n }\n return returnValue;\n}\n\nfunction
checkWebGLError(gl: WebGLRenderingContext) {\n const error = gl.getError();\n if (error !== gl.NO_ERROR)
{\n   throw new Error('WebGL Error: ' + getWebGLErrorMessage(gl, error));\n }\n}\n\n//
https://en.wikipedia.org/wiki/Half-precision_floating-point_format\nconst MIN_FLOAT16 = 5.96e-8;\nconst
MAX_FLOAT16 = 65504;\n\nexport function canBeRepresented(num: number): boolean {\n if
(env().getBool('WEBGL_RENDER_FLOAT32_ENABLED') || num === 0 ||\n   (MIN_FLOAT16 <
Math.abs(num) && Math.abs(num) < MAX_FLOAT16)) {\n   return true;\n }\n return false;\n}\n\nexport
function getWebGLErrorMessage(\n   gl: WebGLRenderingContext, status: number): string {\n switch (status) {\n
    case gl.NO_ERROR:\n   return 'NO_ERROR';\n   case gl.INVALID_ENUM:\n   return
'INVALID_ENUM';\n   case gl.INVALID_VALUE:\n   return 'INVALID_VALUE';\n   case

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gl.INVALID_OPERATION:\n      return 'INVALID_OPERATION';\n    case
gl.INVALID_FRAMEBUFFER_OPERATION:\n      return 'INVALID_FRAMEBUFFER_OPERATION';\n    case
gl.OUT_OF_MEMORY:\n      return 'OUT_OF_MEMORY';\n    case gl.CONTEXT_LOST_WEBGL:\n      return
'CONTEXT_LOST_WEBGL';\n    default:\n      return `Unknown error code ${status}`;\n  }\n}\n\nexport function
getExtensionOrThrow(\n    gl: WebGLRenderingContext, extensionName: string): {} {\n  return
throwIfNull<{}>(\n      gl, () => gl.getExtension(extensionName),\n      'Extension \"' + extensionName + '\" not
supported on this browser.');\n}\n\nexport function createVertexShader(\n    gl: WebGLRenderingContext,
vertexShaderSource: string): WebGLShader {\n  const vertexShader: WebGLShader =
throwIfNull<WebGLShader>(\n      gl, () => gl.createShader(gl.VERTEX_SHADER),\n
    'Unable to create vertex WebGLShader.');\n  callAndCheck(gl, () => gl.shaderSource(vertexShader,
vertexShaderSource));\n  callAndCheck(gl, () => gl.compileShader(vertexShader));\n  if
(gl.getShaderParameter(vertexShader, gl.COMPILE_STATUS) === false) {\n
console.log(gl.getShaderInfoLog(vertexShader));\n    throw new Error('Failed to compile vertex shader.');\n  }\n
return vertexShader;\n}\n\nexport function createFragmentShader(\n    gl: WebGLRenderingContext,
fragmentShaderSource: string): WebGLShader {\n  const fragmentShader: WebGLShader =
throwIfNull<WebGLShader>(\n      gl, () => gl.createShader(gl.FRAGMENT_SHADER),\n      'Unable to create
fragment WebGLShader.');\n  callAndCheck(gl, () => gl.shaderSource(fragmentShader, fragmentShaderSource));\n
callAndCheck(gl, () => gl.compileShader(fragmentShader));\n  if (gl.getShaderParameter(fragmentShader,
gl.COMPILE_STATUS) === false) {\n    logShaderSourceAndInfoLog(\n        fragmentShaderSource,
gl.getShaderInfoLog(fragmentShader));\n
   throw new Error('Failed to compile fragment shader.');\n  }\n  return fragmentShader;\n}\n\nconst
lineNumberRegex = /ERROR: [0-9]+:([0-9]+):/g;\nfunction logShaderSourceAndInfoLog(\n    shaderSource: string,
shaderInfoLog: string) {\n  const lineNumberRegexResult = lineNumberRegex.exec(shaderInfoLog);\n  if
(lineNumberRegexResult == null) {\n    console.log(`Couldn't parse line number in error: ${shaderInfoLog}`);\n
console.log(shaderSource);\n    return;\n  }\n\n  const lineNumber = +lineNumberRegexResult[1];\n\n  const
shaderLines = shaderSource.split('\\n');\n  const pad = shaderLines.length.toString().length + 2;\n  const
linesWithLineNumbers = shaderLines.map(\n      (line, lineNumber) =>\n          util.rightPad((lineNumber +
1).toString(), pad) + line);\n  let maxLineLength = 0;\n  for (let i = 0; i < linesWithLineNumbers.length; i++) {\n
maxLineLength = Math.max(linesWithLineNumbers[i].length, maxLineLength);\n  }\n\n  const beforeErrorLines =
linesWithLineNumbers.slice(0,
 lineNumber - 1);\n  const errorLine = linesWithLineNumbers.slice(lineNumber - 1, lineNumber);\n  const
afterErrorLines = linesWithLineNumbers.slice(lineNumber);\n\n  console.log(beforeErrorLines.join('\\n'));\n
console.log(shaderInfoLog.split('\\n')[0]);\n  console.log(\n      `%c ${util.rightPad(errorLine[0],
maxLineLength)}`,\n      'border:1px solid red; background-color:#e3d2d2; color:#a61717');\n
console.log(afterErrorLines.join('\\n'));\n}\n\nexport function createProgram(gl: WebGLRenderingContext):
WebGLProgram {\n  return throwIfNull<WebGLProgram>(\n      gl, () => gl.createProgram(), 'Unable to create
WebGLProgram.');\n}\n\nexport function linkProgram(gl: WebGLRenderingContext, program: WebGLProgram)
{\n  callAndCheck(gl, () => gl.linkProgram(program));\n  if (gl.getProgramParameter(program, gl.LINK_STATUS)
=== false) {\n    console.log(gl.getProgramInfoLog(program));\n    throw new Error('Failed to link vertex and
fragment shaders.');\n  }\n}\n\nexport
 function validateProgram(\n    gl: WebGLRenderingContext, program: WebGLProgram) {\n  callAndCheck(gl, ()
=> gl.validateProgram(program));\n  if (gl.getProgramParameter(program, gl.VALIDATE_STATUS) === false) {\n
  console.log(gl.getProgramInfoLog(program));\n    throw new Error('Shader program validation failed.');\n
}\n}\n\nexport function createStaticVertexBuffer(\n    gl: WebGLRenderingContext, data: Float32Array):
WebGLBuffer {\n  const buffer: WebGLBuffer = throwIfNull<WebGLBuffer>(\n      gl, () => gl.createBuffer(),
'Unable to create WebGLBuffer');\n  callAndCheck(gl, () => gl.bindBuffer(gl.ARRAY_BUFFER, buffer));\n
callAndCheck(gl, () => gl.bufferData(gl.ARRAY_BUFFER, data, gl.STATIC_DRAW));\n  return
buffer;\n}\n\nexport function createStaticIndexBuffer(\n    gl: WebGLRenderingContext, data: Uint16Array):
```

WebGLBuffer {\n const buffer: WebGLBuffer = throwIfNull<WebGLBuffer>(\n   gl, () => gl.createBuffer(),
'Unable to create WebGLBuffer');\n callAndCheck(gl, () => gl.bindBuffer(gl.ELEMENT_ARRAY_BUFFER,
 buffer));\n callAndCheck(\n   gl, () => gl.bufferData(gl.ELEMENT_ARRAY_BUFFER, data,
gl.STATIC_DRAW));\n return buffer;\n}\n\nexport function getNumChannels(): number {\n if
(env().getNumber('WEBGL_VERSION') === 2) {\n   return 1;\n }\n return 4;\n}\n\nexport function
createTexture(gl: WebGLRenderingContext): WebGLTexture {\n return throwIfNull<WebGLTexture>(\n   gl, ()
=> gl.createTexture(), 'Unable to create WebGLTexture.');\n}\n\nexport function validateTextureSize(width:
number, height: number) {\n const maxTextureSize = env().getNumber('WEBGL_MAX_TEXTURE_SIZE');\n if
((width <= 0) || (height <= 0)) {\n   const requested = `[${width}x${height}]`;\n   throw new Error('Requested
texture size ' + requested + ' is invalid.');\n }\n if ((width > maxTextureSize) || (height > maxTextureSize)) {\n
const requested = `[${width}x${height}]`;\n   const max = `[${maxTextureSize}x${maxTextureSize}]`;\n   throw
new Error(\n   'Requested
 texture size ' + requested +\n   ' greater than WebGL maximum on this browser / GPU ' + max + '.');\n
}\n}\n\nexport function createFramebuffer(gl: WebGLRenderingContext): WebGLFramebuffer {\n return
throwIfNull<WebGLFramebuffer>(\n   gl, () => gl.createFramebuffer(), 'Unable to create
WebGLFramebuffer.');\n}\n\nexport function bindVertexBufferToProgramAttribute(\n   gl:
WebGLRenderingContext, program: WebGLProgram, attribute: string,\n   buffer: WebGLBuffer,
arrayEntriesPerItem: number, itemStrideInBytes: number,\n   itemOffsetInBytes: number): boolean {\n const loc =
gl.getAttribLocation(program, attribute);\n if (loc === -1) {\n   // The GPU compiler decided to strip out this
attribute because it's unused,\n   // thus no need to bind.\n   return false;\n }\n callAndCheck(gl, () =>
gl.bindBuffer(gl.ARRAY_BUFFER, buffer));\n callAndCheck(\n   gl,\n   () => gl.vertexAttribPointer(\n
loc, arrayEntriesPerItem, gl.FLOAT, false, itemStrideInBytes,\n
        itemOffsetInBytes));\n callAndCheck(gl, () => gl.enableVertexAttribArray(loc));\n return true;\n}\n\nexport
function bindTextureUnit(\n   gl: WebGLRenderingContext, texture: WebGLTexture, textureUnit: number) {\n
validateTextureUnit(gl, textureUnit);\n callAndCheck(gl, () => gl.activeTexture(gl.TEXTURE0 + textureUnit));\n
callAndCheck(gl, () => gl.bindTexture(gl.TEXTURE_2D, texture));\n}\n\nexport function unbindTextureUnit(\n
gl: WebGLRenderingContext, textureUnit: number) {\n validateTextureUnit(gl, textureUnit);\n callAndCheck(gl,
() => gl.activeTexture(gl.TEXTURE0 + textureUnit));\n callAndCheck(gl, () => gl.bindTexture(gl.TEXTURE_2D,
null));\n}\n\nexport function getProgramUniformLocationOrThrow(\n   gl: WebGLRenderingContext, program:
WebGLProgram,\n   uniformName: string): WebGLUniformLocation {\n return
throwIfNull<WebGLUniformLocation>(\n   gl, () => gl.getUniformLocation(program, uniformName),\n
'uniform \"' + uniformName + '\" not present in
 program.');\n}\n\nexport function getProgramUniformLocation(\n   gl: WebGLRenderingContext, program:
WebGLProgram,\n   uniformName: string): WebGLUniformLocation {\n return gl.getUniformLocation(program,
uniformName);\n}\n\nexport function bindTextureToProgramUniformSampler(\n   gl: WebGLRenderingContext,
texture: WebGLTexture,\n   uniformSamplerLocation: WebGLUniformLocation, textureUnit: number) {\n
callAndCheck(gl, () => bindTextureUnit(gl, texture, textureUnit));\n callAndCheck(gl, () =>
gl.uniform1i(uniformSamplerLocation, textureUnit));\n}\n\nexport function bindCanvasToFramebuffer(gl:
WebGLRenderingContext) {\n callAndCheck(gl, () => gl.bindFramebuffer(gl.FRAMEBUFFER, null));\n
callAndCheck(gl, () => gl.viewport(0, 0, gl.canvas.width, gl.canvas.height));\n callAndCheck(gl, () => gl.scissor(0,
0, gl.canvas.width, gl.canvas.height));\n}\n\nexport function bindColorTextureToFramebuffer(\n   gl:
WebGLRenderingContext, texture: WebGLTexture,\n   framebuffer: WebGLFramebuffer)
 {\n callAndCheck(gl, () => gl.bindFramebuffer(gl.FRAMEBUFFER, framebuffer));\n callAndCheck(\n   gl,\n
() => gl.framebufferTexture2D(\n   gl.FRAMEBUFFER, gl.COLOR_ATTACHMENT0, gl.TEXTURE_2D,
texture, 0));\n}\n\nexport function unbindColorTextureFromFramebuffer(\n   gl: WebGLRenderingContext,
framebuffer: WebGLFramebuffer) {\n callAndCheck(gl, () => gl.bindFramebuffer(gl.FRAMEBUFFER,
framebuffer));\n callAndCheck(\n   gl,\n   () => gl.framebufferTexture2D(\n   gl.FRAMEBUFFER,
gl.COLOR_ATTACHMENT0, gl.TEXTURE_2D, null, 0));\n}\n\nexport function validateFramebuffer(gl:

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WebGLRenderingContext) {\n  const status = gl.checkFramebufferStatus(gl.FRAMEBUFFER);\n  if (status !==
gl.FRAMEBUFFER_COMPLETE) {\n    throw new Error(\n        'Error binding framebuffer: ' +
getFramebufferErrorMessage(gl, status));\n  }\n}\n\nexport function getFramebufferErrorMessage(\n    gl:
WebGLRenderingContext, status: number): string {\n  switch (status) {\n    case
gl.FRAMEBUFFER_INCOMPLETE_ATTACHMENT:\n
      return 'FRAMEBUFFER_INCOMPLETE_ATTACHMENT';\n    case
gl.FRAMEBUFFER_INCOMPLETE_MISSING_ATTACHMENT:\n      return
'FRAMEBUFFER_INCOMPLETE_MISSING_ATTACHMENT';\n    case
gl.FRAMEBUFFER_INCOMPLETE_DIMENSIONS:\n      return
'FRAMEBUFFER_INCOMPLETE_DIMENSIONS';\n    case gl.FRAMEBUFFER_UNSUPPORTED:\n      return
'FRAMEBUFFER_UNSUPPORTED';\n    default:\n      return `unknown error ${status}`;\n  }\n}\n\nfunction
throwIfNull<T>(\n    gl: WebGLRenderingContext, returnTOrNull: () => T | null,\n    failureMessage: string): T {\n
const tOrNull: T|null = callAndCheck(gl, () => returnTOrNull());\n  if (tOrNull == null) {\n    throw new
Error(failureMessage);\n  }\n  return tOrNull;\n}\n\nfunction validateTextureUnit(gl: WebGLRenderingContext,
textureUnit: number) {\n  const maxTextureUnit = gl.MAX_COMBINED_TEXTURE_IMAGE_UNITS - 1;\n
const glTextureUnit = textureUnit + gl.TEXTURE0;\n  if (glTextureUnit < gl.TEXTURE0 || glTextureUnit >
maxTextureUnit) {\n    const
  textureUnitRange = `[gl.TEXTURE0, gl.TEXTURE${maxTextureUnit}]`;\n    throw new Error(`textureUnit must
be in ${textureUnitRange}.`);\n  }\n}\n\nexport function getBatchDim(shape: number[], dimsToSkip = 2): number
{\n  return util.sizeFromShape(shape.slice(0, shape.length - dimsToSkip));\n}\n\nexport function
getRowsCols(shape: number[]): [number, number] {\n  if (shape.length === 0) {\n    throw Error('Cannot get rows
and columns of an empty shape array.');\n  }\n\n  return [\n    shape.length > 1 ? shape[shape.length - 2] : 1,
shape[shape.length - 1]\n  ];\n}\n\nexport function getShapeAs3D(shape: number[]): [number, number, number] {\n
let shapeAs3D: [number, number, number] = [1, 1, 1];\n  const isScalar = shape.length === 0 || (shape.length === 1
&& shape[0] === 1);\n  if (!isScalar) {\n    shapeAs3D =\n        [getBatchDim(shape), ...getRowsCols(shape)] as
[number, number, number];\n  }\n  return shapeAs3D;\n}\n\nexport function getTextureShapeFromLogicalShape(\n
  logShape:
  number[], isPacked = false): [number, number] {\n  let maxTexSize =
env().getNumber('WEBGL_MAX_TEXTURE_SIZE');\n  if (isPacked) {\n    maxTexSize = maxTexSize * 2;\n\n
// This logic ensures we accurately count the number of packed texels needed\n    // to accommodate the tensor. We
can only pack values in the same texel if\n    // they are from adjacent pairs of rows/cols within the same batch. So if
a\n    // tensor has 3 rows, we pretend it has 4 rows in order to account for the\n    // fact that the texels containing the
third row are half empty.\n    logShape = logShape.map(\n        (d, i) => i >= logShape.length - 2 ?\n
util.nearestLargerEven(logShape[i]) :\n            logShape[i]);\n\n    // Packed texture height is at least 2 (the channel
height of a single\n    // texel).\n    if (logShape.length === 1) {\n      logShape = [2, logShape[0]];\n    }\n  }\n\n  // If
logical shape is 2, we don't squeeze, since we want to match physical.\n  if (logShape.length !==
  2) {\n    const squeezeResult = util.squeezeShape(logShape);\n    logShape = squeezeResult.newShape;\n  }\n\n  let
size = util.sizeFromShape(logShape);\n  if (logShape.length <= 1 && size <= maxTexSize) {\n    return [1, size];\n
} else if (\n      logShape.length === 2 && logShape[0] <= maxTexSize &&\n      logShape[1] <= maxTexSize) {\n
return logShape as [number, number];\n  } else if (\n      logShape.length === 3 && logShape[0] * logShape[1] <=
maxTexSize &&\n      logShape[2] <= maxTexSize) {\n    return [logShape[0] * logShape[1], logShape[2]];\n  } else
if (\n      logShape.length === 3 && logShape[0] <= maxTexSize &&\n      logShape[1] * logShape[2] <=
maxTexSize) {\n    return [logShape[0], logShape[1] * logShape[2]];\n  } else if (\n      logShape.length === 4 &&\n
    logShape[0] * logShape[1] * logShape[2] <= maxTexSize &&\n      logShape[3] <= maxTexSize) {\n    return
[logShape[0] * logShape[1] * logShape[2], logShape[3]];\n  } else if (\n      logShape.length === 4
  && logShape[0] <= maxTexSize &&\n      logShape[1] * logShape[2] * logShape[3] <= maxTexSize) {\n    return
[logShape[0], logShape[1] * logShape[2] * logShape[3]];\n  } else {\n    if (isPacked) {\n      // For packed textures
size equals the number of channels required to\n      // accommodate the texture data. However in order to squarify
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such that\n      // inner dimensions stay even, we rewrite size to equal the number of\n      // texels. Then in the return statement we rehydrate the squarified\n      // dimensions to channel units.\n\n      const batchDim = getBatchDim(logShape);\n      let rows = 2, cols = 2;\n      if (logShape.length) {\n        [rows, cols] = getRowsCols(logShape);\n      }\n      size = batchDim * (rows / 2) * (cols / 2);\n      return util.sizeToSquarishShape(size).map(d => d * 2) as [number, number];\n    }\n    return util.sizeToSquarishShape(size);\n  }\n}\n\nfunction isEven(n: number): boolean {\n  return n % 2 === 0;\n}\n\n/**\n * This determines whether
 reshaping a packed texture requires rearranging\n * the data within the texture, assuming 2x2 packing.\n */\nexport function isReshapeFree(shape1: number[], shape2: number[]): boolean {\n  shape1 = shape1.slice(-2);\n  shape2 = shape2.slice(-2);\n\n  if (util.arraysEqual(shape1, shape2)) {\n    return true;\n  }\n\n  if (!shape1.length || !shape2.length) {  // One of the shapes is a scalar.\n    return true;\n  }\n\n  if (shape1[0] === 0 || shape1[1] === 0 || shape2[0] === 0 ||\n      shape2[1] === 0) {\n    return true;\n  }\n\n  if (shape1.length !== shape2.length) {  // One of the shapes is a vector.\n    const shape1Cols = shape1.slice(-1)[0];\n    const shape2Cols = shape2.slice(-1)[0];\n    if (shape1Cols === shape2Cols) {\n      return true;\n    }\n\n    if (isEven(shape1Cols) && isEven(shape2Cols) &&\n      (shape1[0] === 1 || shape2[0] === 1)) {\n      return true;\n    }\n  }\n  return shape1[1] === shape2[1] && isEven(shape1[0]) && isEven(shape2[0]);\n}\n\n// We cache
 webgl params because the environment gets reset between\n// unit tests and we don't want to constantly query the WebGLContext for\n// MAX_TEXTURE_SIZE.\nlet MAX_TEXTURE_SIZE: number;\nlet MAX_TEXTURES_IN_SHADER: number;\n\nexport function getWebGLMaxTextureSize(webGLVersion: number): number {\n  if (MAX_TEXTURE_SIZE == null) {\n    const gl = getWebGLContext(webGLVersion);\n    MAX_TEXTURE_SIZE = gl.getParameter(gl.MAX_TEXTURE_SIZE);\n  }\n  return MAX_TEXTURE_SIZE;\n}\n\nexport function resetMaxTextureSize() {\n  MAX_TEXTURE_SIZE = null;\n}\nexport function resetMaxTexturesInShader() {\n  MAX_TEXTURES_IN_SHADER = null;\n}\n\nexport function getMaxTexturesInShader(webGLVersion: number): number {\n  if (MAX_TEXTURES_IN_SHADER == null) {\n    const gl = getWebGLContext(webGLVersion);\n    MAX_TEXTURES_IN_SHADER = gl.getParameter(gl.MAX_TEXTURE_IMAGE_UNITS);\n  }\n  // We cap at 16 to avoid spurious runtime \"memory exhausted\" error.\n  return Math.min(16, MAX_TEXTURES_IN_SHADER);\n}\n\nexport
 function getWebGLDisjointQueryTimerVersion(webGLVersion: number):\n    number {\n  if (webGLVersion === 0) {\n    return 0;\n  }\n\n  let queryTimerVersion: number;\n  const gl = getWebGLContext(webGLVersion);\n\n  if (hasExtension(gl, 'EXT_disjoint_timer_query_webgl2') &&\n      webGLVersion === 2) {\n    queryTimerVersion = 2;\n  } else if (hasExtension(gl, 'EXT_disjoint_timer_query')) {\n    queryTimerVersion = 1;\n  } else {\n    queryTimerVersion = 0;\n  }\n  return queryTimerVersion;\n}\n\nexport function hasExtension(gl: WebGLRenderingContext, extensionName: string) {\n  const ext = gl.getExtension(extensionName);\n  return ext != null;\n}\n\nexport function isWebGLVersionEnabled(webGLVersion: 1|2) {\n  try {\n    const gl = getWebGLContext(webGLVersion);\n    if (gl != null) {\n      return true;\n    }\n  } catch (e) {\n    console.log('Error when getting WebGL context: ', e);\n    return false;\n  }\n  return false;\n}\n\nexport function isCapableOfRenderingToFloatTexture(webGLVersion:
 number):\n    boolean {\n  if (webGLVersion === 0) {\n    return false;\n  }\n\n  const gl = getWebGLContext(webGLVersion);\n\n  if (webGLVersion === 1) {\n    if (!hasExtension(gl, 'OES_texture_float')) {\n      return false;\n    }\n  } else {\n    if (!hasExtension(gl, 'EXT_color_buffer_float')) {\n      return false;\n    }\n  }\n\n  const isFrameBufferComplete = createFloatTextureAndBindToFramebuffer(gl);\n  return isFrameBufferComplete;\n}\n\n/**\n * Check if we can download values from a float/half-float texture.\n *\n * Note that for performance reasons we use binding a texture to a framebuffer\n * as a proxy for ability to download float values later using readPixels. The\n * texture params of this texture will not match those in readPixels exactly\n * but if we are unable to bind some kind of float texture to the frameBuffer\n * then we definitely will not be able to read float values from it.\n */\nexport function isDownloadFloatTextureEnabled(webGLVersion:
 number): boolean {\n  if (webGLVersion === 0) {\n    return false;\n  }\n\n  const gl = getWebGLContext(webGLVersion);\n\n  if (webGLVersion === 1) {\n    if (!hasExtension(gl, 'OES_texture_float'))
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{\n return false;\n }\n if (!hasExtension(gl, 'WEBGL_color_buffer_float')) {\n return false;\n }\n } else {\n if (hasExtension(gl, 'EXT_color_buffer_float')) {\n return createFloatTextureAndBindToFramebuffer(gl);\n }\n\n const COLOR_BUFFER_HALF_FLOAT = 'EXT_color_buffer_half_float';\n if (hasExtension(gl, COLOR_BUFFER_HALF_FLOAT)) {\n const textureHalfFloatExtension =\n gl.getExtension(COLOR_BUFFER_HALF_FLOAT);\n return createHalfFloatTextureAndBindToFramebuffer(\n gl, textureHalfFloatExtension);\n }\n\n return false;\n}\n\n const isFrameBufferComplete = createFloatTextureAndBindToFramebuffer(gl);\n return isFrameBufferComplete;\n}\n\nfunction createFloatTextureAndBindToFramebuffer(gl: WebGLRenderingContext):\n boolean {\n const texConfig = getTextureConfig(gl);\n\n const texture = gl.createTexture();\n gl.bindTexture(gl.TEXTURE_2D, texture);\n\n const width = 1;\n const height = 1;\n gl.texImage2D(\n gl.TEXTURE_2D, 0, texConfig.internalFormatFloat, width, height, 0,\n texConfig.textureFormatFloat, texConfig.textureTypeFloat, null);\n\n const frameBuffer = gl.createFramebuffer();\n gl.bindFramebuffer(gl.FRAMEBUFFER, frameBuffer);\n gl.framebufferTexture2D(\n gl.FRAMEBUFFER, gl.COLOR_ATTACHMENT0, gl.TEXTURE_2D, texture, 0);\n\n const isFrameBufferComplete =\n gl.checkFramebufferStatus(gl.FRAMEBUFFER) === gl.FRAMEBUFFER_COMPLETE;\n\n gl.bindTexture(gl.TEXTURE_2D, null);\n gl.bindFramebuffer(gl.FRAMEBUFFER, null);\n gl.deleteTexture(texture);\n gl.deleteFramebuffer(frameBuffer);\n\n return isFrameBufferComplete;\n}\n\nfunction createHalfFloatTextureAndBindToFramebuffer(\n // tslint:disable-next-line:no-any\n gl: WebGLRenderingContext, textureHalfFloatExtension:\n any): boolean {\n const texConfig = getTextureConfig(gl, textureHalfFloatExtension);\n const texture = gl.createTexture();\n gl.bindTexture(gl.TEXTURE_2D, texture);\n\n const width = 1;\n const height = 1;\n gl.texImage2D(\n gl.TEXTURE_2D, 0, texConfig.internalFormatHalfFloat, width, height, 0,\n texConfig.textureFormatFloat, texConfig.textureTypeHalfFloat, null);\n\n const frameBuffer = gl.createFramebuffer();\n gl.bindFramebuffer(gl.FRAMEBUFFER, frameBuffer);\n gl.framebufferTexture2D(\n gl.FRAMEBUFFER, gl.COLOR_ATTACHMENT0, gl.TEXTURE_2D, texture, 0);\n\n const isFrameBufferComplete =\n gl.checkFramebufferStatus(gl.FRAMEBUFFER) === gl.FRAMEBUFFER_COMPLETE;\n\n gl.bindTexture(gl.TEXTURE_2D, null);\n gl.bindFramebuffer(gl.FRAMEBUFFER, null);\n gl.deleteTexture(texture);\n gl.deleteFramebuffer(frameBuffer);\n\n return isFrameBufferComplete;\n}\n\nexport function isWebGLFenceEnabled(webGLVersion: number) {\n if (webGLVersion !== 2) {\n return false;\n }\n const gl = getWebGLContext(webGLVersion);\n\n // tslint:disable-next-line:no-any\n const isEnabled = (gl as any).fenceSync != null;\n return isEnabled;\n}\n\nexport function assertNotComplex(\n tensor: TensorInfo|TensorInfo[], opName: string): void {\n if (!Array.isArray(tensor)) {\n tensor = [tensor];\n }\n tensor.forEach(t => {\n if (t != null) {\n util.assert(\n t.dtype !== 'complex64',\n () => `${opName} does not support complex64 tensors ` +\n 'in the WebGL backend.');\n }\n });\n}\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ===\n */\n\nimport {device_util, env} from '@tensorflow/tfjs-core';\n\nimport {getMaxTexturesInShader, getWebGLDisjointQueryTimerVersion, getWebGLMaxTextureSize, isCapableOfRenderingToFloatTexture, isDownloadFloatTextureEnabled, isWebGLFenceEnabled, isWebGLVersionEnabled} from './webgl_util';\n\nconst ENV = env();\n\n/**\n * This file contains WebGL-specific flag registrations.\n */\n\n/**\n * True if WebGL is supported.\n */\nENV.registerFlag('HAS_WEBGL', () => ENV.getNumber('WEBGL_VERSION') > 0);\n\n/** 0:

No WebGL, 1: WebGL 1.0, 2: WebGL 2.0. */\nENV.registerFlag('WEBGL_VERSION', () => {\n if (isWebGLVersionEnabled(2)) {\n   return 2;\n } else if (isWebGLVersionEnabled(1)) {\n   return 1;\n }\n return 0;\n});\n\n/** Whether to check for numerical representation problems. */\nENV.registerFlag('WEBGL_CHECK_NUMERICAL_PROBLEMS', () => false);\n\nENV.registerFlag(\n'WEBGL_BUFFER_SUPPORTED', () => ENV.get('WEBGL_VERSION') === 2);\n\n/** Whether the WebGL backend will sometimes forward ops to the CPU. */\nENV.registerFlag('WEBGL_CPU_FORWARD', () => true);\n\n/** Whether the WebGL backend will always use f16 textures for rendering. */\nENV.registerFlag('WEBGL_FORCE_F16_TEXTURES', () => false);\n\n/** Whether to turn all packing related flags on. */\nENV.registerFlag('WEBGL_PACK', () => ENV.getBool('HAS_WEBGL'));\n\n/** Whether we will pack the batchnormalization op. */\nENV.registerFlag('WEBGL_PACK_NORMALIZATION', () => ENV.getBool('WEBGL_PACK'));\n\n/** Whether we will pack the clip op. */\nENV.registerFlag('WEBGL_PACK_CLIP', () => ENV.getBool('WEBGL_PACK'));\n\n/** Whether we will pack the depthwise conv op. */\n// TODO: https://github.com/tensorflow/tfjs/issues/1679\nENV.registerFlag('WEBGL_PACK_DEPTHWISECONV', () => false);\n\n/** Whether we will pack binary ops. */\nENV.registerFlag(\n'WEBGL_PACK_BINARY_OPERATIONS', () => ENV.getBool('WEBGL_PACK'));\n\n/** Whether we will pack unary ops. */\nENV.registerFlag(\n   'WEBGL_PACK_UNARY_OPERATIONS', () => ENV.getBool('WEBGL_PACK'));\n\n/** Whether we will pack array ops. */\nENV.registerFlag(\n'WEBGL_PACK_ARRAY_OPERATIONS', () => ENV.getBool('WEBGL_PACK'));\n\n/** Whether we will pack image ops. */\nENV.registerFlag(\n   'WEBGL_PACK_IMAGE_OPERATIONS', () => ENV.getBool('WEBGL_PACK'));\n\n/** Whether we will pack reduce ops. */\nENV.registerFlag('WEBGL_PACK_REDUCE', () => ENV.getBool('WEBGL_PACK'));\n\n/** Whether packed WebGL kernels lazily unpack their outputs. */\nENV.registerFlag('WEBGL_LAZILY_UNPACK', () => ENV.getBool('WEBGL_PACK'));\n\n/** Whether we will use the im2col algorithm to speed up convolutions. */\nENV.registerFlag('WEBGL_CONV_IM2COL', () => ENV.getBool('WEBGL_PACK'));\n\n/** The maximum texture dimension. */\nENV.registerFlag(\n   'WEBGL_MAX_TEXTURE_SIZE',\n   () => getWebGLMaxTextureSize(ENV.getNumber('WEBGL_VERSION')));\n\n/** The maximum texture dimension. */\nENV.registerFlag(\n   'WEBGL_MAX_TEXTURES_IN_SHADER',\n   () => getMaxTexturesInShader(ENV.getNumber('WEBGL_VERSION')));\n\n/**\n * The disjoint_query_timer extension version.\n * 0: disabled, 1: EXT_disjoint_timer_query, 2:\n * EXT_disjoint_timer_query_webgl2.\n * In Firefox with WebGL 2.0,\n * EXT_disjoint_timer_query_webgl2 is not available, so we must use the\n * WebGL 1.0 extension.\n */\nENV.registerFlag('WEBGL_DISJOINT_QUERY_TIMER_EXTENSION_VERSION', () => {\n const webGLVersion = ENV.getNumber('WEBGL_VERSION');\n\n if (webGLVersion === 0) {\n   return 0;\n }\n return getWebGLDisjointQueryTimerVersion(webGLVersion);\n});\n\n/**\n * Whether the timer object from the disjoint_query_timer extension gives\n * timing information that is reliable.\n */\nENV.registerFlag(\n'WEBGL_DISJOINT_QUERY_TIMER_EXTENSION_RELIABLE',\n   () => ENV.getNumber('WEBGL_DISJOINT_QUERY_TIMER_EXTENSION_VERSION') > 0 &&\n!device_util.isMobile());\n\n/**\n * Whether the device is physically capable of rendering to float32 textures.\n */\nENV.registerFlag(\n   'WEBGL_RENDER_FLOAT32_CAPABLE',\n   () => isCapableOfRenderingToFloatTexture(ENV.getNumber('WEBGL_VERSION')));\n\n/**\n * Whether rendering to float32 textures is enabled. If disabled, renders to\n * float16 textures.\n */\nENV.registerFlag('WEBGL_RENDER_FLOAT32_ENABLED', () => {\n return ENV.getBool('WEBGL_FORCE_F16_TEXTURES') ?\n   false :\n   ENV.getBool('WEBGL_RENDER_FLOAT32_CAPABLE');\n});\n\n/**\n * Whether downloading float textures is enabled (16 or 32 bit). If disabled,\n * uses IEEE 754 encoding of the float32 values to 4 uint8 when downloading.\n */\nENV.registerFlag(\n   'WEBGL_DOWNLOAD_FLOAT_ENABLED',\n   () => isDownloadFloatTextureEnabled(ENV.getNumber('WEBGL_VERSION')));\n\n/** Whether the fence API is

available.
*/\nENV.registerFlag(\n 'WEBGL_FENCE_API_ENABLED',\n () => isWebGLFenceEnabled(ENV.getNumber('WEBGL_VERSION')));\n\n/**\n * Tensors with size <= than this will be uploaded as uniforms, not textures.\n */\nENV.registerFlag('WEBGL_SIZE_UPLOAD_UNIFORM', () => {\n // Use uniform uploads only when 32bit floats are supported. In\n // 16bit\n // environments there are problems with comparing a 16bit texture value\n // with a 32bit uniform value.\n const useUniforms = ENV.getBool('WEBGL_RENDER_FLOAT32_ENABLED');\n return useUniforms ? 4 : 0;\n});\n\n/**\n * If the total number of bytes allocated on the GPU is greater than this\n * number, we will aggressively delete textures upon disposal with\n * gl.deleteMatrixTexture, rather than making them available for reuse.\n *\n * Default value -1 indicates that we will never aggressively delete textures.\n */\nENV.registerFlag('WEBGL_DELETE_TEXTURE_THRESHOLD',\n () => {\n return -1;\n },\n threshold => {\n if (threshold < 0 && threshold !== -1) {\n throw new Error(\n `WEBGL_DELETE_TEXTURE_THRESHOLD must be -1 (indicating never ` +\n `delete) or at least 0, but got ${threshold}.`);\n }\n });\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\nimport {env} from '@tensorflow/tfjs-core';\n\nexport type GLSL = {\n version: string,\n attribute: string,\n varyingVs: string,\n varyingFs: string,\n texture2D: string,\n output: string,\n defineOutput: string,\n defineSpecialNaN: string,\n defineSpecialInf: string,\n defineRound: string\n};\n\nexport function getGlslDifferences(): GLSL {\n let version: string;\n let attribute: string;\n let varyingVs: string;\n let varyingFs: string;\n let texture2D: string;\n let output: string;\n let defineOutput: string;\n let defineSpecialNaN: string;\n let defineSpecialInf: string;\n let defineRound: string;\n\n if (env().getNumber('WEBGL_VERSION') === 2) {\n version = '#version 300 es';\n attribute = 'in';\n varyingVs = 'out';\n varyingFs = 'in';\n texture2D = 'texture';\n output = 'outputColor';\n defineOutput = 'out vec4 outputColor;';\n\n // Use custom isnan definition to work across differences between\n // implementations on various platforms. While this should happen in ANGLE\n // we still see differences between android and windows (on chrome) when\n // using isnan directly.\n defineSpecialNaN = `\n bool isnan_custom(float val) {\n return (val > 0.0 || val < 0.0) ? false : val != 0.0;\n }\n\n bvec4 isnan_custom(vec4 val) {\n return bvec4(isnan_custom(val.x),\n isnan_custom(val.y), isnan_custom(val.z), isnan_custom(val.w));\n }\n\n #define isnan(value) isnan_custom(value)\n `;\n // In webgl 2 we do not need to specify a custom isinf so there is no\n // need for a special INFINITY constant.\n defineSpecialInf = ``;\n defineRound = `\n #define round(value) newRound(value)\n int newRound(float value) {\n return int(floor(value + 0.5));\n }\n\n ivec4 newRound(vec4 value) {\n return ivec4(floor(value + vec4(0.5)));\n }\n `;\n } else {\n version = '';\n attribute = 'attribute';\n varyingVs = 'varying';\n varyingFs = 'varying';\n texture2D = 'texture2D';\n output = 'gl_FragColor';\n defineOutput = '';\n // WebGL1 has no built in isnan so we define one here.\n defineSpecialNaN = `\n #define isnan(value) isnan_custom(value)\n bool isnan_custom(float val) {\n return (val > 0. || val < 1. || val == 0.) ? false : true;\n }\n bvec4 isnan_custom(vec4 val) {\n return bvec4(isnan(val.x), isnan(val.y), isnan(val.z), isnan(val.w));\n }\n `;\n defineSpecialInf = `\n uniform float INFINITY;\n\n bool isinf(float val) {\n return abs(val) == INFINITY;\n }\n bvec4 isinf(vec4 val) {\n return equal(abs(val), vec4(INFINITY));\n }\n `;\n defineRound = `\n int round(float value) {\n return int(floor(value + 0.5));\n }\n\n ivec4 round(vec4 value) {\n return ivec4(floor(value + vec4(0.5)));\n }\n `;\n }\n\n return {\n version,\n attribute,\n varyingVs,\n varyingFs,\n texture2D,\n

output,\n defineOutput,\n
  defineSpecialNaN,\n defineSpecialInf,\n defineRound\n };\n}\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {util} from '@tensorflow/tfjs-core';\n\n/**\n * Produces GLSL code that derives logical coordinates from a flat\n * index. The code performs integer division with each stride and decrements\n
 * the index until the index equals the final dimension coordinate.\n */\nexport function getLogicalCoordinatesFromFlatIndex(\n coords: string[], shape: number[], index = 'index'): string {\n const strides = util.computeStrides(shape);\n return strides\n .map((stride, i) => {\n const line1 = `int ${coords[i]} = ${index} / ${stride}`;\n const line2 = i === strides.length - 1 ?\n `int ${coords[i + 1]} = ${index} - ${coords[i]} * ${stride}` :\n `index -= ${coords[i]} * ${stride}`;\n return `${line1}; ${line2};`;\n })\n
  .join('');\n}\n\nfunction buildVec(x: string[]): string {\n if (x.length === 1) {\n return `${x[0]}`;\n }\n return `vec${x.length}(${x.join(',')})`;\n}\n\n/**\n * Produces GLSL code that computes the dot product of the input x and y\n * vectors. Handles splitting inputs into increments of vec4s when necessary.\n */\nexport function dotify(x: string[], y: string[]): string {\n if (x.length !== y.length)
 {\n throw new Error(\n `Vectors to be dotted must be of the same length -` +\n `got ${x.length} and ${y.length}`);\n }\n\n const slices: string[] = [];\n const nearestVec4 = Math.floor(x.length / 4);\n const nearestVec4Remainder = x.length % 4;\n\n for (let i = 0; i < nearestVec4; i++) {\n const xSlice = x.slice(i * 4, i * 4 + 4);\n const ySlice = y.slice(i * 4, i * 4 + 4);\n slices.push(`${buildVec(xSlice)}, ${buildVec(ySlice)}`);\n }\n\n if (nearestVec4Remainder !== 0) {\n let xSlice = x.slice(nearestVec4 * 4);\n let ySlice = y.slice(nearestVec4 * 4);\n if (xSlice.length === 1) {\n xSlice = xSlice.map(d => `float(${d})`);\n ySlice = ySlice.map(d => `float(${d})`);\n }\n slices.push(`${buildVec(xSlice)}, ${buildVec(ySlice)}`);\n }\n\n return slices.map((d, i) => `dot(${d})`).join('+');\n}\n\n/**\n * Produces GLSL that computes the flat index from 3D coordinates.\n */\nexport function getFlatIndexFrom3D(shape: [number, number,
 number]): string {\n const strides = util.computeStrides(shape).map(d => d.toString());\n\n return `\n int getFlatIndex(ivec3 coords) {\n  return coords.x * ${strides[0]} + coords.y * ${strides[1]} + coords.z;\n }\n`;\n}\n\nexport const ENCODE_FLOAT_SNIPPET = `\n const float FLOAT_MAX = 1.70141184e38;\n const float FLOAT_MIN = 1.17549435e-38;\n\n lowp vec4 encode_float(highp float v) {\n if (isnan(v)) {\n return vec4(255, 255, 255, 255);\n }\n\n highp float av = abs(v);\n\n if(av < FLOAT_MIN) {\n return vec4(0.0, 0.0, 0.0, 0.0);\n } else if(v > FLOAT_MAX) {\n return vec4(0.0, 0.0, 128.0, 127.0) / 255.0;\n } else if(v < -FLOAT_MAX) {\n return vec4(0.0, 0.0, 128.0, 255.0) / 255.0;\n }\n\n highp vec4 c = vec4(0,0,0,0);\n\n highp float e = floor(log2(av));\n highp float m = exp2(fract(log2(av))) - 1.0;\n\n c[2] = floor(128.0 * m);\n m -= c[2] / 128.0;\n c[1] = floor(32768.0 * m);\n m -= c[1] / 32768.0;\n c[0] = floor(8388608.0 * m);\n\n highp float ebias = e + 127.0;\n c[3] = floor(ebias / 2.0);\n ebias -= c[3] * 2.0;\n c[2] += floor(ebias) * 128.0;\n\n c[3] += 128.0 * step(0.0, -v);\n\n return c / 255.0;\n }\n`;\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {getGlslDifferences} from './glsl_version';\nimport

{GPGPUProgram} from './gpgpu_math';\nimport * as shader_util from './shader_compiler_util';\nimport {getDenseTexShape, PackingScheme} from './tex_util';\n\nexport class DecodeMatrixProgram implements GPGPUProgram {\n variableNames = ['A'];\n userCode: string;\n outputShape: [number, number, number];\n packedInputs = false;\n packedOutput = true;\n outPackingScheme = PackingScheme.DENSE;\n\n constructor(outputShape: [number, number, number]) {\n const texShape = getDenseTexShape(outputShape);\n const glsl = getGlslDifferences();\n this.outputShape = outputShape;\n\n this.userCode = `\n ivec3 outCoordsFromFlatIndex(int index) {\n ${\n shader_util.getLogicalCoordinatesFromFlatIndex(\n ['r', 'c', 'd'], outputShape)}\n return ivec3(r, c, d);\n }\n\n void main() {\n ivec2 resTexRC = ivec2(resultUV.yx *\n vec2(${texShape[0]}, ${texShape[1]}));\n int index = 4 * (resTexRC.x * ${texShape[1]} +
resTexRC.y);\n\n vec4 result = vec4(0.);\n\n for (int i=0; i<4; i++) {\n int flatIndex = index + i;\n ivec3 rc = outCoordsFromFlatIndex(flatIndex);\n result[i] = getA(rc.x, rc.y, rc.z);\n }\n\n ${glsl.output} = result;\n }\n `;\n }\n}\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
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*/\n\nimport {getGlslDifferences} from './glsl_version';\nimport {GPGPUProgram} from './gpgpu_math';\nimport * as shader_util from './shader_compiler_util';\nimport {getDenseTexShape, PackingScheme} from './tex_util';\n\nexport class DecodeMatrixPackedProgram implements GPGPUProgram {\n variableNames = ['A'];\n userCode: string;\n packedInputs = true;\n packedOutput = true;\n outputShape: [number, number, number];\n outPackingScheme = PackingScheme.DENSE;\n\n constructor(outputShape: [number, number, number]) {\n const texShape = getDenseTexShape(outputShape);\n const glsl = getGlslDifferences();\n this.outputShape = outputShape;\n\n this.userCode = `\n ivec3 outCoordsFromFlatIndex(int index) {\n ${\n shader_util.getLogicalCoordinatesFromFlatIndex(\n ['r', 'c', 'd'], outputShape)}\n return ivec3(r, c, d);\n }\n\n void main() {\n ivec2 resTexRC = ivec2(resultUV.yx *\n vec2(${texShape[0]}, ${texShape[1]}));\n int index = 4 * (resTexRC.x * ${texShape[1]} + resTexRC.y);\n\n vec4 result = vec4(0.);\n\n for (int i=0; i<4; i++) {\n int flatIndex = index + i;\n ivec3 rc = outCoordsFromFlatIndex(flatIndex);\n result[i] = getChannel(getA(rc.x, rc.y, rc.z), vec2(rc.y, rc.z));\n }\n\n ${glsl.output} = result;\n }\n `;\n }\n}\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions
and\n * limitations under the License.\n *
==\n
*/\n\nimport {getGlslDifferences} from './glsl_version';\nimport {GPGPUProgram} from './gpgpu_math';\nimport {ENCODE_FLOAT_SNIPPET} from './shader_compiler_util';\nimport {TextureUsage} from './tex_util';\n\nexport class EncodeFloatProgram implements GPGPUProgram {\n variableNames = ['A'];\n userCode: string;\n outputShape: number[];\n outTexUsage = TextureUsage.DOWNLOAD;\n\n constructor(outputShape: number[]) {\n const glsl = getGlslDifferences();\n this.outputShape = outputShape;\n this.userCode = `\n ${ENCODE_FLOAT_SNIPPET}\n\n void main() {\n float x = getAAtOutCoords();\n ${glsl.output} = encode_float(x);\n }\n `;\n }\n}\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n

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==========\n */\n\nimport {getGlslDifferences} from './glsl_version';\nimport {GPGPUProgram} from './gpgpu_math';\nimport {ENCODE_FLOAT_SNIPPET} from './shader_compiler_util';\nimport {TextureUsage} from './tex_util';\n\nexport class EncodeFloatPackedProgram implements GPGPUProgram {\n variableNames = ['A'];\n userCode: string;\n outputShape: number[];\n packedInputs = true;\n packedOutput = false;\n outTexUsage = TextureUsage.DOWNLOAD;\n\n constructor(outputShape:
[number, number, number]) {\n const glsl = getGlslDifferences();\n this.outputShape = outputShape;\n this.userCode = `\n ${ENCODE_FLOAT_SNIPPET}\n\n void main() {\n ivec3 coords = getOutputCoords();\n float x = getChannel(getAAtOutCoords(), vec2(coords.y, coords.z));\n ${glsl.output} = encode_float(x);\n }\n `;\n }\n}\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n
* ==========\n */\n\nimport {getGlslDifferences} from './glsl_version';\nimport {GPGPUProgram} from './gpgpu_math';\nimport * as shader_util from './shader_compiler_util';\n\nexport class EncodeMatrixProgram implements GPGPUProgram {\n variableNames = ['A'];\n userCode: string;\n outputShape: number[];\n\n constructor(\n outputShape: [number, number, number], texShape: [number, number],\n inputIsUnsignedByte = false) {\n const glsl = getGlslDifferences();\n const [height, width] = texShape;\n this.outputShape = outputShape;\n\n let output = `result`;\n if (inputIsUnsignedByte) {\n output = `floor(result * 255. + 0.5)`;\n }\n\n this.userCode = `\n ${shader_util.getFlatIndexFrom3D(outputShape)}\n\n void main() {\n ivec3 coords = getOutputCoords();\n\n int flatIndex = getFlatIndex(coords);\n int offset = imod(flatIndex, 4);\n\n flatIndex
= idiv(flatIndex, 4, 1.);\n\n int r = flatIndex / ${width};\n int c = imod(flatIndex, ${width});\n vec2 uv = (vec2(c, r) + halfCR) / vec2(${width}.0, ${height}.0);\n vec4 values = ${glsl.texture2D}(A, uv);\n\n float result;\n\n if(offset == 0) {\n result = values[0];\n } else if(offset == 1) {\n result = values[1];\n } else if(offset == 2) {\n result = values[2];\n } else {\n result = values[3];\n }\n\n ${glsl.output} = vec4(${output}, 0., 0., 0.);\n }\n `;\n }\n}\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the
License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {getGlslDifferences} from './glsl_version';\nimport {GPGPUProgram} from './gpgpu_math';\nimport * as shader_util from './shader_compiler_util';\n\n/*\nThis is how the shader encodes a tensor with shape = [2, 3,

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5]\n(indices are [batch, row, col]).\n\n000|001  002|003  004|xxx  020|021  022|023  024|xxx\n------- ------- ------- ------- ------- -------\n010|011  012|013  014|xxx  xxx|xxx  xxx|xxx  xxx|xxx\n\n100|101  102|103  104|xxx  120|121  122|123  124|xxx\n------- ------- ------- ------- ------- -------\n110|111  112|113  114|xxx  xxx|xxx  xxx|xxx  xxx|xxx\n\nSingle texels contain only values from the same batch, and from adjacent rows\nand columns.\n */\n\nexport class EncodeMatrixPackedProgram implements GPGPUProgram {\n variableNames = ['A'];\n userCode: string;\n outputShape: number[];\n packedInputs = false;\n packedOutput = true;\n\n constructor(\n outputShape: [number, number, number], texShape: [number, number],\n inputIsUnsignedByte = false) {\n const glsl = getGlslDifferences();\n const [height, width] = texShape;\n this.outputShape = outputShape;\n\n let mainLoop = '';\n let output = 'result';\n if (inputIsUnsignedByte) {\n output = 'floor(result * 255. + 0.5)';\n }\n\n for (let row = 0; row <= 1; row++) {\n for (let col = 0; col <= 1; col++) {\n const channel = row * 2 + col;\n\n mainLoop += `\n localCoords = coords;\n if(localCoords[2] + ${col} < ${outputShape[2]}) {\n localCoords[2] += ${col};\n if(localCoords[1] + ${row} < ${outputShape[1]}) {\n localCoords[1] += ${row};\n\n flatIndex = getFlatIndex(localCoords);\n offset = imod(flatIndex, 4);\n\n flatIndex = idiv(flatIndex, 4, 1.);\n\n r = flatIndex / ${width};\n c = imod(flatIndex, ${width});\n uv = (vec2(c, r) + halfCR) / vec2(${width}.0, ${height}.0);\n values = ${glsl.texture2D}(A, uv);\n\n if(offset == 0) {\n result[${channel}] = values[0];\n } else if(offset == 1) {\n result[${channel}] = values[1];\n } else if(offset == 2) {\n result[${channel}] = values[2];\n } else {\n result[${channel}] = values[3];\n }\n }\n }\n `;\n }\n }\n\n this.userCode = `\n ${shader_util.getFlatIndexFrom3D(outputShape)}\n\n void main() {\n ivec3 coords = getOutputCoords();\n\n vec4 result = vec4(0.);\n int flatIndex, r, c, offset;\n ivec3 localCoords;\n vec2 uv;\n vec4 values;\n\n ${mainLoop}\n\n ${glsl.output} = ${output};\n }\n `;\n }\n}\n","/**\n * @license\n * Copyright 2017 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n =============================================================================\n */\n\nimport {PixelData, TypedArray} from '@tensorflow/tfjs-core';\n\nimport {getGlslDifferences} from './glsl_version';\nimport * as tex_util from './tex_util';\nimport {TextureConfig} from './tex_util';\nimport * as webgl_util from './webgl_util';\n\nexport function createVertexShader(gl: WebGLRenderingContext): WebGLShader {\n const glsl = getGlslDifferences();\n const vertexShaderSource = `${glsl.version}\n precision highp float;\n ${glsl.attribute} vec3 clipSpacePos;\n ${glsl.attribute} vec2 uv;\n ${glsl.varyingVs} vec2 resultUV;\n\n void main() {\n gl_Position = vec4(clipSpacePos, 1);\n resultUV = uv;\n }`;\n return webgl_util.createVertexShader(gl, vertexShaderSource);\n}\n\nexport function createVertexBuffer(gl: WebGLRenderingContext): WebGLBuffer {\n // [x y z u v] * [upper-left, lower-left, upper-right, lower-right]\n const vertexArray = new Float32Array(\n [-1, 1, 0, 0, 1, -1, -1, 0, 0, 0, 1, 1, 0, 1, 1, 1, -1, 0, 1, 0]);\n return webgl_util.createStaticVertexBuffer(gl, vertexArray);\n}\n\nexport function createIndexBuffer(gl: WebGLRenderingContext): WebGLBuffer {\n // OpenGL (and WebGL) have \"CCW == front\" winding\n const triangleVertexIndices = new Uint16Array([0, 1, 2, 2, 1, 3]);\n return webgl_util.createStaticIndexBuffer(gl, triangleVertexIndices);\n}\n\nfunction createAndConfigureTexture(\n gl: WebGLRenderingContext, width: number, height: number,\n internalFormat: number, textureFormat: number,\n textureType: number): WebGLTexture {\n webgl_util.validateTextureSize(width, height);\n const texture = webgl_util.createTexture(gl);\n\n const tex2d = gl.TEXTURE_2D;\n webgl_util.callAndCheck(gl, () =>
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gl.bindTexture(tex2d, texture));\n  webgl_util.callAndCheck(\n      gl, () => gl.texParameteri(tex2d,
gl.TEXTURE_WRAP_S, gl.CLAMP_TO_EDGE));\n  webgl_util.callAndCheck(\n      gl, () =>
gl.texParameteri(tex2d, gl.TEXTURE_WRAP_T, gl.CLAMP_TO_EDGE));\n  webgl_util.callAndCheck(\n      gl, ()
=> gl.texParameteri(tex2d, gl.TEXTURE_MIN_FILTER, gl.NEAREST));\n  webgl_util.callAndCheck(\n      gl, ()
=> gl.texParameteri(tex2d, gl.TEXTURE_MAG_FILTER,
 gl.NEAREST));\n  webgl_util.callAndCheck(\n      gl,\n      () => gl.texImage2D(\n          tex2d, 0, internalFormat,
width, height, 0, textureFormat,\n          textureType, null));\n  webgl_util.callAndCheck(gl, () =>
gl.bindTexture(gl.TEXTURE_2D, null));\n  return texture;\n}\n\nexport function
getInternalFormatForFloat32MatrixTexture(\n    textureConfig: TextureConfig) {\n  return
textureConfig.internalFormatFloat;\n}\n\nexport function createFloat32MatrixTexture(\n    gl:
WebGLRenderingContext, rows: number, columns: number,\n    textureConfig: TextureConfig): WebGLTexture {\n
const [width, height] =\n      tex_util.getUnpackedMatrixTextureShapeWidthHeight(rows, columns);\n  return
createAndConfigureTexture(\n      gl, width, height,\n
getInternalFormatForFloat32MatrixTexture(textureConfig),\n      textureConfig.textureFormatFloat,
gl.FLOAT);\n}\n\nexport function getInternalFormatForFloat16MatrixTexture(\n    textureConfig: TextureConfig)
{\n  return textureConfig.internalFormatHalfFloat;\n}\n\nexport
 function createFloat16MatrixTexture(\n    gl: WebGLRenderingContext, rows: number, columns: number,\n
textureConfig: TextureConfig): WebGLTexture {\n  const [width, height] =\n
tex_util.getUnpackedMatrixTextureShapeWidthHeight(rows, columns);\n  return createAndConfigureTexture(\n
gl, width, height,\n      getInternalFormatForFloat16MatrixTexture(textureConfig),\n
textureConfig.textureFormatFloat, textureConfig.textureTypeHalfFloat);\n}\n\nexport function
getInternalFormatForUnsignedBytesMatrixTexture(\n    textureConfig: TextureConfig) {\n  return
textureConfig.downloadTextureFormat;\n}\n\nexport function createUnsignedBytesMatrixTexture(\n    gl:
WebGLRenderingContext, rows: number, columns: number,\n    textureConfig: TextureConfig): WebGLTexture {\n
const [width, height] =\n      tex_util.getUnpackedMatrixTextureShapeWidthHeight(rows, columns);\n  return
createAndConfigureTexture(\n      gl, width, height,\n
getInternalFormatForUnsignedBytesMatrixTexture(textureConfig),
 gl.RGBA,\n      gl.UNSIGNED_BYTE);\n}\n\nexport function getInternalFormatForPackedMatrixTexture(\n
textureConfig: TextureConfig) {\n  return textureConfig.internalFormatPackedFloat;\n}\n\nexport function
createPackedMatrixTexture(\n    gl: WebGLRenderingContext, rows: number, columns: number,\n    textureConfig:
TextureConfig): WebGLTexture {\n  const [width, height] =\n
tex_util.getPackedMatrixTextureShapeWidthHeight(rows, columns);\n  return createAndConfigureTexture(\n      gl,
width, height, getInternalFormatForPackedMatrixTexture(textureConfig),\n      gl.RGBA, gl.FLOAT);\n}\n\nexport
function getInternalFormatForFloat16PackedMatrixTexture(\n    textureConfig: TextureConfig) {\n  return
textureConfig.internalFormatPackedHalfFloat;\n}\n\nexport function createFloat16PackedMatrixTexture(\n    gl:
WebGLRenderingContext, rows: number, columns: number,\n    textureConfig: TextureConfig): WebGLTexture {\n
const [width,
 height] =\n      tex_util.getPackedMatrixTextureShapeWidthHeight(rows, columns);\n  return
createAndConfigureTexture(\n      gl, width, height,\n
getInternalFormatForFloat16PackedMatrixTexture(textureConfig), gl.RGBA,\n
textureConfig.textureTypeHalfFloat);\n}\n\nexport function bindVertexProgramAttributeStreams(\n    gl:
WebGLRenderingContext, program: WebGLProgram,\n    vertexBuffer: WebGLBuffer): boolean {\n  const
posOffset = 0;               // x is the first buffer element\n  const uvOffset = 3 * 4;           // uv comes after [x y z]\n
const stride = (3 * 4) + (2 * 4);  // xyz + uv, each entry is 4-byte float.\n  webgl_util.callAndCheck(\n      gl, () =>
gl.bindBuffer(gl.ARRAY_BUFFER, vertexBuffer));\n  const success =
webgl_util.bindVertexBufferToProgramAttribute(\n      gl, program, 'clipSpacePos', vertexBuffer, 3, stride,
posOffset);\n  return success &&\n      webgl_util.bindVertexBufferToProgramAttribute(\n          gl, program, 'uv',
vertexBuffer, 2, stride, uvOffset);\n}\n\nexport
```

```
function uploadDenseMatrixToTexture(\n    gl: WebGLRenderingContext, texture: WebGLTexture, width:
number,\n    height: number, data: TypedArray, textureConfig: TextureConfig) {\n  webgl_util.callAndCheck(gl, ()
=> gl.bindTexture(gl.TEXTURE_2D, texture));\n\n  let dataForUpload: TypedArray, texelDataType: number,
internalFormat: number;\n  if (data instanceof Uint8Array) {\n    dataForUpload = new Uint8Array(width * height *
4);\n    texelDataType = gl.UNSIGNED_BYTE;\n    internalFormat = gl.RGBA;\n  } else {\n    dataForUpload =
new Float32Array(width * height * 4);\n    texelDataType = gl.FLOAT;\n    internalFormat =
textureConfig.internalFormatPackedFloat;\n  }\n\n  dataForUpload.set(data);\n\n  webgl_util.callAndCheck(\n
gl,\n      () => gl.texImage2D(\n          gl.TEXTURE_2D, 0, internalFormat, width, height, 0, gl.RGBA,\n
texelDataType, dataForUpload));\n\n  webgl_util.callAndCheck(gl, () => gl.bindTexture(gl.TEXTURE_2D,
null));\n}\n\nexport function
 uploadPixelDataToTexture(\n    gl: WebGLRenderingContext, texture: WebGLTexture,\n    pixels:
PixelData|ImageData|HTMLImageElement|HTMLCanvasElement|\n    HTMLVideoElement) {\n
webgl_util.callAndCheck(gl, () => gl.bindTexture(gl.TEXTURE_2D, texture));\n  if ((pixels as PixelData).data
instanceof Uint8Array) {\n    webgl_util.callAndCheck(\n        gl,\n        () => gl.texImage2D(\n
gl.TEXTURE_2D, 0, gl.RGBA, pixels.width, pixels.height, 0, gl.RGBA,\n            gl.UNSIGNED_BYTE, (pixels as
PixelData).data));\n  } else {\n    webgl_util.callAndCheck(\n        gl,\n        () => gl.texImage2D(\n
gl.TEXTURE_2D, 0, gl.RGBA, gl.RGBA, gl.UNSIGNED_BYTE,\n            pixels as ImageData |
HTMLImageElement | HTMLCanvasElement |\n                HTMLVideoElement));\n  }\n\n
webgl_util.callAndCheck(gl, () => gl.bindTexture(gl.TEXTURE_2D, null));\n}\n\nexport function
createBufferFromOutputTexture(\n    gl2: WebGL2RenderingContext, rows: number, columns: number,\n
  textureConfig: TextureConfig): WebGLBuffer {\n  // Create and bind the buffer.\n  const buffer =
gl2.createBuffer();\n  webgl_util.callAndCheck(\n      gl2, () => gl2.bindBuffer(gl2.PIXEL_PACK_BUFFER,
buffer));\n\n  // Initialize the buffer to the size of the texture in bytes.\n  const bytesPerFloat = 4;\n  const
valuesPerTexel = 4;\n  const bufferSizeBytes = bytesPerFloat * valuesPerTexel * rows * columns;\n\n
webgl_util.callAndCheck(\n      gl2,\n      () => gl2.bufferData(\n          gl2.PIXEL_PACK_BUFFER,
bufferSizeBytes, gl2.STREAM_READ));\n\n  // Enqueue a command on the GPU command queue to copy of
texture into the\n  // buffer.\n  webgl_util.callAndCheck(\n      gl2, () => gl2.readPixels(0, 0, columns, rows,
gl2.RGBA, gl2.FLOAT, 0));\n\n  webgl_util.callAndCheck(\n      gl2, () =>
gl2.bindBuffer(gl2.PIXEL_PACK_BUFFER, null));\n\n  return buffer;\n}\n\nexport function
downloadFloat32MatrixFromBuffer(\n    gl: WebGLRenderingContext, buffer: WebGLBuffer,\n    size: number):
Float32Array
 {\n  const gl2 = gl as WebGL2RenderingContext;\n\n  const downloadTarget = new Float32Array(size);\n\n
gl2.bindBuffer(gl2.PIXEL_PACK_BUFFER, buffer);\n  gl2.getBufferSubData(gl2.PIXEL_PACK_BUFFER, 0,
downloadTarget);\n  gl2.bindBuffer(gl2.PIXEL_PACK_BUFFER, null);\n\n  return downloadTarget;\n}\n\nexport
function downloadByteEncodedFloatMatrixFromOutputTexture(\n    gl: WebGLRenderingContext, rows: number,
columns: number,\n    textureConfig: TextureConfig) {\n  const [w, h] =\n
tex_util.getUnpackedMatrixTextureShapeWidthHeight(rows, columns);\n\n  const numChannels = 4;\n  const
downloadTarget = new Uint8Array(\n      tex_util.getUnpackedArraySizeFromMatrixSize(rows * columns,
numChannels));\n\n  webgl_util.callAndCheck(\n      gl,\n      () => gl.readPixels(\n          0, 0, w, h,
textureConfig.downloadTextureFormat, gl.UNSIGNED_BYTE,\n          downloadTarget));\n\n  // By wrapping the
buffer in a Float32Array, we use native browser IEEE 754\n  // decoding of the 4 bytes
 that back each 32 bit float.\n  return new Float32Array(downloadTarget.buffer);\n}\n\nexport function
downloadPackedMatrixFromBuffer(\n    gl: WebGLRenderingContext, buffer: WebGLBuffer, batch: number, rows:
number,\n    cols: number, physicalRows: number, physicalCols: number,\n    textureConfig: TextureConfig):
Float32Array {\n  const gl2 = gl as WebGL2RenderingContext;\n\n  const downloadTarget =\n      new
Float32Array(tex_util.getPackedRGBAArraySizeFromMatrixShape(\n          physicalRows, physicalCols));\n\n
gl2.bindBuffer(gl2.PIXEL_PACK_BUFFER, buffer);\n  gl2.getBufferSubData(gl2.PIXEL_PACK_BUFFER, 0,
downloadTarget);\n  gl2.bindBuffer(gl2.PIXEL_PACK_BUFFER, null);\n\n  return downloadTarget;\n}\n\nexport
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function downloadMatrixFromPackedOutputTexture(\n    gl: WebGLRenderingContext, physicalRows: number,\n physicalCols: number): Float32Array {\n  const packedRGBA = new Float32Array(physicalRows * physicalCols * 4);\n  webgl_util.callAndCheck(\n      gl,\n      () => gl.readPixels(\n          0, 0, physicalCols, physicalRows, gl.RGBA, gl.FLOAT, packedRGBA));\n\n  return packedRGBA;\n}\n","/**\n * @license\n * Copyright 2017 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==========================================================================\n */\n\nimport {env, PixelData, TypedArray, util} from '@tensorflow/tfjs-core';\n\nimport {getWebGLContext, setWebGLContext} from './canvas_util';\nimport * as gpgpu_util from './gpgpu_util';\nimport * as tex_util from './tex_util';\nimport {TextureConfig} from './tex_util';\nimport {WebGL1DisjointQueryTimerExtension, WebGL2DisjointQueryTimerExtension} from './webgl_types';\nimport * as webgl_util from './webgl_util';\n\nexport interface FenceContext {\n  query: WebGLQuery|WebGLSync;\n  isFencePassed(): boolean;\n}\n\nexport class GPGPUContext {\n  gl: WebGLRenderingContext;\n  textureFloatExtension: {};\n  textureHalfFloatExtension: {};\n colorBufferFloatExtension: {};\n  colorBufferHalfFloatExtension: {};\n  disjointQueryTimerExtension: WebGL2DisjointQueryTimerExtension|\n      WebGL1DisjointQueryTimerExtension;\n  vertexBuffer: WebGLBuffer;\n  indexBuffer: WebGLBuffer;\n  framebuffer: WebGLFramebuffer;\n  outputTexture: WebGLTexture|null = null;\n  program: WebGLProgram|null = null;\n  private disposed = false;\n  private disjoint: boolean;\n  textureConfig: TextureConfig;\n\n  constructor(gl?: WebGLRenderingContext) {\n    const glVersion = env().getNumber('WEBGL_VERSION');\n    if (gl != null) {\n      this.gl = gl;\n      setWebGLContext(glVersion, gl);\n    } else {\n      this.gl = getWebGLContext(glVersion);\n    }\n    // WebGL 2.0 enables texture floats without an extension.\n    let COLOR_BUFFER_FLOAT = 'WEBGL_color_buffer_float';\n    const COLOR_BUFFER_HALF_FLOAT = 'EXT_color_buffer_half_float';\n    if (env().getNumber('WEBGL_VERSION') === 1) {\n      const TEXTURE_FLOAT = 'OES_texture_float';\n      const TEXTURE_HALF_FLOAT = 'OES_texture_half_float';\n\n      this.textureFloatExtension =\n          webgl_util.getExtensionOrThrow(this.gl, TEXTURE_FLOAT);\n      if (webgl_util.hasExtension(this.gl, TEXTURE_HALF_FLOAT)) {\n        this.textureHalfFloatExtension =\n            webgl_util.getExtensionOrThrow(this.gl, TEXTURE_HALF_FLOAT);\n      } else if (env().get('WEBGL_FORCE_F16_TEXTURES')) {\n        throw new Error(\n            'GL context does not support half float textures, yet the ' +\n            'environment flag WEBGL_FORCE_F16_TEXTURES is set to true.');\n      }\n\n      this.colorBufferFloatExtension =\n          this.gl.getExtension(COLOR_BUFFER_FLOAT);\n      if (webgl_util.hasExtension(this.gl, COLOR_BUFFER_HALF_FLOAT)) {\n        this.colorBufferHalfFloatExtension =\n            webgl_util.getExtensionOrThrow(this.gl, COLOR_BUFFER_HALF_FLOAT);\n      } else if (env().get('WEBGL_FORCE_F16_TEXTURES')) {\n        throw new Error(\n            'GL context does not support color renderable half floats, yet ' +\n            'the environment flag WEBGL_FORCE_F16_TEXTURES is set to true.');\n      }\n    } else {\n      COLOR_BUFFER_FLOAT = 'EXT_color_buffer_float';\n      if (webgl_util.hasExtension(this.gl, COLOR_BUFFER_FLOAT)) {\n        this.colorBufferFloatExtension =\n            this.gl.getExtension(COLOR_BUFFER_FLOAT);\n      } else if (webgl_util.hasExtension(this.gl, COLOR_BUFFER_HALF_FLOAT)) {\n        this.colorBufferHalfFloatExtension =\n            this.gl.getExtension(COLOR_BUFFER_HALF_FLOAT);\n\n      } else {\n        throw new Error('GL context does not support color renderable floats');\n      }\n    }\n\n    this.vertexBuffer = gpgpu_util.createVertexBuffer(this.gl);\n    this.indexBuffer =
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gpgpu_util.createIndexBuffer(this.gl);\n    this.framebuffer = webgl_util.createFramebuffer(this.gl);\n\n
this.textureConfig =\n        tex_util.getTextureConfig(this.gl, this.textureHalfFloatExtension);\n  }\n\n  private get
debug(): boolean {\n    return env().getBool('DEBUG');\n  }\n\n  public dispose() {\n    if (this.disposed) {\n
return;\n    }\n    if (this.program != null) {\n      console.warn(\n          'Disposing a GPGPUContext that still has a
bound WebGLProgram.' +\n          ' This is probably a resource leak, delete the program with ' +\n
'GPGPUContext.deleteProgram before disposing.');\n    }\n    if (this.outputTexture != null) {\n      console.warn(\n
    'Disposing a GPGPUContext that still has a bound output matrix ' +\n
      'texture.  This is probably a resource leak, delete the output ' +\n          'matrix texture with
GPGPUContext.deleteMatrixTexture before ' +\n          'disposing.');\n    }\n    const gl = this.gl;\n
webgl_util.callAndCheck(gl, () => gl.finish());\n    webgl_util.callAndCheck(gl, () =>
gl.bindFramebuffer(gl.FRAMEBUFFER, null));\n    webgl_util.callAndCheck(gl, () =>
gl.deleteFramebuffer(this.framebuffer));\n    webgl_util.callAndCheck(gl, () =>
gl.bindBuffer(gl.ARRAY_BUFFER, null));\n    webgl_util.callAndCheck(\n        gl, () =>
gl.bindBuffer(gl.ELEMENT_ARRAY_BUFFER, null));\n    webgl_util.callAndCheck(gl, () =>
gl.deleteBuffer(this.indexBuffer));\n    this.disposed = true;\n  }\n\n  public createFloat32MatrixTexture(rows:
number, columns: number):\n      WebGLTexture {\n    this.throwIfDisposed();\n    return
gpgpu_util.createFloat32MatrixTexture(\n        this.gl, rows, columns, this.textureConfig);\n  }\n\n  public
createFloat16MatrixTexture(rows: number, columns: number):\n
    WebGLTexture {\n    this.throwIfDisposed();\n    return gpgpu_util.createFloat16MatrixTexture(\n        this.gl,
rows, columns, this.textureConfig);\n  }\n\n  public createUnsignedBytesMatrixTexture(rows: number, columns:
number):\n      WebGLTexture {\n    this.throwIfDisposed();\n    return
gpgpu_util.createUnsignedBytesMatrixTexture(\n        this.gl, rows, columns, this.textureConfig);\n  }\n\n  public
uploadPixelDataToTexture(\n      texture: WebGLTexture,\n      pixels:
PixelData|ImageData|HTMLImageElement|HTMLCanvasElement) {\n    this.throwIfDisposed();\n
gpgpu_util.uploadPixelDataToTexture(this.gl, texture, pixels);\n  }\n\n  public uploadDenseMatrixToTexture(\n
texture: WebGLTexture, width: number, height: number, data: TypedArray) {\n    this.throwIfDisposed();\n
gpgpu_util.uploadDenseMatrixToTexture(\n        this.gl, texture, width, height, data, this.textureConfig);\n  }\n\n
public createFloat16PackedMatrixTexture(rows: number, columns: number):\n
    WebGLTexture {\n    this.throwIfDisposed();\n    return gpgpu_util.createFloat16PackedMatrixTexture(\n
this.gl, rows, columns, this.textureConfig);\n  }\n\n  public createPackedMatrixTexture(rows: number, columns:
number):\n      WebGLTexture {\n    this.throwIfDisposed();\n    return gpgpu_util.createPackedMatrixTexture(\n
 this.gl, rows, columns, this.textureConfig);\n  }\n\n  public deleteMatrixTexture(texture: WebGLTexture) {\n
this.throwIfDisposed();\n    if (this.outputTexture === texture) {\n
webgl_util.unbindColorTextureFromFramebuffer(this.gl, this.framebuffer);\n      this.outputTexture = null;\n    }\n
webgl_util.callAndCheck(this.gl, () => this.gl.deleteTexture(texture));\n  }\n\n  public
downloadByteEncodedFloatMatrixFromOutputTexture(\n      texture: WebGLTexture, rows: number, columns:
number): Float32Array {\n    return this.downloadMatrixDriver(\n        texture,\n        () =>
gpgpu_util.downloadByteEncodedFloatMatrixFromOutputTexture(\n
        this.gl, rows, columns, this.textureConfig));\n  }\n\n  public downloadPackedMatrixFromBuffer(\n      buffer:
WebGLBuffer, batch: number, rows: number, columns: number,\n      physicalRows: number, physicalCols:
number): Float32Array {\n    return gpgpu_util.downloadPackedMatrixFromBuffer(\n        this.gl, buffer, batch,
rows, columns, physicalRows, physicalCols,\n        this.textureConfig);\n  }\n\n  public
downloadFloat32MatrixFromBuffer(buffer: WebGLBuffer, size: number):\n      Float32Array {\n    return
gpgpu_util.downloadFloat32MatrixFromBuffer(this.gl, buffer, size);\n  }\n\n  public createBufferFromTexture(\n
texture: WebGLTexture, rows: number, columns: number): WebGLBuffer {\n
this.bindTextureToFrameBuffer(texture);\n    const result = gpgpu_util.createBufferFromOutputTexture(\n
this.gl as WebGL2RenderingContext, rows, columns, this.textureConfig);\n
this.unbindTextureToFrameBuffer();\n    return result;\n  }\n\n  public createAndWaitForFence():
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```
 Promise<void> {\n    const fenceContext = this.createFence(this.gl);\n    return this.pollFence(fenceContext);\n  }\n\n  private createFence(gl: WebGLRenderingContext): FenceContext {\n    let query:
WebGLQuery|WebGLSync;\n    let isFencePassed: () => boolean;\n\n    if
(env().getBool('WEBGL_FENCE_API_ENABLED')) {\n      const gl2 = gl as WebGL2RenderingContext;\n\n
const sync = gl2.fenceSync(gl2.SYNC_GPU_COMMANDS_COMPLETE, 0);\n      gl.flush();\n\n
isFencePassed = () => {\n        const status = gl2.clientWaitSync(sync, 0, 0);\n        return status ===
gl2.ALREADY_SIGNALED ||\n            status === gl2.CONDITION_SATISFIED;\n      };\n\n      query = sync;\n
} else if (\n        env().getNumber('WEBGL_DISJOINT_QUERY_TIMER_EXTENSION_VERSION') > 0) {\n
query = this.beginQuery();\n      this.endQuery();\n      isFencePassed = () => this.isQueryAvailable(\n          query,\n
        env().getNumber('WEBGL_DISJOINT_QUERY_TIMER_EXTENSION_VERSION'));\n    } else {\n
    // If we have no way to fence, return true immediately. This will fire in\n      // WebGL 1.0 when there is no
disjoint query timer. In this case, because\n      // the fence passes immediately, we'll immediately ask for a
download of\n      // the texture, which will cause the UI thread to hang.\n      isFencePassed = () => true;\n    }\n\n
return {query, isFencePassed};\n  }\n\n  public downloadMatrixFromPackedTexture(\n      texture: WebGLTexture,
physicalRows: number,\n      physicalCols: number): Float32Array {\n    return this.downloadMatrixDriver(\n
texture,\n        () => gpgpu_util.downloadMatrixFromPackedOutputTexture(\n            this.gl, physicalRows,
physicalCols));\n  }\n\n  private vertexAttrsAreBound = false;\n\n  public createProgram(fragmentShaderSource:
string): WebGLProgram {\n    this.throwIfDisposed();\n    const gl = this.gl;\n    const fragmentShader:
WebGLShader =\n        webgl_util.createFragmentShader(gl, fragmentShaderSource);\n    const vertexShader:
 WebGLShader = gpgpu_util.createVertexShader(gl);\n    const program: WebGLProgram =
webgl_util.createProgram(gl);\n    webgl_util.callAndCheck(gl, () => gl.attachShader(program, vertexShader));\n
webgl_util.callAndCheck(gl, () => gl.attachShader(program, fragmentShader));\n    webgl_util.linkProgram(gl,
program);\n    if (this.debug) {\n      webgl_util.validateProgram(gl, program);\n    }\n    if
(!this.vertexAttrsAreBound) {\n      this.setProgram(program);\n      this.vertexAttrsAreBound =
gpgpu_util.bindVertexProgramAttributeStreams(\n          gl, this.program, this.vertexBuffer);\n    }\n    return
program;\n  }\n\n  public deleteProgram(program: WebGLProgram) {\n    this.throwIfDisposed();\n    if (program
=== this.program) {\n      this.program = null;\n    }\n    if (program != null) {\n      webgl_util.callAndCheck(this.gl,
() => this.gl.deleteProgram(program));\n    }\n  }\n\n  public setProgram(program: WebGLProgram|null) {\n
this.throwIfDisposed();\n    this.program
 = program;\n    if ((this.program != null) && this.debug) {\n      webgl_util.validateProgram(this.gl,
this.program);\n    }\n    webgl_util.callAndCheck(this.gl, () => this.gl.useProgram(program));\n  }\n\n  public
getUniformLocation(\n      program: WebGLProgram, uniformName: string,\n      shouldThrow = true):
WebGLUniformLocation {\n    this.throwIfDisposed();\n    if (shouldThrow) {\n      return
webgl_util.getProgramUniformLocationOrThrow(\n          this.gl, program, uniformName);\n    } else {\n      return
webgl_util.getProgramUniformLocation(\n          this.gl, program, uniformName);\n    }\n  }\n\n  public
getAttributeLocation(program: WebGLProgram, attribute: string):\n      number {\n    this.throwIfDisposed();\n
return webgl_util.callAndCheck(\n        this.gl, () => this.gl.getAttribLocation(program, attribute));\n  }\n\n  public
getUniformLocationNoThrow(program: WebGLProgram, uniformName: string):\n      WebGLUniformLocation {\n
  this.throwIfDisposed();\n
    return this.gl.getUniformLocation(program, uniformName);\n  }\n\n  public setInputMatrixTexture(\n
inputMatrixTexture: WebGLTexture, uniformLocation: WebGLUniformLocation,\n      textureUnit: number) {\n
this.throwIfDisposed();\n    this.throwIfNoProgram();\n    webgl_util.bindTextureToProgramUniformSampler(\n
this.gl, inputMatrixTexture, uniformLocation, textureUnit);\n  }\n\n  public setOutputMatrixTexture(\n
outputMatrixTexture: WebGLTexture, rows: number, columns: number) {\n
this.setOutputMatrixTextureDriver(outputMatrixTexture, columns, rows);\n  }\n\n  public
setOutputPackedMatrixTexture(\n      outputPackedMatrixTexture: WebGLTexture, rows: number, columns:
number) {\n    this.throwIfDisposed();\n    const [width, height] =\n
tex_util.getPackedMatrixTextureShapeWidthHeight(rows, columns);\n
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this.setOutputMatrixTextureDriver(outputPackedMatrixTexture, width, height);\n  }\n\n  public
setOutputMatrixWriteRegion(\n      startRow: number, numRows:
 number, startColumn: number,\n      numColumns: number) {\n    this.setOutputMatrixWriteRegionDriver(\n
startColumn, startRow, numColumns, numRows);\n  }\n\n  public setOutputPackedMatrixWriteRegion(\n
startRow: number, numRows: number, startColumn: number,\n      numColumns: number) {\n    throw new
Error('setOutputPackedMatrixWriteRegion not implemented.');\n  }\n\n  public debugValidate() {\n    if
(this.program != null) {\n      webgl_util.validateProgram(this.gl, this.program);\n    }\n
webgl_util.validateFramebuffer(this.gl);\n  }\n\n  public executeProgram() {\n    this.throwIfDisposed();\n
this.throwIfNoProgram();\n    const gl = this.gl;\n    if (this.debug) {\n      this.debugValidate();\n    }\n
webgl_util.callAndCheck(\n        gl, () => gl.drawElements(gl.TRIANGLES, 6, gl.UNSIGNED_SHORT, 0));\n
}\n\n  public blockUntilAllProgramsCompleted() {\n    this.throwIfDisposed();\n    webgl_util.callAndCheck(this.gl,
() => this.gl.finish());\n  }\n\n  private
 getQueryTimerExtension(): WebGL1DisjointQueryTimerExtension\n      |WebGL2DisjointQueryTimerExtension
{\n    if (this.disjointQueryTimerExtension == null) {\n      this.disjointQueryTimerExtension =\n
webgl_util.getExtensionOrThrow(\n            this.gl,\n            env().getNumber(\n
'WEBGL_DISJOINT_QUERY_TIMER_EXTENSION_VERSION') === 2 ?\n
'EXT_disjoint_timer_query_webgl2' :\n                'EXT_disjoint_timer_query') as\n
WebGL1DisjointQueryTimerExtension |\n          WebGL2DisjointQueryTimerExtension;\n    }\n    return
this.disjointQueryTimerExtension;\n  }\n\n  private getQueryTimerExtensionWebGL2():
WebGL2DisjointQueryTimerExtension {\n    return this.getQueryTimerExtension();\n  }\n\n  private
getQueryTimerExtensionWebGL1(): WebGL1DisjointQueryTimerExtension {\n    return
this.getQueryTimerExtension() as WebGL1DisjointQueryTimerExtension;\n  }\n\n  beginQuery(): WebGLQuery
{\n    if (env().getNumber('WEBGL_DISJOINT_QUERY_TIMER_EXTENSION_VERSION')
 === 2) {\n      const gl2 = this.gl as WebGL2RenderingContext;\n      const ext =
this.getQueryTimerExtensionWebGL2();\n\n      const query = gl2.createQuery();\n
gl2.beginQuery(ext.TIME_ELAPSED_EXT, query);\n      return query;\n    }\n    const ext =
this.getQueryTimerExtensionWebGL1();\n    const query = ext.createQueryEXT() as WebGLQuery;\n
ext.beginQueryEXT(ext.TIME_ELAPSED_EXT, query);\n    return query;\n  }\n\n  endQuery() {\n    if
(env().getNumber('WEBGL_DISJOINT_QUERY_TIMER_EXTENSION_VERSION') === 2) {\n      const gl2 =
this.gl as WebGL2RenderingContext;\n      const ext = this.getQueryTimerExtensionWebGL2();\n
gl2.endQuery(ext.TIME_ELAPSED_EXT);\n      return;\n    }\n    const ext =
this.getQueryTimerExtensionWebGL1();\n    ext.endQueryEXT(ext.TIME_ELAPSED_EXT);\n  }\n\n  public async
waitForQueryAndGetTime(query: WebGLQuery): Promise<number> {\n    await util.repeatedTry(\n        () =>
this.disposed ||  // while testing
 contexts are created / disposed\n                          // in rapid succession, so without this check we\n
      // may poll for the query timer indefinitely\n          this.isQueryAvailable(\n              query,\n
env().getNumber(\n                  'WEBGL_DISJOINT_QUERY_TIMER_EXTENSION_VERSION')));\n    return
this.getQueryTime(\n        query,
env().getNumber('WEBGL_DISJOINT_QUERY_TIMER_EXTENSION_VERSION'));\n  }\n\n  private
getQueryTime(query: WebGLQuery, queryTimerVersion: number): number {\n    if (queryTimerVersion === 0) {\n
    return null;\n    }\n\n    if (queryTimerVersion === 2) {\n      const gl2 = this.gl as WebGL2RenderingContext;\n\n
    const timeElapsedNanos = gl2.getQueryParameter(query, gl2.QUERY_RESULT);\n      // Return milliseconds.\n
   return timeElapsedNanos / 1000000;\n    } else {\n      const ext = this.getQueryTimerExtensionWebGL1();\n\n
const timeElapsedNanos =\n          ext.getQueryObjectEXT(query,
 ext.QUERY_RESULT_EXT);\n      // Return milliseconds.\n      return timeElapsedNanos / 1000000;\n    }\n  }\n\n
private isQueryAvailable(query: WebGLQuery, queryTimerVersion: number):\n      boolean {\n    if
(queryTimerVersion === 0) {\n      return true;\n    }\n\n    if (queryTimerVersion === 2) {\n      const gl2 = this.gl
as WebGL2RenderingContext;\n      const ext = this.getQueryTimerExtensionWebGL2();\n\n      const available =\n
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gl2.getQueryParameter(query, gl2.QUERY_RESULT_AVAILABLE);\n      if (this.disjoint == null) {\n
this.disjoint = this.gl.getParameter(ext.GPU_DISJOINT_EXT);\n      }\n\n      return available && !this.disjoint;\n
} else {\n      const ext = this.getQueryTimerExtensionWebGL1();\n\n      const available =\n
ext.getQueryObjectEXT(query, ext.QUERY_RESULT_AVAILABLE_EXT);\n      if (this.disjoint == null) {\n
this.disjoint = this.gl.getParameter(ext.GPU_DISJOINT_EXT);\n      }\n\n      return available && !this.disjoint;\n
    }\n  }\n\n  pollFence(fenceContext: FenceContext) {\n    return new Promise<void>(resolve => {\n
this.addItemToPoll(() => fenceContext.isFencePassed(), () => resolve());\n    });\n  }\n\n  private itemsToPoll:
PollItem[] = [];\n\n  pollItems(): void {\n    // Find the last query that has finished.\n    const index =
linearSearchLastTrue(this.itemsToPoll.map(x => x.isDoneFn));\n    for (let i = 0; i <= index; ++i) {\n      const
{resolveFn} = this.itemsToPoll[i];\n      resolveFn();\n    }\n    this.itemsToPoll = this.itemsToPoll.slice(index +
1);\n  }\n\n  private addItemToPoll(isDoneFn: () => boolean, resolveFn: () => void) {\n
this.itemsToPoll.push({isDoneFn, resolveFn});\n    if (this.itemsToPoll.length > 1) {\n      // We already have a
running loop that polls.\n      return;\n    }\n    // Start a new loop that polls.\n    util.repeatedTry(() => {\n
this.pollItems();\n      // End the loop if no more items to poll.\n      return this.itemsToPoll.length ===
 0;\n    });\n  }\n\n  private bindTextureToFrameBuffer(texture: WebGLTexture) {\n    this.throwIfDisposed();\n
webgl_util.bindColorTextureToFramebuffer(\n        this.gl, texture, this.framebuffer);\n    if (this.debug) {\n
webgl_util.validateFramebuffer(this.gl);\n    }\n  }\n\n  private unbindTextureToFrameBuffer() {\n    if
(this.outputTexture != null) {\n      webgl_util.bindColorTextureToFramebuffer(\n          this.gl, this.outputTexture,
this.framebuffer);\n      if (this.debug) {\n        webgl_util.validateFramebuffer(this.gl);\n      }\n    } else {\n
webgl_util.unbindColorTextureFromFramebuffer(this.gl, this.framebuffer);\n    }\n  }\n\n  private
downloadMatrixDriver(\n      texture: WebGLTexture,\n      downloadAndDecode: () => Float32Array):
Float32Array {\n    this.bindTextureToFrameBuffer(texture);\n    const result = downloadAndDecode();\n
this.unbindTextureToFrameBuffer();\n\n    return result;\n  }\n\n  private setOutputMatrixTextureDriver(\n
outputMatrixTextureMaybePacked:
 WebGLTexture, width: number,\n      height: number) {\n    this.throwIfDisposed();\n    const gl = this.gl;\n
webgl_util.bindColorTextureToFramebuffer(\n        gl, outputMatrixTextureMaybePacked, this.framebuffer);\n    if
(this.debug) {\n      webgl_util.validateFramebuffer(gl);\n    }\n    this.outputTexture =
outputMatrixTextureMaybePacked;\n    webgl_util.callAndCheck(gl, () => gl.viewport(0, 0, width, height));\n
webgl_util.callAndCheck(gl, () => gl.scissor(0, 0, width, height));\n  }\n\n  private
setOutputMatrixWriteRegionDriver(\n      x: number, y: number, width: number, height: number) {\n
this.throwIfDisposed();\n    webgl_util.callAndCheck(\n        this.gl, () => this.gl.scissor(x, y, width, height));\n
}\n\n  private throwIfDisposed() {\n    if (this.disposed) {\n      throw new Error('Attempted to use disposed
GPGPUContext.');\n    }\n  }\n\n  private throwIfNoProgram() {\n    if (this.program == null) {\n      throw new
Error('No
 GPU program is currently set.');\n    }\n  }\n}\n\ntype PollItem = {\n  isDoneFn: () => boolean,\n  resolveFn: () =>
void\n};\n\n/**\n * Finds the index of the last true element using linear search.\n * Note: We can't do binary search
because Chrome expects us to explicitly\n * test all fences before download:\n *
https://github.com/tensorflow/tfjs/issues/1145\n */\nexport function linearSearchLastTrue(arr: Array<() =>
boolean>): number {\n  let i = 0;\n  for (; i < arr.length; ++i) {\n    const isDone = arr[i]();\n    if (!isDone) {\n
break;\n    }\n  }\n  return i - 1;\n}\n","/**\n * @license\n * Copyright 2017 Google LLC. All Rights Reserved.\n *
Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in
compliance with the License.\n * You may obtain a copy of the License at\n *\n *
http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing,
software\n * distributed under the License
 is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either
express or implied.\n * See the License for the specific language governing permissions and\n * limitations under
the License.\n *
==========================================================================\n
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*/\n\nimport {backend_util, util} from '@tensorflow/tfjs-core';\nconst {getBroadcastDims} = backend_util;\nimport {getGlslDifferences, GLSL} from './glsl_version';\nimport * as shader_util from './shader_compiler_util';\n\nexport type ShapeInfo = {\n  logicalShape: number[],\n  texShape: [number, number],\n  isUniform: boolean,\n  isPacked: boolean,\n  flatOffset: number\n};\n\nexport type InputInfo = {\n  name: string,\n  shapeInfo: ShapeInfo\n};\n\nexport function makeShader(\n    inputsInfo: InputInfo[], outputShape: ShapeInfo, userCode: string,\n    usesPackedTextures: boolean): string {\n  const prefixSnippets: string[] = [];\n  inputsInfo.forEach(x => {\n    const size = util.sizeFromShape(x.shapeInfo.logicalShape);\n\n
    // Snippet when we decided to upload the values as uniform.\n    if (x.shapeInfo.isUniform) {\n
prefixSnippets.push(\n          `uniform float ${x.name}${size > 1 ? `[${size}]` : ''};`);\n    } else {\n
prefixSnippets.push(`uniform sampler2D ${x.name};`);\n      prefixSnippets.push(`uniform int offset${x.name};`);\n
  }\n  });\n  const inputPrefixSnippet = prefixSnippets.join('\\n');\n\n  const inputSamplingSnippet =\n
inputsInfo\n          .map(x => getInputSamplingSnippet(x, outputShape, usesPackedTextures))\n          .join('\\n');\n
const outTexShape = outputShape.texShape;\n  const glsl = getGlslDifferences();\n  const
floatTextureSampleSnippet = getFloatTextureSampleSnippet(glsl);\n  let outputSamplingSnippet: string;\n  let
floatTextureSetOutputSnippet: string;\n  let shaderPrefix = getShaderPrefix(glsl);\n\n  if (outputShape.isPacked) {\n
  outputSamplingSnippet =\n        getPackedOutputSamplingSnippet(outputShape.logicalShape,
  outTexShape);\n    floatTextureSetOutputSnippet = getFloatTextureSetRGBASnippet(glsl);\n  } else {\n
outputSamplingSnippet =\n        getOutputSamplingSnippet(outputShape.logicalShape, outTexShape);\n
floatTextureSetOutputSnippet = getFloatTextureSetRSnippet(glsl);\n  }\n\n  if (usesPackedTextures) {\n
shaderPrefix += SHADER_PACKED_PREFIX;\n  }\n\n  const source = [\n    shaderPrefix,
floatTextureSampleSnippet, floatTextureSetOutputSnippet,\n    inputPrefixSnippet, outputSamplingSnippet,
inputSamplingSnippet, userCode\n  ].join('\\n');\n  return source;\n}\n\nfunction getSamplerFromInInfo(inInfo:
InputInfo): string {\n  const shape = inInfo.shapeInfo.logicalShape;\n  switch (shape.length) {\n    case 0:\n      return
getSamplerScalar(inInfo);\n    case 1:\n      return getSampler1D(inInfo);\n    case 2:\n      return
getSampler2D(inInfo);\n    case 3:\n      return getSampler3D(inInfo);\n    case 4:\n      return
getSampler4D(inInfo);\n    case 5:\n      return
  getSampler5D(inInfo);\n    case 6:\n      return getSampler6D(inInfo);\n    default:\n      throw new Error(\n
`${shape.length}-D input sampling` +\n          ` is not yet supported`);\n  }\n}\n\nfunction
getPackedSamplerFromInInfo(inInfo: InputInfo): string {\n  const shape = inInfo.shapeInfo.logicalShape;\n  switch
(shape.length) {\n    case 0:\n      return getPackedSamplerScalar(inInfo);\n    case 1:\n      return
getPackedSampler1D(inInfo);\n    case 2:\n      return getPackedSampler2D(inInfo);\n    case 3:\n      return
getPackedSampler3D(inInfo);\n    default:\n      return getPackedSamplerND(inInfo);\n  }\n}\n\nfunction
getInputSamplingSnippet(\n    inInfo: InputInfo, outShapeInfo: ShapeInfo,\n    usesPackedTextures = false): string
{\n  let res = '';\n  if (usesPackedTextures) {\n    res += getPackedSamplerFromInInfo(inInfo);\n  } else {\n    res +=
getSamplerFromInInfo(inInfo);\n  }\n\n  const inShape = inInfo.shapeInfo.logicalShape;\n  const outShape =
outShapeInfo.logicalShape;\n
  if (inShape.length <= outShape.length) {\n    if (usesPackedTextures) {\n      res +=
getPackedSamplerAtOutputCoords(inInfo, outShapeInfo);\n    } else {\n      res +=
getSamplerAtOutputCoords(inInfo, outShapeInfo);\n    }\n  }\n  return res;\n}\n\nfunction
getPackedOutputSamplingSnippet(\n    outShape: number[], outTexShape: [number, number]): string {\n  switch
(outShape.length) {\n    case 0:\n      return getOutputScalarCoords();\n    case 1:\n      return
getOutputPacked1DCoords(outShape as [number], outTexShape);\n    case 2:\n      return
getOutputPacked2DCoords(outShape as [number, number], outTexShape);\n    case 3:\n      return
getOutputPacked3DCoords(\n          outShape as [number, number, number], outTexShape);\n    default:\n      return
getOutputPackedNDCoords(outShape, outTexShape);\n  }\n}\n\nfunction getOutputSamplingSnippet(\n
outShape: number[], outTexShape: [number, number]): string {\n  switch (outShape.length) {\n    case 0:\n      return
  getOutputScalarCoords();\n    case 1:\n      return getOutput1DCoords(outShape as [number], outTexShape);\n
case 2:\n      return getOutput2DCoords(outShape as [number, number], outTexShape);\n    case 3:\n      return
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getOutput3DCoords(\n          outShape as [number, number, number], outTexShape);\n    case 4:\n      return
getOutput4DCoords(\n          outShape as [number, number, number, number], outTexShape);\n    case 5:\n      return
getOutput5DCoords(\n          outShape as [number, number, number, number, number], outTexShape);\n    case 6:\n
  return getOutput6DCoords(\n          outShape as [number, number, number, number, number, number],\n
outTexShape);\n    default:\n      throw new Error(\n          `${outShape.length}-D output sampling is not yet
supported`);\n  }\n}\n\nfunction getFloatTextureSampleSnippet(glsl: GLSL): string {\n  return `\n    float
sampleTexture(sampler2D textureSampler, vec2 uv) {\n      return ${glsl.texture2D}(textureSampler, uv).r;\n
  }\n  `;\n}\n\nfunction getFloatTextureSetRSnippet(glsl: GLSL): string {\n  return `\n    void setOutput(float val)
{\n      ${glsl.output} = vec4(val, 0, 0, 0);\n    }\n  `;\n}\n\nfunction getFloatTextureSetRGBASnippet(glsl: GLSL):
string {\n  return `\n    void setOutput(vec4 val) {\n      ${glsl.output} = val;\n    }\n  `;\n}\n\nfunction
getShaderPrefix(glsl: GLSL): string {\n  const SHADER_PREFIX = `${glsl.version}\n    precision highp float;\n
precision highp int;\n    precision highp sampler2D;\n    ${glsl.varyingFs} vec2 resultUV;\n
${glsl.defineOutput}\n    const vec2 halfCR = vec2(0.5, 0.5);\n\n    struct ivec5\n    {\n      int x;\n      int y;\n      int
z;\n      int w;\n      int u;\n    };\n\n    struct ivec6\n    {\n      int x;\n      int y;\n      int z;\n      int w;\n      int u;\n
int v;\n    };\n\n    uniform float NAN;\n    ${glsl.defineSpecialNaN}\n    ${glsl.defineSpecialInf}\n
${glsl.defineRound}\n\n    int imod(int x, int y) {\n      return
 x - y * (x / y);\n    }\n\n    int idiv(int a, int b, float sign) {\n      int res = a / b;\n      int mod = imod(a, b);\n      if
(sign < 0. && mod != 0) {\n        res -= 1;\n      }\n      return res;\n    }\n\n    //Based on the work of Dave Hoskins\n
 //https://www.shadertoy.com/view/4djSRW\n    #define HASHSCALE1 443.8975\n    float random(float seed){\n
 vec2 p = resultUV * seed;\n      vec3 p3  = fract(vec3(p.xyx) * HASHSCALE1);\n      p3 += dot(p3, p3.yzx +
19.19);\n      return fract((p3.x + p3.y) * p3.z);\n    }\n\n    ${SAMPLE_1D_SNIPPET}\n
${SAMPLE_2D_SNIPPET}\n    ${SAMPLE_3D_SNIPPET}\n  `;\n\n  return SHADER_PREFIX;\n}\n\nconst
SAMPLE_1D_SNIPPET = `\nvec2 uvFromFlat(int texNumR, int texNumC, int index) {\n  int texR = index /
texNumC;\n  int texC = index - texR * texNumC;\n  return (vec2(texC, texR) + halfCR) / vec2(texNumC,
texNumR);\n}\nvec2 packedUVfrom1D(int texNumR, int texNumC, int index) {\n  int texelIndex = index / 2;\n  int
texR = texelIndex / texNumC;\n
  int texC = texelIndex - texR * texNumC;\n  return (vec2(texC, texR) + halfCR) / vec2(texNumC,
texNumR);\n}\n`;\n\nconst SAMPLE_2D_SNIPPET = `\nvec2 packedUVfrom2D(int texelsInLogicalRow, int
texNumR,\n  int texNumC, int row, int col) {\n  int texelIndex = (row / 2) * texelsInLogicalRow + (col / 2);\n  int
texR = texelIndex / texNumC;\n  int texC = texelIndex - texR * texNumC;\n  return (vec2(texC, texR) + halfCR) /
vec2(texNumC, texNumR);\n}\n`;\n\nconst SAMPLE_3D_SNIPPET = `\nvec2 packedUVfrom3D(int texNumR, int
texNumC,\n    int texelsInBatch, int texelsInLogicalRow, int b,\n    int row, int col) {\n  int index = b * texelsInBatch
+ (row / 2) * texelsInLogicalRow + (col / 2);\n  int texR = index / texNumC;\n  int texC = index - texR *
texNumC;\n  return (vec2(texC, texR) + halfCR) / vec2(texNumC, texNumR);\n}\n`;\n\nconst
SHADER_PACKED_PREFIX = `\n  float getChannel(vec4 frag, vec2 innerDims) {\n    vec2 modCoord =
mod(innerDims, 2.);\n    return modCoord.x == 0. ?\n      (modCoord.y
 == 0. ? frag.r : frag.g) :\n      (modCoord.y == 0. ? frag.b : frag.a);\n  }\n  float getChannel(vec4 frag, int dim) {\n
float modCoord = mod(float(dim), 2.);\n    return modCoord == 0. ? frag.r : frag.g;\n  }\n`;\n\nfunction
getOutputScalarCoords() {\n  return `\n    int getOutputCoords() {\n      return 0;\n    }\n  `;\n}\n\nfunction
getOutputPacked1DCoords(\n    shape: [number], texShape: [number, number]): string {\n  const packedTexShape
=\n      [Math.ceil(texShape[0] / 2), Math.ceil(texShape[1] / 2)];\n  if (packedTexShape[0] === 1) {\n    return `\n
int getOutputCoords() {\n        return 2 * int(resultUV.x * ${packedTexShape[1]}.0);\n      }\n    `;\n  }\n\n  if
(packedTexShape[1] === 1) {\n    return `\n      int getOutputCoords() {\n        return 2 * int(resultUV.y *
${packedTexShape[0]}.0);\n      }\n    `;\n  }\n\n  return `\n    int getOutputCoords() {\n      ivec2 resTexRC =
ivec2(resultUV.yx *\n                             vec2(${packedTexShape[0]}, ${packedTexShape[1]}));\n
    return 2 * (resTexRC.x * ${packedTexShape[1]} + resTexRC.y);\n    }\n  `;\n}\n\nfunction
getOutput1DCoords(\n    shape: [number], texShape: [number, number]): string {\n  if (texShape[0] === 1) {\n
return `\n      int getOutputCoords() {\n        return int(resultUV.x * ${texShape[1]}.0);\n      }\n    `;\n  }\n  if
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(texShape[1] === 1) {\n    return `\n      int getOutputCoords() {\n        return int(resultUV.y * ${texShape[0]}.0);\n
  }\n    `;\n  }\n  return `\n    int getOutputCoords() {\n      ivec2 resTexRC = ivec2(resultUV.yx *\n
vec2(${texShape[0]}, ${texShape[1]}));\n      return resTexRC.x * ${texShape[1]} + resTexRC.y;\n    }\n
`;\n}\n\nfunction getOutputPacked3DCoords(\n    shape: [number, number, number], texShape: [number, number]):
string {\n  const packedTexShape =\n      [Math.ceil(texShape[0] / 2), Math.ceil(texShape[1] / 2)];\n  const
texelsInLogicalRow = Math.ceil(shape[2] / 2);\n  const texelsInBatch = texelsInLogicalRow
 * Math.ceil(shape[1] / 2);\n\n  return `\n    ivec3 getOutputCoords() {\n      ivec2 resTexRC = ivec2(resultUV.yx *\n
                vec2(${packedTexShape[0]}, ${packedTexShape[1]}));\n      int index = resTexRC.x *
${packedTexShape[1]} + resTexRC.y;\n\n      int b = index / ${texelsInBatch};\n      index -= b *
${texelsInBatch};\n\n      int r = 2 * (index / ${texelsInLogicalRow});\n      int c = imod(index,
${texelsInLogicalRow}) * 2;\n\n      return ivec3(b, r, c);\n    }\n  `;\n}\n\nfunction getOutput3DCoords(\n    shape:
[number, number, number], texShape: [number, number]): string {\n  const coordsFromIndexSnippet =\n
shader_util.getLogicalCoordinatesFromFlatIndex(['r', 'c', 'd'], shape);\n\n  return `\n    ivec3 getOutputCoords() {\n
 ivec2 resTexRC = ivec2(resultUV.yx *\n                vec2(${texShape[0]}, ${texShape[1]}));\n      int index
= resTexRC.x * ${texShape[1]} + resTexRC.y;\n      ${coordsFromIndexSnippet}\n      return
 ivec3(r, c, d);\n    }\n  `;\n}\n\nfunction getOutputPackedNDCoords(\n    shape: number[], texShape: [number,
number]): string {\n  const packedTexShape =\n      [Math.ceil(texShape[0] / 2), Math.ceil(texShape[1] / 2)];\n\n
const texelsInLogicalRow = Math.ceil(shape[shape.length - 1] / 2);\n  const texelsInBatch =\n
texelsInLogicalRow * Math.ceil(shape[shape.length - 2] / 2);\n  let texelsInBatchN = texelsInBatch;\n  let batches =
``;\n  let coords = 'b, r, c';\n\n  for (let b = 2; b < shape.length - 1; b++) {\n    texelsInBatchN *= shape[shape.length -
b - 1];\n    batches = `\n      int b${b} = index / ${texelsInBatchN};\n      index -= b${b} * ${texelsInBatchN};\n    `
+ batches;\n    coords = `b${b}, ` + coords;\n  }\n\n  return `\n    ivec${shape.length} getOutputCoords() {\n
ivec2 resTexRC = ivec2(resultUV.yx *\n                vec2(${packedTexShape[0]},
${packedTexShape[1]}));\n      int index = resTexRC.x * ${packedTexShape[1]} + resTexRC.y;\n\n
 ${batches}\n\n      int b = index / ${texelsInBatch};\n      index -= b * ${texelsInBatch};\n\n      int r = 2 * (index /
${texelsInLogicalRow});\n      int c = imod(index, ${texelsInLogicalRow}) * 2;\n\n      return
ivec${shape.length}(${coords});\n    }\n  `;\n}\n\nfunction getOutput4DCoords(\n    shape: [number, number,
number, number],\n    texShape: [number, number]): string {\n  const coordsFromIndexSnippet =
shader_util.getLogicalCoordinatesFromFlatIndex(\n      ['r', 'c', 'd', 'd2'], shape);\n\n  return `\n    ivec4
getOutputCoords() {\n      ivec2 resTexRC = ivec2(resultUV.yx *\n        vec2(${texShape[0]}, ${texShape[1]}));\n
 int index = resTexRC.x * ${texShape[1]} + resTexRC.y;\n      ${coordsFromIndexSnippet}\n      return ivec4(r, c,
d, d2);\n    }\n  `;\n}\n\nfunction getOutput5DCoords(\n    shape: [number, number, number, number, number],\n
texShape: [number, number]): string {\n  const coordsFromIndexSnippet =
shader_util.getLogicalCoordinatesFromFlatIndex(\n
    ['r', 'c', 'd', 'd2', 'd3'], shape);\n\n  return `\n    ivec5 getOutputCoords() {\n      ivec2 resTexRC =
ivec2(resultUV.yx * vec2(${texShape[0]},\n                        ${texShape[1]}));\n\n      int index = resTexRC.x *
${texShape[1]} + resTexRC.y;\n\n      ${coordsFromIndexSnippet}\n\n      ivec5 outShape = ivec5(r, c, d, d2, d3);\n
  return outShape;\n    }\n  `;\n}\n\nfunction getOutput6DCoords(\n    shape: [number, number, number, number,
number, number],\n    texShape: [number, number]): string {\n  const coordsFromIndexSnippet =
shader_util.getLogicalCoordinatesFromFlatIndex(\n      ['r', 'c', 'd', 'd2', 'd3', 'd4'], shape);\n\n  return `\n    ivec6
getOutputCoords() {\n      ivec2 resTexRC = ivec2(resultUV.yx *\n        vec2(${texShape[0]}, ${texShape[1]}));\n
 int index = resTexRC.x * ${texShape[1]} + resTexRC.y;\n\n      ${coordsFromIndexSnippet}\n\n      ivec6 result =
ivec6(r, c, d, d2, d3, d4);\n      return result;\n    }\n  `;\n}\n\nfunction getOutputPacked2DCoords(\n
    shape: [number, number], texShape: [number, number]): string {\n  const packedTexShape =\n
[Math.ceil(texShape[0] / 2), Math.ceil(texShape[1] / 2)];\n  if (util.arraysEqual(shape, texShape)) {\n    return `\n
ivec2 getOutputCoords() {\n      return 2 * ivec2(resultUV.yx * vec2(${packedTexShape[0]}, ${\n
packedTexShape[1]}));\n    }\n  `;\n  }\n\n  // texels needed to accommodate a logical row\n  const
texelsInLogicalRow = Math.ceil(shape[1] / 2);\n\n  /**\n   * getOutputCoords\n   *\n   * resTexRC: The rows and
```

columns of the texels. If you move over one\n * texel to the right in the packed texture, you are moving over one column\n * (not two).\n *\n * index: The texel index\n */\n return `\n ivec2 getOutputCoords() {\n ivec2 resTexRC = ivec2(resultUV.yx *\n vec2(${packedTexShape[0]}, ${packedTexShape[1]}));\n\n int index = resTexRC.x * ${packedTexShape[1]} + resTexRC.y;\n int r = 2 * (index / ${texelsInLogicalRow});\n int c = imod(index, ${texelsInLogicalRow}) * 2;\n\n return ivec2(r, c);\n }\n `;\n}\n\nfunction getOutput2DCoords(\n shape: [number, number], texShape: [number, number]): string {\n if (util.arraysEqual(shape, texShape)) {\n return `\n ivec2 getOutputCoords() {\n return ivec2(resultUV.yx * vec2(${texShape[0]}, ${texShape[1]}));\n }\n `;\n }\n if (shape[1] === 1) {\n return `\n ivec2 getOutputCoords() {\n ivec2 resTexRC = ivec2(resultUV.yx *\n vec2(${texShape[0]}, ${texShape[1]}));\n int index = resTexRC.x * ${texShape[1]} + resTexRC.y;\n return ivec2(index, 0);\n }\n `;\n }\n if (shape[0] === 1) {\n return `\n ivec2 getOutputCoords() {\n ivec2 resTexRC = ivec2(resultUV.yx *\n vec2(${texShape[0]}, ${texShape[1]}));\n int index = resTexRC.x * ${texShape[1]} + resTexRC.y;\n return ivec2(0, index);\n }\n `;\n }\n return `\n ivec2 getOutputCoords() {\n ivec2 resTexRC = ivec2(resultUV.yx *\n vec2(${texShape[0]}, ${texShape[1]}));\n int index = resTexRC.x * ${texShape[1]} + resTexRC.y;\n int r = index / ${shape[1]};\n int c = index - r * ${shape[1]};\n return ivec2(r, c);\n }\n `;\n}\n\nfunction getFlatOffsetUniformName(texName: string): string {\n return `offset${texName}`;\n}\n\nfunction getPackedSamplerScalar(inputInfo: InputInfo): string {\n const texName = inputInfo.name;\n const funcName = 'get' + texName.charAt(0).toUpperCase() + texName.slice(1);\n const glsl = getGlslDifferences();\n return `\n vec4 ${funcName}() {\n return ${glsl.texture2D}(${texName}, halfCR);\n }\n `;\n}\n\nfunction getSamplerScalar(inputInfo: InputInfo): string {\n const texName = inputInfo.name;\n const funcName = 'get' + texName.charAt(0).toUpperCase() + texName.slice(1);\n if (inputInfo.shapeInfo.isUniform) {\n return `float ${funcName}() {return ${texName};}`;\n }\n const [texNumR, texNumC] = inputInfo.shapeInfo.texShape;\n if (texNumR === 1 && texNumC === 1) {\n return `\n float ${funcName}() {\n return sampleTexture(${texName}, halfCR);\n }\n `;\n }\n\n const [tNumR, tNumC] = inputInfo.shapeInfo.texShape;\n const offset = getFlatOffsetUniformName(texName);\n return `\n float ${funcName}() {\n vec2 uv = uvFromFlat(${tNumR}, ${tNumC}, ${offset});\n return sampleTexture(${texName}, uv);\n }\n `;\n}\n\nfunction getPackedSampler1D(inputInfo: InputInfo): string {\n const texName = inputInfo.name;\n const funcName = 'get' + texName.charAt(0).toUpperCase() + texName.slice(1);\n const texShape = inputInfo.shapeInfo.texShape;\n const packedTexShape =\n [Math.ceil(texShape[0] / 2), Math.ceil(texShape[1] / 2)];\n const glsl = getGlslDifferences();\n\n return `\n vec4 ${funcName}(int index) {\n vec2 uv = packedUVfrom1D(\n ${packedTexShape[0]}, ${packedTexShape[1]}, index);\n return ${glsl.texture2D}(${texName}, uv);\n }\n `;\n}\n\nfunction getSampler1D(inputInfo: InputInfo): string {\n const texName = inputInfo.name;\n const funcName = 'get' + texName.charAt(0).toUpperCase() + texName.slice(1);\n\n if (inputInfo.shapeInfo.isUniform) {\n // Uniform arrays will be less than 65505 (no risk of float16 overflow).\n return `\n float ${funcName}(int index) {\n ${getUniformSampler(inputInfo)}\n }\n `;\n }\n\n const texShape = inputInfo.shapeInfo.texShape;\n const tNumR = texShape[0];\n const tNumC = texShape[1];\n\n if (tNumC === 1 && tNumR === 1) {\n return `\n float ${funcName}(int index) {\n return sampleTexture(${texName}, halfCR);\n }\n `;\n }\n const offset = getFlatOffsetUniformName(texName);\n if (tNumC === 1) {\n return `\n float ${funcName}(int index) {\n vec2 uv = vec2(0.5, (float(index + ${offset}) + 0.5) / ${tNumR}.0);\n return sampleTexture(${texName}, uv);\n }\n `;\n }\n if (tNumR === 1) {\n return `\n float ${funcName}(int index) {\n vec2 uv = vec2((float(index + ${offset}) + 0.5) / ${tNumC}.0, 0.5);\n return sampleTexture(${texName}, uv);\n }\n `;\n }\n return `\n float ${funcName}(int index) {\n vec2 uv = uvFromFlat(${tNumR}, ${tNumC}, index + ${offset});\n return sampleTexture(${texName}, uv);\n }\n `;\n}\n\nfunction getPackedSampler2D(inputInfo: InputInfo): string {\n const shape = inputInfo.shapeInfo.logicalShape;\n const texName = inputInfo.name;\n const funcName = 'get' + texName.charAt(0).toUpperCase() + texName.slice(1);\n const texShape = inputInfo.shapeInfo.texShape;\n\n const

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texNumR = texShape[0];\n  const texNumC = texShape[1];\n  const glsl = getGlslDifferences();\n  if (texShape !=
null && util.arraysEqual(shape, texShape)) {\n    return `\n      vec4 ${funcName}(int row, int col) {\n        vec2 uv
= (vec2(col,
 row) + halfCR) / vec2(${texNumC}.0, ${texNumR}.0);\n\n        return ${glsl.texture2D}(${texName}, uv);\n
}\n    `;\n  }\n\n  const packedTexShape =\n      [Math.ceil(texShape[0] / 2), Math.ceil(texShape[1] / 2)];\n  const
valuesPerRow = Math.ceil(shape[1] / 2);\n\n  return `\n    vec4 ${funcName}(int row, int col) {\n      vec2 uv =
packedUVfrom2D(${valuesPerRow}, ${packedTexShape[0]}, ${\n      packedTexShape[1]}, row, col);\n      return
${glsl.texture2D}(${texName}, uv);\n    }\n  `;\n}\n\nfunction getSampler2D(inputInfo: InputInfo): string {\n  const
shape = inputInfo.shapeInfo.logicalShape;\n  const texName = inputInfo.name;\n  const funcName = 'get' +
texName.charAt(0).toUpperCase() + texName.slice(1);\n  const texShape = inputInfo.shapeInfo.texShape;\n\n  if
(texShape != null && util.arraysEqual(shape, texShape)) {\n    const texNumR = texShape[0];\n    const texNumC =
texShape[1];\n    return `\n    float ${funcName}(int row, int col) {\n      vec2 uv = (vec2(col,
 row) + halfCR) / vec2(${texNumC}.0, ${texNumR}.0);\n      return sampleTexture(${texName}, uv);\n    }\n  `;\n
}\n\n  const {newShape, keptDims} = util.squeezeShape(shape);\n  const squeezedShape = newShape;\n  if
(squeezedShape.length < shape.length) {\n    const newInputInfo = squeezeInputInfo(inputInfo, squeezedShape);\n
const params = ['row', 'col'];\n    return `\n      ${getSamplerFromInInfo(newInputInfo)}\n      float ${funcName}(int
row, int col) {\n        return ${funcName}(${getSqueezedParams(params, keptDims)});\n      }\n    `;\n  }\n\n  if
(inputInfo.shapeInfo.isUniform) {\n    // Uniform arrays will be less than 65505 (no risk of float16 overflow).\n
return `\n      float ${funcName}(int row, int col) {\n        int index = round(dot(vec2(row, col), vec2(${shape[1]},
1)));\n        ${getUniformSampler(inputInfo)}\n      }\n    `;\n  }\n\n  const texNumR = texShape[0];\n  const
texNumC = texShape[1];\n  const offset = getFlatOffsetUniformName(texName);\n  if (texNumC
 === 1) {\n    // index is used directly as physical (no risk of float16 overflow).\n    return `\n    float
${funcName}(int row, int col) {\n      float index = dot(vec3(row, col, ${offset}), vec3(${shape[1]}, 1, 1));\n
vec2 uv = vec2(0.5, (index + 0.5) / ${texNumR}.0);\n      return sampleTexture(${texName}, uv);\n    }\n  `;\n  }\n
if (texNumR === 1) {\n    // index is used directly as physical (no risk of float16 overflow).\n    return `\n    float
${funcName}(int row, int col) {\n      float index = dot(vec3(row, col, ${offset}), vec3(${shape[1]}, 1, 1));\n
vec2 uv = vec2((index + 0.5) / ${texNumC}.0, 0.5);\n      return sampleTexture(${texName}, uv);\n    }\n  `;\n  }\n\n
return `\n  float ${funcName}(int row, int col) {\n    // Explicitly use integer operations as dot() only works on
floats.\n    int index = row * ${shape[1]} + col + ${offset};\n    vec2 uv = uvFromFlat(${texNumR}, ${texNumC},
index);\n    return sampleTexture(${texName}, uv);\n  }\n`;\n}\n\nfunction
 getPackedSampler3D(inputInfo: InputInfo): string {\n  const shape = inputInfo.shapeInfo.logicalShape;\n  const
texName = inputInfo.name;\n  const funcName = 'get' + texName.charAt(0).toUpperCase() + texName.slice(1);\n
const texShape = inputInfo.shapeInfo.texShape;\n  const packedTexShape =\n      [Math.ceil(texShape[0] / 2),
Math.ceil(texShape[1] / 2)];\n\n  if (shape[0] === 1) {\n    const squeezedShape = shape.slice(1);\n    const keptDims
= [1, 2];\n    const newInputInfo = squeezeInputInfo(inputInfo, squeezedShape);\n    const params = ['b', 'row',
'col'];\n    return `\n      ${getPackedSamplerFromInInfo(newInputInfo)}\n      vec4 ${funcName}(int b, int row,
int col) {\n        return ${funcName}(${getSqueezedParams(params, keptDims)});\n      }\n    `;\n  }\n\n  const
texNumR = packedTexShape[0];\n  const texNumC = packedTexShape[1];\n\n  const valuesPerRow =
Math.ceil(shape[2] / 2);\n  const texelsInBatch = valuesPerRow * Math.ceil(shape[1] / 2);\n  const glsl
 = getGlslDifferences();\n\n  return `\n    vec4 ${funcName}(int b, int row, int col) {\n      vec2 uv =
packedUVfrom3D(\n        ${texNumR}, ${texNumC}, ${texelsInBatch}, ${valuesPerRow}, b, row, col);\n
return ${glsl.texture2D}(${texName}, uv);\n    }\n  `;\n}\n\nfunction getSampler3D(inputInfo: InputInfo): string {\n
const shape = inputInfo.shapeInfo.logicalShape;\n  const texName = inputInfo.name;\n  const funcName = 'get' +
texName.charAt(0).toUpperCase() + texName.slice(1);\n  const stride0 = shape[1] * shape[2];\n  const stride1 =
shape[2];\n\n  const {newShape, keptDims} = util.squeezeShape(shape);\n  const squeezedShape = newShape;\n  if
(squeezedShape.length < shape.length) {\n    const newInputInfo = squeezeInputInfo(inputInfo, squeezedShape);\n
const params = ['row', 'col', 'depth'];\n    return `\n      ${getSamplerFromInInfo(newInputInfo)}\n      float
${funcName}(int row, int col, int depth) {\n        return ${funcName}(${getSqueezedParams(params,
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keptDims)});\n
      }\n    `;\n  }\n\n  if (inputInfo.shapeInfo.isUniform) {\n    // Uniform arrays will be less than 65505 (no risk of
float16 overflow).\n    return `\n      float ${funcName}(int row, int col, int depth) {\n        int index =
round(dot(vec3(row, col, depth),\n                          vec3(${stride0}, ${stride1}, 1)));\n
${getUniformSampler(inputInfo)}\n      }\n    `;\n  }\n\n  const texShape = inputInfo.shapeInfo.texShape;\n  const
texNumR = texShape[0];\n  const texNumC = texShape[1];\n  const flatOffset = inputInfo.shapeInfo.flatOffset;\n  if
(texNumC === stride0 && flatOffset == null) {\n    // texC is used directly as physical (no risk of float16
overflow).\n    return `\n      float ${funcName}(int row, int col, int depth) {\n        float texR = float(row);\n
float texC = dot(vec2(col, depth), vec2(${stride1}, 1));\n        vec2 uv = (vec2(texC, texR) + halfCR) /\n
vec2(${texNumC}.0, ${texNumR}.0);\n        return sampleTexture(${texName},
uv);\n      }\n    `;\n  }\n\n  if (texNumC === stride1 && flatOffset == null) {\n    // texR is used directly as
physical (no risk of float16 overflow).\n    return `\n    float ${funcName}(int row, int col, int depth) {\n      float
texR = dot(vec2(row, col), vec2(${shape[1]}, 1));\n      float texC = float(depth);\n      vec2 uv = (vec2(texC, texR) +
halfCR) / vec2(${texNumC}.0, ${texNumR}.0);\n      return sampleTexture(${texName}, uv);\n    }\n  `;\n  }\n\n
const offset = getFlatOffsetUniformName(texName);\n  return `\n    float ${funcName}(int row, int col, int depth)
{\n      // Explicitly use integer operations as dot() only works on floats.\n      int index = row * ${stride0} + col *
${stride1} + depth + ${offset};\n      vec2 uv = uvFromFlat(${texNumR}, ${texNumC}, index);\n      return
sampleTexture(${texName}, uv);\n    }\n  `;\n}\n\nfunction getPackedSamplerND(inputInfo: InputInfo): string {\n
const shape = inputInfo.shapeInfo.logicalShape;\n
  const rank = shape.length;\n  const texName = inputInfo.name;\n  const funcName = 'get' +
texName.charAt(0).toUpperCase() + texName.slice(1);\n  const texShape = inputInfo.shapeInfo.texShape;\n  const
packedTexShape =\n      [Math.ceil(texShape[0] / 2), Math.ceil(texShape[1] / 2)];\n  const texNumR =
packedTexShape[0];\n  const texNumC = packedTexShape[1];\n\n  const valuesPerRow = Math.ceil(shape[rank - 1]
/ 2);\n  let texelsInBatch = valuesPerRow * Math.ceil(shape[rank - 2] / 2);\n  let params = `int b, int row, int col`;\n
let index = `b * ${texelsInBatch} + (row / 2) * ${valuesPerRow} + (col / 2)`;\n  for (let b = 2; b < rank - 1; b++) {\n
params = `int b${b}, ` + params;\n    texelsInBatch *= shape[rank - b - 1];\n    index = `b${b} * ${texelsInBatch} +
` + index;\n  }\n  const glsl = getGlslDifferences();\n  return `\n    vec4 ${funcName}(${params}) {\n      int index =
${index};\n      int texR = index / ${texNumC};\n      int texC = index - texR * ${texNumC};\n
    vec2 uv = (vec2(texC, texR) + halfCR) / vec2(${texNumC}, ${texNumR});\n      return
${glsl.texture2D}(${texName}, uv);\n    }\n  `;\n}\n\nfunction getSampler4D(inputInfo: InputInfo): string {\n  const
shape = inputInfo.shapeInfo.logicalShape;\n  const texName = inputInfo.name;\n  const funcName = 'get' +
texName.charAt(0).toUpperCase() + texName.slice(1);\n  const stride2 = shape[3];\n  const stride1 = shape[2] *
stride2;\n  const stride0 = shape[1] * stride1;\n\n  const {newShape, keptDims} = util.squeezeShape(shape);\n  if
(newShape.length < shape.length) {\n    const newInputInfo = squeezeInputInfo(inputInfo, newShape);\n    const
params = ['row', 'col', 'depth', 'depth2'];\n    return `\n      ${getSamplerFromInInfo(newInputInfo)}\n      float
${funcName}(int row, int col, int depth, int depth2) {\n        return ${funcName}(${getSqueezedParams(params,
keptDims)});\n      }\n    `;\n  }\n\n  if (inputInfo.shapeInfo.isUniform) {\n    // Uniform arrays will be less than
65505 (no
 risk of float16 overflow).\n    return `\n      float ${funcName}(int row, int col, int depth, int depth2) {\n        int
index = round(dot(vec4(row, col, depth, depth2),\n                          vec4(${stride0}, ${stride1}, ${stride2}, 1)));\n
  ${getUniformSampler(inputInfo)}\n      }\n    `;\n  }\n\n  const flatOffset = inputInfo.shapeInfo.flatOffset;\n  const
texShape = inputInfo.shapeInfo.texShape;\n  const texNumR = texShape[0];\n  const texNumC = texShape[1];\n\n
if (texNumC === stride0 && flatOffset == null) {\n    // texC is used directly as physical (no risk of float16
overflow).\n    return `\n      float ${funcName}(int row, int col, int depth, int depth2) {\n        float texR =
float(row);\n        float texC =\n            dot(vec3(col, depth, depth2),\n                vec3(${stride1}, ${stride2}, 1));\n
  vec2 uv = (vec2(texC, texR) + halfCR) /\n                vec2(${texNumC}.0, ${texNumR}.0);\n        return
sampleTexture(${texName}, uv);\n      }\n
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  `;\n  }\n  if (texNumC === stride2 && flatOffset == null) {\n    // texR is used directly as physical (no risk of
float16 overflow).\n    return `\n      float ${funcName}(int row, int col, int depth, int depth2) {\n        float texR =
dot(vec3(row, col, depth),\n                      vec3(${shape[1] * shape[2]}, ${shape[2]}, 1));\n        float texC =
float(depth2);\n        vec2 uv = (vec2(texC, texR) + halfCR) /\n                  vec2(${texNumC}.0, ${texNumR}.0);\n
  return sampleTexture(${texName}, uv);\n      }\n    `;\n  }\n\n  const offset =
getFlatOffsetUniformName(texName);\n  return `\n    float ${funcName}(int row, int col, int depth, int depth2) {\n
 // Explicitly use integer operations as dot() only works on floats.\n      int index = row * ${stride0} + col *
${stride1} +\n          depth * ${stride2} + depth2;\n      vec2 uv = uvFromFlat(${texNumR}, ${texNumC}, index +
${offset});\n      return sampleTexture(${texName}, uv);\n    }\n  `;\n}\n\nfunction getSampler5D(inputInfo:
 InputInfo): string {\n  const shape = inputInfo.shapeInfo.logicalShape;\n  const texName = inputInfo.name;\n  const
funcName = 'get' + texName.charAt(0).toUpperCase() + texName.slice(1);\n  const stride3 = shape[4];\n  const
stride2 = shape[3] * stride3;\n  const stride1 = shape[2] * stride2;\n  const stride0 = shape[1] * stride1;\n\n  const
{newShape, keptDims} = util.squeezeShape(shape);\n  if (newShape.length < shape.length) {\n    const
newInputInfo = squeezeInputInfo(inputInfo, newShape);\n    const params = ['row', 'col', 'depth', 'depth2', 'depth3'];\n
  return `\n      ${getSamplerFromInInfo(newInputInfo)}\n      float ${funcName}(int row, int col, int depth, int
depth2, int depth3) {\n        return ${funcName}(${getSqueezedParams(params, keptDims)});\n      }\n    `;\n  }\n\n
if (inputInfo.shapeInfo.isUniform) {\n    // Uniform arrays will be less than 65505 (no risk of float16 overflow).\n
return `\n      float ${funcName}(int row, int col, int depth,
 int depth2, int depth3) {\n        float index = dot(\n          vec4(row, col, depth, depth2),\n          vec4(${stride0},
${stride1}, ${stride2}, ${stride3})) +\n          depth3;\n        ${getUniformSampler(inputInfo)}\n      }\n    `;\n  }\n\n
const flatOffset = inputInfo.shapeInfo.flatOffset;\n  const texShape = inputInfo.shapeInfo.texShape;\n  const
texNumR = texShape[0];\n  const texNumC = texShape[1];\n\n  if (texNumC === stride0 && flatOffset == null) {\n
  // texC is used directly as physical (no risk of float16 overflow).\n    return `\n      float ${funcName}(int row, int
col, int depth, int depth2, int depth3) {\n        int texR = row;\n        float texC = dot(vec4(col, depth, depth2,
depth3),\n                      vec4(${stride1}, ${stride2}, ${stride3}, 1));\n        vec2 uv = (vec2(texC, texR) + halfCR)
/\n                  vec2(${texNumC}.0, ${texNumR}.0);\n        return sampleTexture(${texName}, uv);\n      }\n    `;\n
}\n\n  if (texNumC === stride3 &&
 flatOffset == null) {\n    // texR is used directly as physical (no risk of float16 overflow).\n    return `\n      float
${funcName}(int row, int col, int depth, int depth2, int depth3) {\n        float texR = dot(\n          vec4(row, col,
depth, depth2),\n          vec4(${shape[1] * shape[2] * shape[3]},\n              ${shape[2] * shape[3]}, ${shape[3]},
1));\n        int texC = depth3;\n        vec2 uv = (vec2(texC, texR) + halfCR) /\n                  vec2(${texNumC}.0,
${texNumR}.0);\n        return sampleTexture(${texName}, uv);\n      }\n    `;\n  }\n\n  const offset =
getFlatOffsetUniformName(texName);\n  return `\n    float ${funcName}(int row, int col, int depth, int depth2, int
depth3) {\n      // Explicitly use integer operations as dot() only works on floats.\n      int index = row * ${stride0} +
col * ${stride1} + depth * ${stride2} +\n          depth2 * ${stride3} + depth3 + ${offset};\n      vec2 uv =
uvFromFlat(${texNumR}, ${texNumC}, index);\n      return sampleTexture(${texName},
 uv);\n    }\n  `;\n}\n\nfunction getSampler6D(inputInfo: InputInfo): string {\n  const shape =
inputInfo.shapeInfo.logicalShape;\n  const texName = inputInfo.name;\n  const funcName = 'get' +
texName.charAt(0).toUpperCase() + texName.slice(1);\n\n  const {newShape, keptDims} =
util.squeezeShape(shape);\n  if (newShape.length < shape.length) {\n    const newInputInfo =
squeezeInputInfo(inputInfo, newShape);\n    const params = ['row', 'col', 'depth', 'depth2', 'depth3', 'depth4'];\n
return `\n      ${getSamplerFromInInfo(newInputInfo)}\n      float ${funcName}(int row, int col, int depth,\n
    int depth2, int depth3, int depth4) {\n        return ${funcName}(${getSqueezedParams(params, keptDims)});\n
}\n    `;\n  }\n\n  const stride4 = shape[5];\n  const stride3 = shape[4] * stride4;\n  const stride2 = shape[3] *
stride3;\n  const stride1 = shape[2] * stride2;\n  const stride0 = shape[1] * stride1;\n\n  if
(inputInfo.shapeInfo.isUniform) {\n    //
 Uniform arrays will be less than 65505 (no risk of float16 overflow).\n    return `\n      float ${funcName}(int row,
int col, int depth,\n                  int depth2, int depth3, int depth4) {\n        int index = round(dot(\n          vec4(row,
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col, depth, depth2),\n          vec4(${stride0}, ${stride1}, ${stride2}, ${stride3})) +\n          dot(\n
vec2(depth3, depth4),\n          vec2(${stride4}, 1)));\n        ${getUniformSampler(inputInfo)}\n      }\n    `;\n  }\n\n
const flatOffset = inputInfo.shapeInfo.flatOffset;\n  const texShape = inputInfo.shapeInfo.texShape;\n  const
texNumR = texShape[0];\n  const texNumC = texShape[1];\n  if (texNumC === stride0 && flatOffset == null) {\n
// texC is used directly as physical (no risk of float16 overflow).\n    return `\n      float ${funcName}(int row, int
col, int depth,\n                  int depth2, int depth3, int depth4) {\n        int texR = row;\n        float texC =
dot(vec4(col, depth, depth2, depth3),\n
      vec4(${stride1}, ${stride2}, ${stride3}, ${stride4})) +\n              float(depth4);\n        vec2 uv = (vec2(texC,
texR) + halfCR) /\n                  vec2(${texNumC}.0, ${texNumR}.0);\n        return sampleTexture(${texName},
uv);\n      }\n    `;\n  }\n  if (texNumC === stride4 && flatOffset == null) {\n    // texR is used directly as physical
(no risk of float16 overflow).\n    return `\n      float ${funcName}(int row, int col, int depth,\n                  int
depth2, int depth3, int depth4) {\n        float texR = dot(vec4(row, col, depth, depth2),\n          vec4(${shape[1] *
shape[2] * shape[3] * shape[4]},\n              ${shape[2] * shape[3] * shape[4]},\n              ${shape[3] * shape[4]},\n
          ${shape[4]})) + float(depth3);\n        int texC = depth4;\n        vec2 uv = (vec2(texC, texR) + halfCR) /\n
        vec2(${texNumC}.0, ${texNumR}.0);\n        return sampleTexture(${texName}, uv);\n      }\n    `;\n  }\n
const offset = getFlatOffsetUniformName(texName);\n
  return `\n    float ${funcName}(int row, int col, int depth,\n                  int depth2, int depth3, int depth4) {\n      //
Explicitly use integer operations as dot() only works on floats.\n      int index = row * ${stride0} + col * ${stride1}
+ depth * ${stride2} +\n          depth2 * ${stride3} + depth3 * ${stride4} + depth4 + ${offset};\n      vec2 uv =
uvFromFlat(${texNumR}, ${texNumC}, index);\n      return sampleTexture(${texName}, uv);\n    }\n
`;\n}\n\nfunction getUniformSampler(inputInfo: InputInfo): string {\n  const texName = inputInfo.name;\n  const
inSize = util.sizeFromShape(inputInfo.shapeInfo.logicalShape);\n\n  if (inSize < 2) {\n    return `return
${texName};`;\n  }\n  return `\n    for (int i = 0; i < ${inSize}; i++) {\n      if (i == index) {\n        return
${texName}[i];\n      }\n    }\n  `;\n}\n\nfunction getPackedSamplerAtOutputCoords(\n    inputInfo: InputInfo,
outShapeInfo: ShapeInfo) {\n  const texName = inputInfo.name;\n  const
  texFuncSnippet = texName.charAt(0).toUpperCase() + texName.slice(1);\n  const funcName = 'get' +
texFuncSnippet + 'AtOutCoords';\n  const inRank = inputInfo.shapeInfo.logicalShape.length;\n  const outRank =
outShapeInfo.logicalShape.length;\n\n  const broadcastDims = getBroadcastDims(\n
inputInfo.shapeInfo.logicalShape, outShapeInfo.logicalShape);\n\n  const type = getCoordsDataType(outRank);\n
const rankDiff = outRank - inRank;\n  let coordsSnippet: string;\n  const fields = ['x', 'y', 'z', 'w', 'u', 'v'];\n\n  if
(inRank === 0) {\n    coordsSnippet = '';\n  } else if (outRank < 2 && broadcastDims.length >= 1) {\n
coordsSnippet = 'coords = 0;';\n  } else {\n    coordsSnippet =\n        broadcastDims.map(d => `coords.${fields[d +
rankDiff]} = 0;`)\n            .join('\\n');\n  }\n  let unpackedCoordsSnippet = '';\n  if (outRank < 2 && inRank > 0) {\n
unpackedCoordsSnippet = 'coords';\n  } else {\n    unpackedCoordsSnippet = inputInfo.shapeInfo.logicalShape\n

                .map((s, i) => `coords.${fields[i + rankDiff]}`)\n                            .join(', ');\n  }\n\n  let output =
`return outputValue;`;\n  const inSize = util.sizeFromShape(inputInfo.shapeInfo.logicalShape);\n  const
isInputScalar = inSize === 1;\n  const outSize = util.sizeFromShape(outShapeInfo.logicalShape);\n  const
isOutputScalar = outSize === 1;\n\n  if (inRank === 1 && !isInputScalar && !isOutputScalar) {\n    output = `\n
return vec4(outputValue.xy, outputValue.xy);\n    `;\n  } else if (isInputScalar && !isOutputScalar) {\n    if (outRank
=== 1) {\n      output = `\n        return vec4(outputValue.x, outputValue.x, 0., 0.);\n      `;\n    } else {\n      output =
`\n        return vec4(outputValue.x);\n      `;\n    }\n  } else if (broadcastDims.length) {\n    const rows = inRank - 2;\n
  const cols = inRank - 1;\n\n    if (broadcastDims.indexOf(rows) > -1 && broadcastDims.indexOf(cols) > -1) {\n
output = `return vec4(outputValue.x);`;\n
  } else if (broadcastDims.indexOf(rows) > -1) {\n      output = `return vec4(outputValue.x, outputValue.y, ` +\n
`outputValue.x, outputValue.y);`;\n    } else if (broadcastDims.indexOf(cols) > -1) {\n      output = `return
vec4(outputValue.xx, outputValue.zz);`;\n    }\n  }\n\n  return `\n    vec4 ${funcName}() {\n      ${type} coords =
getOutputCoords();\n      ${coordsSnippet}\n      vec4 outputValue =
```

get${texFuncSnippet}(${unpackedCoordsSnippet});\n ${output}\n }\n `;\n}\n\nfunction getSamplerAtOutputCoords(\n inputInfo: InputInfo, outShapeInfo: ShapeInfo) {\n const texName = inputInfo.name;\n const texFuncSnippet = texName.charAt(0).toUpperCase() + texName.slice(1);\n const funcName = 'get' + texFuncSnippet + 'AtOutCoords';\n const outTexShape = outShapeInfo.texShape;\n const inTexShape = inputInfo.shapeInfo.texShape;\n const inRank = inputInfo.shapeInfo.logicalShape.length;\n const outRank = outShapeInfo.logicalShape.length;\n\n if (!inputInfo.shapeInfo.isUniform && inRank === outRank &&\n inputInfo.shapeInfo.flatOffset == null &&\n util.arraysEqual(inTexShape, outTexShape)) {\n return `\n float ${funcName}() {\n return sampleTexture(${texName}, resultUV);\n }\n `;\n }\n\n const type = getCoordsDataType(outRank);\n const broadcastDims = getBroadcastDims(\n inputInfo.shapeInfo.logicalShape, outShapeInfo.logicalShape);\n const rankDiff = outRank - inRank;\n let coordsSnippet: string;\n const fields = ['x', 'y', 'z', 'w', 'u', 'v'];\n\n if (inRank === 0) {\n coordsSnippet = '';\n } else if (outRank < 2 && broadcastDims.length >= 1) {\n coordsSnippet = 'coords = 0;';\n } else {\n coordsSnippet =\n broadcastDims.map(d => `coords.${fields[d + rankDiff]} = 0;`)\n .join('\\n');\n }\n let unpackedCoordsSnippet = '';\n if (outRank < 2 && inRank > 0) {\n unpackedCoordsSnippet = 'coords';\n } else {\n unpackedCoordsSnippet = inputInfo.shapeInfo.logicalShape\n .map((s, i) => `coords.${fields[i + rankDiff]}`)\n .join(', ');\n }\n\n return `\n float ${funcName}() {\n ${type} coords = getOutputCoords();\n ${coordsSnippet}\n return get${texFuncSnippet}(${unpackedCoordsSnippet});\n }\n `;\n}\n\nexport function getCoordsDataType(rank: number): string {\n if (rank <= 1) {\n return 'int';\n } else if (rank === 2) {\n return 'ivec2';\n } else if (rank === 3) {\n return 'ivec3';\n } else if (rank === 4) {\n return 'ivec4';\n } else if (rank === 5) {\n return 'ivec5';\n } else if (rank === 6) {\n return 'ivec6';\n } else {\n throw Error(`GPU for rank ${rank} is not yet supported`);\n }\n}\n\n/** Returns a new input info (a copy) that has a squeezed logical shape. */\nfunction squeezeInputInfo(\n inInfo: InputInfo, squeezedShape: number[]): InputInfo {\n // Deep copy.\n const newInputInfo: InputInfo = JSON.parse(JSON.stringify(inInfo));\n newInputInfo.shapeInfo.logicalShape = squeezedShape;\n return newInputInfo;\n}\n\nfunction getSqueezedParams(params: string[], keptDims: number[]): string {\n return keptDims.map(d => params[d]).join(', ');\n}\n","/**\n * @license\n * Copyright 2017 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {env, Tensor, TypedArray, util} from '@tensorflow/tfjs-core';\n\nimport {GPGPUContext} from './gpgpu_context';\nimport * as shader_compiler from './shader_compiler';\nimport {InputInfo, ShapeInfo} from './shader_compiler';\nimport {PackingScheme, TextureData, TextureUsage} from './tex_util';\n\nexport interface GPGPUProgram {\n variableNames: string[];\n outputShape: number[];\n userCode: string;\n /** If true, this program expects packed input textures. Defaults to false. */\n packedInputs?: boolean;\n /** If true, this program produces a packed texture. Defaults to false. */\n packedOutput?: boolean;\n /**\n * Affects what type of texture we allocate for the output. Defaults to\n * `TextureUsage.RENDER`.\n */\n outTexUsage?: TextureUsage;\n /**\n * The type of scheme to use when packing texels for the output values.\n * See `PackingScheme` for details. Defaults to `PackingScheme.SHARED_BATCH`.\n */\n outPackingScheme?: PackingScheme;\n}\n\nexport interface GPGPUBinary {\n webGLProgram: WebGLProgram;\n program: GPGPUProgram;\n uniformLocations: {[name: string]: WebGLUniformLocation};\n source: string;\n inShapeInfos: ShapeInfo[];\n outShapeInfo: ShapeInfo;\n infLoc: WebGLUniformLocation;\n nanLoc: WebGLUniformLocation;\n}\n\nexport interface TensorData {\n shape: number[];\n texData: TextureData;\n isUniform: boolean;\n // Available when we decide to upload as uniform instead of texture.\n uniformValues?: TypedArray;\n}\n\nexport function compileProgram<T extends Tensor, K extends Tensor>(\n gpgpu:

```
GPGPUContext, program: GPGPUProgram, inputs: TensorData[],\n    output: TensorData): GPGPUBinary {\n
const userCode = program.userCode;\n  const inputInfos: InputInfo[] = inputs.map((input, i) => {\n    const
shapeInfo: ShapeInfo = {\n      logicalShape: input.shape,\n      texShape: input.isUniform ? null :
input.texData.texShape,\n      isUniform: input.isUniform,\n      isPacked: input.isUniform ? false :
input.texData.isPacked,\n      flatOffset: null\n    };\n    if (input.texData
 != null && input.texData.slice != null &&\n        input.texData.slice.flatOffset > 0) {\n      shapeInfo.flatOffset =
input.texData.slice.flatOffset;\n    }\n    return {name: program.variableNames[i], shapeInfo};\n  });\n  const
inShapeInfos = inputInfos.map(x => x.shapeInfo);\n  const outShapeInfo: ShapeInfo = {\n    logicalShape:
output.shape,\n    texShape: output.texData.texShape,\n    isUniform: false,\n    isPacked: output.texData.isPacked,\n
  flatOffset: null\n  };\n  const source = shader_compiler.makeShader(\n      inputInfos, outShapeInfo, userCode,
program.packedInputs);\n\n  const webGLProgram = gpgpu.createProgram(source);\n\n  // Add special uniforms
(NAN, INFINITY)\n  let infLoc: WebGLUniformLocation = null;\n  const nanLoc =
gpgpu.getUniformLocation(webGLProgram, 'NAN', false);\n  if (env().getNumber('WEBGL_VERSION') === 1)
{\n    infLoc = gpgpu.getUniformLocation(webGLProgram, 'INFINITY', false);\n  }\n\n  // Add user-defined
uniforms\n  const uniformLocations:
 {[name: string]: WebGLUniformLocation} = {};\n  for (let i = 0; i < program.variableNames.length; i++) {\n
const varName = program.variableNames[i];\n    const shouldThrow = false;\n    uniformLocations[varName] =\n
 gpgpu.getUniformLocation(webGLProgram, varName, shouldThrow);\n    uniformLocations[`offset${varName}`]
=\n        gpgpu.getUniformLocation(webGLProgram, `offset${varName}`, shouldThrow);\n  }\n\n  return {\n
program,\n    source,\n    webGLProgram,\n    uniformLocations,\n    inShapeInfos,\n    outShapeInfo,\n    infLoc,\n
nanLoc,\n  };\n}\n\nfunction validateBinaryAndProgram(\n    shapeInfos: ShapeInfo[], inputs: TensorData[]) {\n  if
(shapeInfos.length !== inputs.length) {\n    throw Error(\n        `Binary was compiled with ${shapeInfos.length}
inputs, but ` +\n        `was executed with ${inputs.length} inputs`);\n  }\n\n  shapeInfos.forEach((s, i) => {\n    const
shapeA = s.logicalShape;\n    const input = inputs[i];\n    const shapeB = input.shape;\n\n
    if (!util.arraysEqual(shapeA, shapeB)) {\n      throw Error(\n          `Binary was compiled with different shapes
than ` +\n          `the current args. Shapes ${shapeA} and ${shapeB} must match`);\n    }\n    // The input is uploaded
as uniform.\n    if (s.isUniform && input.isUniform) {\n      return;\n    }\n\n    const texShapeA = s.texShape;\n
const texShapeB = input.isUniform ? null : input.texData.texShape;\n    if (!util.arraysEqual(texShapeA,
texShapeB)) {\n      throw Error(\n          `Binary was compiled with different texture shapes than the` +\n          `
current args. Shape ${texShapeA} and ${texShapeB} must match`);\n    }\n  });\n}\n\nexport function
runProgram<T extends Tensor, K extends Tensor>(\n    gpgpu: GPGPUContext, binary: GPGPUBinary, inputs:
TensorData[],\n    output: TensorData,\n    customSetup?: (gpgpu: GPGPUContext, webGLProgram:
WebGLProgram) =>\n        void): void {\n  validateBinaryAndProgram(binary.inShapeInfos, inputs);\n
validateBinaryAndProgram([binary.outShapeInfo],
 [output]);\n\n  const outTex = output.texData.texture;\n  const outTexShape = output.texData.texShape;\n  if
(output.texData.isPacked) {\n    gpgpu.setOutputPackedMatrixTexture(outTex, outTexShape[0], outTexShape[1]);\n
} else {\n    gpgpu.setOutputMatrixTexture(outTex, outTexShape[0], outTexShape[1]);\n  }\n
gpgpu.setProgram(binary.webGLProgram);\n\n  // Set special uniforms (NAN, INFINITY)\n  if
(env().getNumber('WEBGL_VERSION') === 1) {\n    if (binary.infLoc !== null) {\n
gpgpu.gl.uniform1f(binary.infLoc, Infinity);\n    }\n  }\n  if (binary.nanLoc !== null) {\n
gpgpu.gl.uniform1f(binary.nanLoc, NaN);\n  }\n\n  // Set user-defined inputs\n  inputs.forEach((input, i) => {\n
const varName = binary.program.variableNames[i];\n    const varLoc = binary.uniformLocations[varName];\n
const varOffsetLoc = binary.uniformLocations[`offset${varName}`];\n\n    if (varLoc == null) {\n      // The
compiler inferred that this variable is not used
 in this shader.\n      return;\n    }\n\n    if (input.isUniform) {\n      // Upload the values of the tensor as uniform.\n
if (util.sizeFromShape(input.shape) < 2) {\n        gpgpu.gl.uniform1f(varLoc, input.uniformValues[0]);\n      } else
{\n        let vals = input.uniformValues;\n        if (!(vals instanceof Float32Array)) {\n          vals = new
Float32Array(vals);\n        }\n        gpgpu.gl.uniform1fv(varLoc, vals);\n      }\n      return;\n    }\n\n    // If the input
```

was sliced, upload the flat offset index.\n   if (input.texData.slice != null && varOffsetLoc != null) {\n gpgpu.gl.uniform1i(varOffsetLoc, input.texData.slice.flatOffset);\n   }\n\n gpgpu.setInputMatrixTexture(input.texData.texture, varLoc, i);\n });\n\n if (customSetup != null) {\n customSetup(gpgpu, binary.webGLProgram);\n }\n gpgpu.executeProgram();\n}\n\nexport function makeShaderKey(\n   program: GPGPUProgram, inputs: TensorData[], output: TensorData): string {\n let keyInputs =
 ";\n inputs.concat(output).forEach(x => {\n   const hasOffset = x.texData != null && x.texData.slice != null &&\n   x.texData.slice.flatOffset > 0;\n   const texShape = x.isUniform ? 'uniform' : x.texData.texShape;\n   keyInputs += `${x.shape}_${texShape}_${hasOffset}`;\n });\n const keyUserCode = program.userCode;\n let key = program.constructor.name;\n // Fast string concat. See https://jsperf.com/string-concatenation/14.\n key += '_' + keyInputs + '_' + keyUserCode;\n return key;\n}\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF
 ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n */\n\nimport {TensorInfo, util} from '@tensorflow/tfjs-core';\n\nexport function assertNotComplex(\n   tensor: TensorInfo|TensorInfo[], opName: string): void {\n if (!Array.isArray(tensor)) {\n   tensor = [tensor];\n }\n tensor.forEach(t => {\n   if (t != null) {\n   util.assert(\n   t.dtype !== 'complex64',\n   () => `${\n opName} does not support complex64 tensors in the CPU backend.`);\n   }\n });\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the License);\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required
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==\n */\n\nimport {Abs, AbsInputs, KernelConfig, KernelFunc, TypedArray, util} from '@tensorflow/tfjs-core';\n\nimport {MathBackendCPU} from '../backend_cpu';\nimport {assertNotComplex} from '../cpu_util';\n\nexport function simpleAbsImpl(vals: TypedArray): Float32Array {\n const resultValues = new Float32Array(vals.length);\n for (let i = 0; i < vals.length; ++i) {\n   resultValues[i] = Math.abs(vals[i]);\n }\n return resultValues;\n}\n\nexport const abs = (args: {inputs: AbsInputs, backend: MathBackendCPU}) => {\n const {x} = args.inputs;\n const cpuBackend = args.backend;\n\n assertNotComplex(x, 'abs');\n\n\n let resultValues = new Float32Array(util.sizeFromShape(x.shape));\n const values = cpuBackend.data.get(x.dataId).values as TypedArray;\n resultValues = simpleAbsImpl(values);\n\n return cpuBackend.makeOutput(resultValues, x.shape, 'float32');\n};\n\nexport const absConfig: KernelConfig = {\n kernelName: Abs,\n backendName: 'cpu',\n kernelFunc: abs as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n *
 limitations under the License.\n *
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*/\n\nimport {backend_util, DataType, NumericDataType, TypedArray, util} from '@tensorflow/tfjs-core';\n\nimport {SimpleBinaryKernelImpl, SimpleBinaryOperation} from './binary_types';\n\n/**\n * Template that creates implementation for binary ops. Supports broadcast.\n */\nexport function createSimpleBinaryKernelImpl(op: SimpleBinaryOperation):\n SimpleBinaryKernelImpl {\n return (aShape: number[], bShape: number[], aVals: TypedArray,\n bVals: TypedArray, dtype: DataType): [TypedArray, number[]] => {\n const newShape = backend_util.assertAndGetBroadcastShape(aShape, bShape);\n\n const resultRank = newShape.length;\n const resultStrides = util.computeStrides(newShape);\n const resultSize = util.sizeFromShape(newShape);\n\n const result =\n util.getTypedArrayFromDType(dtype as NumericDataType, resultSize);\n\n const aRank = aShape.length;\n
 const bRank = bShape.length;\n\n const aStrides = util.computeStrides(aShape);\n const bStrides = util.computeStrides(bShape);\n\n const aBroadcastDims = backend_util.getBroadcastDims(aShape, newShape);\n
 const bBroadcastDims = backend_util.getBroadcastDims(bShape, newShape);\n\n if (aBroadcastDims.length + bBroadcastDims.length === 0) {\n for (let i = 0; i < result.length; ++i) {\n result[i] = op(aVals[i % aVals.length], bVals[i % bVals.length]);\n }\n } else {\n for (let i = 0; i < result.length; ++i) {\n const loc = util.indexToLoc(i, resultRank, resultStrides);\n\n const aLoc = loc.slice(-aRank);\n aBroadcastDims.forEach(d => aLoc[d] = 0);\n const aIndex = util.locToIndex(aLoc, aRank, aStrides);\n\n const bLoc = loc.slice(-bRank);\n bBroadcastDims.forEach(d => bLoc[d] = 0);\n const bIndex = util.locToIndex(bLoc, bRank, bStrides);\n\n result[i] = op(aVals[aIndex], bVals[bIndex]);\n
 }\n }\n\n return [result, newShape];\n };\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {Complex, ComplexInputs, KernelConfig, KernelFunc, TensorInfo, TypedArray} from '@tensorflow/tfjs-core';\n\nimport {MathBackendCPU} from '../backend_cpu';\n\nexport function complex(args: {inputs: ComplexInputs,
 backend: MathBackendCPU}):\n TensorInfo {\n const {inputs, backend} = args;\n const {real, imag} = inputs;\n\n const realVals = backend.data.get(real.dataId).values as TypedArray;\n const imagVals = backend.data.get(imag.dataId).values as TypedArray;\n\n const complexInfo = backend.makeTensorInfo(real.shape, 'complex64');\n\n const complex = backend.data.get(complexInfo.dataId);\n\n // The complex tensor owns the underlying real and imag tensorInfos, only the\n // complex tensor tracks refCount, when complexData is disposed the\n // underlying tensorData will be disposed.\n complex.complexTensorInfos = {\n real: backend.makeTensorInfo(real.shape, 'float32', realVals),\n imag: backend.makeTensorInfo(imag.shape, 'float32', imagVals)\n };\n\n return complexInfo;\n}\n\nexport const complexConfig: KernelConfig = {\n kernelName: Complex,\n backendName: 'cpu',\n kernelFunc: complex as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights
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value.\n * @param backend cpu backend.\n * @param shape Shape for the zeros tensor.\n * @param dtype Optional. If set, the
result has this dtype.\n */\nexport function zeros(\n backend: MathBackendCPU, shape: number[],\n dtype: DataType = 'float32'): TensorInfo {\n if (dtype === 'complex64') {\n const real = zeros(backend, shape, 'float32');\n const imag = zeros(backend, shape, 'float32');\n\n return complex({inputs: {real, imag}, backend});\n }\n\n const values = util.makeZerosTypedArray(util.sizeFromShape(shape), dtype);\n\n return backend.makeTensorInfo(shape, dtype, values);\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either
express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {Identity, IdentityInputs, KernelConfig, KernelFunc, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {MathBackendCPU} from '../backend_cpu';\n\nexport function identity(\n args: {inputs: IdentityInputs, backend: MathBackendCPU}): TensorInfo {\n const {inputs, backend} = args;\n const {x} = inputs;\n\n backend.incRef(x.dataId);\n\n return {dataId: x.dataId, shape: x.shape, dtype: x.dtype};\n}\n\nexport const identityConfig: KernelConfig = {\n kernelName: Identity,\n backendName: 'cpu',\n kernelFunc: identity as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain
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==========\n */\n\nimport {KernelConfig, KernelFunc, Real, RealInputs, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {MathBackendCPU} from '../backend_cpu';\n\nexport function real(args: {inputs: RealInputs, backend: MathBackendCPU}):\n TensorInfo {\n const {inputs, backend} = args;\n const {input} = inputs;\n\n const real = backend.data.get(input.dataId).complexTensorInfos.real;\n const realVal = backend.data.get(real.dataId).values;\n\n // When complex tensor is disposed, its underlying parts will
be disposed too.\n // Make new tensor out of the real value of the complex. This makes sure the\n // value is still accessible even if complex tensor is disposed.\n return backend.makeTensorInfo(real.shape, real.dtype, realVal);\n}\n\nexport const realConfig: KernelConfig = {\n kernelName: Real,\n backendName: 'cpu',\n kernelFunc: real as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the
License.\n *
==========\n */\nimport {Cast, CastAttrs, CastInputs, KernelConfig, KernelFunc, TensorInfo, TypedArray, util} from '@tensorflow/tfjs-core';\n\nimport {MathBackendCPU} from '../backend_cpu';\nimport {createSimpleBinaryKernelImpl} from '../utils/binary_impl';\nimport {zeros} from '../utils/zeros_impl';\n\nimport

{complex} from './Complex';\nimport {identity} from './Identity';\nimport {real} from './Real';\n\nexport function cast(\n args: {inputs: CastInputs, backend: MathBackendCPU, attrs: CastAttrs}):\n TensorInfo {\n const {inputs, backend, attrs} = args;\n const {x} = inputs;\n const {dtype} = attrs;\n\n // Casting to complex64.\n if (dtype === 'complex64') {\n if (x.dtype === 'complex64') {\n   return identity({inputs: {x}, backend});\n }\n\n const zerosTensorInfo = zeros(backend, x.shape, x.dtype);\n const floatX = cast({inputs: {x}, backend, attrs: {dtype: 'float32'}});\n\n const result =\n   complex({inputs: {real: floatX, imag: zerosTensorInfo}, backend});\n\n backend.disposeIntermediateTensorInfo(zerosTensorInfo);\n backend.disposeIntermediateTensorInfo(floatX);\n\n return result;\n }\n\n // Casting from complex64\n if (x.dtype === 'complex64') {\n const realPart = real({inputs: {input: x}, backend});\n const result = cast({inputs: {x: realPart}, backend, attrs: {dtype}});\n\n backend.disposeIntermediateTensorInfo(realPart);\n\n return result;\n }\n\n if (!util.hasEncodingLoss(x.dtype, dtype)) {\n // We don't change the underlying data, since we cast to higher\n // precision.\n const result = identity({inputs: {x}, backend});\n return {dataId: result.dataId, shape: result.shape, dtype};\n }\n\n if (dtype === 'int32') {\n const values = backend.data.get(x.dataId).values as TypedArray;\n const resultValues = Int32Array.from(values);\n return backend.makeTensorInfo(x.shape, 'int32', resultValues);\n }\n\n if (dtype === 'bool') {\n // This is essentially the result of notEqual(x, 0). We avoid using\n // kernel notEqual to avoid circular dependency, i.e. binary_utils ->\n // cast -> notEqual -> binary_utils.\n const xVals = backend.data.get(x.dataId).values as TypedArray;\n const zero = util.toTypedArray([0], x.dtype);\n\n const [resultData, resultShape] = createSimpleBinaryKernelImpl(\n   (a, b) => (a !== b) ? 1 : 0)(x.shape, [], xVals, zero, 'bool');\n\n return backend.makeTensorInfo(resultShape, 'bool', resultData);\n }\n\n throw new Error(`Error in Cast: failed to cast ${x.dtype} to ${dtype}`);\n}\n\nexport const castConfig: KernelConfig = {\n kernelName: Cast,\n backendName: 'cpu',\n kernelFunc: cast as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==\n */\n\nimport {backend_util, BinaryInputs, DataType, KernelFunc, TypedArray, util} from '@tensorflow/tfjs-core';\n\nimport {MathBackendCPU} from '../backend_cpu';\nimport {assertNotComplex} from '../cpu_util';\nimport {cast} from '../kernels/Cast';\nimport {complex} from '../kernels/Complex';\n\nimport {ComplexBinaryKernelImpl, ComplexBinaryOperation, SimpleBinaryKernelImpl} from './binary_types';\n\n/**\n * Template that creates a `KernelFunc` for binary ops.\n * @param name Kernel name.\n * @param binaryKernelImpl A `SimpleBinaryKernelImpl` for the kernel.\n * @param binaryKernelComplexImpl Optional. If exists, represents a\n *   `ComplexBinaryKernelImpl` for the kernel, will be used when input dtype\n *   is `complex64`.\n * @param dtype Optional. If set, the result has this dtype. Otherwise, the\n *   result has the same dtype as the first input. This is mainly used in\n *   comparison kernels, such as Equal, Less, Greater, etc.\n */\nexport function binaryKernelFunc(\n name: string, simpleImpl: SimpleBinaryKernelImpl,\n complexImpl?: ComplexBinaryKernelImpl, dtype?: DataType): KernelFunc {\n if (complexImpl == null) {\n return ({inputs, backend}) => {\n   const {a, b} = inputs as BinaryInputs;\n   const cpuBackend = backend as MathBackendCPU;\n\n   assertNotComplex([a, b], name);\n\n   const aVals = cpuBackend.data.get(a.dataId).values as TypedArray;\n   const bVals = cpuBackend.data.get(b.dataId).values as TypedArray;\n\n   const $dtype = dtype || a.dtype;\n\n   const [resultData, resultShape] =\n   simpleImpl(a.shape, b.shape, aVals, bVals, $dtype);\n\n   return cpuBackend.makeTensorInfo(resultShape, $dtype, resultData);\n };\n }\n\n return ({inputs, backend}) => {\n const {a, b} = inputs as BinaryInputs;\n const cpuBackend = backend as MathBackendCPU;\n\n if (a.dtype === 'complex64' || b.dtype === 'complex64') {\n   const $aComplex = cast(\n

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{inputs: {x: a}, backend: cpuBackend, attrs: {dtype: 'complex64'}});\n\n      const $aComplexVals = cpuBackend.data.get($aComplex.dataId);\n\n      const aReal = $aComplexVals.complexTensorInfos.real;\n      const aImag = $aComplexVals.complexTensorInfos.imag;\n\n      const aRealVals =\n cpuBackend.data.get(aReal.dataId).values as Float32Array;\n      const aImagVals =\n cpuBackend.data.get(aImag.dataId).values as Float32Array;\n\n      const $bComplex = cast(\n          {inputs: {x: b}, backend: cpuBackend, attrs: {dtype:
 'complex64'}});\n\n      const $bComplexVals = cpuBackend.data.get($bComplex.dataId);\n\n      const bReal = $bComplexVals.complexTensorInfos.real;\n      const bImag = $bComplexVals.complexTensorInfos.imag;\n\n      const bRealVals =\n          cpuBackend.data.get(bReal.dataId).values as Float32Array;\n      const bImagVals =\n        cpuBackend.data.get(bImag.dataId).values as Float32Array;\n\n      const [resultRealData, resultImagData, resultShape] = complexImpl(\n          a.shape, b.shape, aRealVals, aImagVals, bRealVals, bImagVals);\n\n      const resultReal =\n          cpuBackend.makeTensorInfo(resultShape, 'float32', resultRealData);\n\n      const resultImag =\n          cpuBackend.makeTensorInfo(resultShape, 'float32', resultImagData);\n\n      const result = complex(\n       {inputs: {real: resultReal, imag: resultImag}, backend: cpuBackend});\n\n      cpuBackend.disposeIntermediateTensorInfo($aComplex);\n      cpuBackend.disposeIntermediateTensorInfo($bComplex);\n
      cpuBackend.disposeIntermediateTensorInfo(resultReal);\n      cpuBackend.disposeIntermediateTensorInfo(resultImag);\n\n      return result;\n    } else {\n      const aVals = cpuBackend.data.get(a.dataId).values as TypedArray;\n      const bVals = cpuBackend.data.get(b.dataId).values as TypedArray;\n\n      const $dtype = dtype || a.dtype;\n\n      const [resultData, resultShape] =\n          simpleImpl(a.shape, b.shape, aVals, bVals, $dtype);\n\n      return cpuBackend.makeTensorInfo(resultShape, $dtype, resultData);\n    }\n  };\n}\n\n/**\n * Template that creates the complex type implementation for binary ops.\n * Supports broadcast.\n */\nexport function createComplexBinaryKernelImpl(op: ComplexBinaryOperation):\n ComplexBinaryKernelImpl {\n  return (aShape: number[], bShape: number[], aRealVals: Float32Array,\n          aImagVals: Float32Array, bRealVals: Float32Array,\n          bImagVals: Float32Array): [TypedArray, TypedArray, number[]] => {\n    const resultShape = backend_util.assertAndGetBroadcastShape(aShape,
 bShape);\n    const resultSize = util.sizeFromShape(resultShape);\n    const resultRank = resultShape.length;\n    const resultStrides = util.computeStrides(resultShape);\n\n    const resultRealVals =
 util.getTypedArrayFromDType('float32', resultSize);\n    const resultImagVals =
 util.getTypedArrayFromDType('float32', resultSize);\n\n    const aBroadcastDims =
 backend_util.getBroadcastDims(aShape, resultShape);\n    const bBroadcastDims =
 backend_util.getBroadcastDims(bShape, resultShape);\n\n    const aVals =
 backend_util.mergeRealAndImagArrays(aRealVals, aImagVals);\n    const bVals =
 backend_util.mergeRealAndImagArrays(bRealVals, bImagVals);\n\n    const aRank = aShape.length;\n    const aStrides = util.computeStrides(aShape);\n\n    const bRank = bShape.length;\n    const bStrides =
 util.computeStrides(bShape);\n\n    if (aBroadcastDims.length + bBroadcastDims.length === 0) {\n      for (let i = 0; i < resultRealVals.length; i++) {\n
    const aIdx = i % aVals.length;\n        const bIdx = i % bVals.length;\n\n        const result =\n op(aVals[aIdx * 2], aVals[aIdx * 2 + 1], bVals[bIdx * 2],\n              bVals[bIdx * 2 + 1]);\n\n        resultRealVals[i] = result.real;\n        resultImagVals[i] = result.imag;\n      }\n    } else {\n      for (let i = 0; i < resultRealVals.length; i++) {\n        const loc = util.indexToLoc(i, resultRank, resultStrides);\n\n        const aLoc = loc.slice(-aRank);\n aBroadcastDims.forEach(d => aLoc[d] = 0);\n        const aIndex = util.locToIndex(aLoc, aRank, aStrides);\n\n const bLoc = loc.slice(-bRank);\n        bBroadcastDims.forEach(d => bLoc[d] = 0);\n        const bIndex =
 util.locToIndex(bLoc, bRank, bStrides);\n\n        const opResult =\n            op(aVals[aIndex * 2], aVals[aIndex * 2 + 1], bVals[bIndex * 2],\n              bVals[bIndex * 2 + 1]);\n\n        resultRealVals[i] = opResult.real;\n resultImagVals[i] = opResult.imag;\n
   }\n    }\n    return [resultRealVals, resultImagVals, resultShape];\n  };\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you
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const addImpl = createSimpleBinaryKernelImpl(((a, b) => a + b));\nexport const addComplexImpl =\n createComplexBinaryKernelImpl(((aReal, aImag, bReal, bImag) => {\n return {real: aReal + bReal, imag: aImag + bImag};\n }));\n\nexport const add = binaryKernelFunc(Add, addImpl, addComplexImpl);\n\nexport const addConfig: KernelConfig = {\n kernelName: Add,\n backendName: 'cpu',\n kernelFunc: add\n};\n\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ===\n */\n\nimport {buffer, DataType, Rank, TensorBuffer, TypedArray, util} from '@tensorflow/tfjs-core';\n\nexport function bincountImpl(\n xVals: TypedArray, weightsVals: TypedArray, weightsDtype: DataType,\n weightsShape: number[], size: number): TypedArray {\n const weightsSize = util.sizeFromShape(weightsShape);\n const outVals = util.makeZerosTypedArray(size, weightsDtype) as TypedArray;\n\n for (let i = 0; i < xVals.length; i++) {\n const value = xVals[i];\n if (value < 0) {\n throw new Error('Input x must be non-negative!');\n }\n\n if (value >= size) {\n continue;\n }\n\n if (weightsSize > 0) {\n outVals[value] += weightsVals[i];\n } else {\n outVals[value] += 1;\n }\n }\n\n return outVals;\n}\n\nexport function bincountReduceImpl<R extends Rank>(\n xBuf: TensorBuffer<R>,
weightsBuf: TensorBuffer<R>, size: number,\n binaryOutput = false): TensorBuffer<R> {\n const numRows = xBuf.shape[0];\n const numCols = xBuf.shape[1];\n\n const outBuf = buffer([numRows, size], weightsBuf.dtype);\n\n for (let i = 0; i < numRows; i++) {\n for (let j = 0; j < numCols; j++) {\n const value = xBuf.get(i, j);\n if (value < 0) {\n throw new Error('Input x must be non-negative!');\n }\n\n if (value >= size) {\n continue;\n }\n\n if (binaryOutput) {\n outBuf.set(1, i, value);\n } else {\n if (weightsBuf.size > 0) {\n outBuf.set(outBuf.get(i, value) + weightsBuf.get(i, j), i, value);\n } else {\n outBuf.set(outBuf.get(i, value) + 1, i, value);\n }\n }\n }\n }\n\n return outBuf as TensorBuffer<R>;\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may
not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ===\n */\n\nimport {NumericDataType, util} from '@tensorflow/tfjs-core';\n\nimport {SimpleUnaryImpl, SimpleUnaryOperation} from './unary_types';\n\n/**\n * Template that creates implementation for unary op.\n */\nexport function createSimpleUnaryImpl(op: SimpleUnaryOperation):\n SimpleUnaryImpl {\n return (values, dtype, attrs) => {\n const newValues =\n util.getTypedArrayFromDType(dtype as NumericDataType, values.length);\n

for (let i = 0; i < values.length; ++i) {\n newValues[i] = op(values[i], attrs);\n }\n return newValues;\n };\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ===\n */\n\nimport {DataType, KernelFunc, TypedArray, UnaryInputs, util} from '@tensorflow/tfjs-core';\n\nimport {MathBackendCPU} from '../backend_cpu';\nimport {assertNotComplex} from '../cpu_util';\n\nimport {SimpleUnaryImpl, SimpleUnaryOperation} from './unary_types';\n\n/**\n * Template that creates a `KernelFunc` for unary ops.\n * @param name Kernel name.\n * @param op A `SimpleUnaryOperation` for the kernel.\n * @param dtype Optional. If set, the result has this dtype. Otherwise, the\n * result has the same dtype as the input. This is mainly used in certain\n * kernels that return bool type, such as isFinite, isInf, etc.\n */\nexport function unaryKernelFunc(\n name: string, op: SimpleUnaryOperation, dtype?: DataType): KernelFunc {\n return ({inputs, attrs, backend}) => {\n const {x} = inputs as UnaryInputs;\n assertNotComplex(x, name);\n if (x.dtype === 'string' || dtype === 'string') {\n throw new Error('unaryKernelFunc does not support string input/output');\n }\n\n const cpuBackend = backend as MathBackendCPU;\n const values = cpuBackend.data.get(x.dataId).values as TypedArray;\n const xSize = util.sizeFromShape(x.shape);\n const $dtype = dtype || x.dtype;\n const newValues = util.getArrayFromDType($dtype, xSize);\n for (let i = 0; i < xSize; ++i) {\n newValues[i] = op(values[i], attrs);\n }\n return cpuBackend.makeTensorInfo(x.shape, $dtype, newValues);\n };\n}\n\n/**\n * Template that creates a `KernelFunc` for unary ops from the given\n * `SimpleUnaryImpl`..\n * @param name Kernel name.\n * @param unaryImpl A `SimpleUnaryImpl` that implements the op.\n * @param dtype Optional. If set, the result has this dtype. Otherwise, the\n * result has the same dtype as the input. This is mainly used in certain\n * kernels that return bool type, such as isFinite, isInf, etc.\n */\nexport function unaryKernelFuncFromImpl(\n name: string, unaryImpl: SimpleUnaryImpl, dtype?: DataType): KernelFunc {\n return ({inputs, attrs, backend}) => {\n const {x} = inputs as UnaryInputs;\n assertNotComplex(x, name);\n if (x.dtype === 'string' || dtype === 'string') {\n throw new Error('unaryKernelFunc does not support string input/output');\n }\n\n const cpuBackend = backend as MathBackendCPU;\n const values = cpuBackend.data.get(x.dataId).values as TypedArray;\n const $dtype = dtype || x.dtype;\n const newValues = unaryImpl(values, $dtype, attrs);\n return cpuBackend.makeTensorInfo(x.shape, $dtype, newValues);\n };\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the License);\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an AS IS BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ===\n */\n\nimport {Ceil, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createSimpleUnaryImpl} from '../utils/unary_impl';\nimport {unaryKernelFuncFromImpl} from '../utils/unary_utils';\n\nexport const ceilImpl = createSimpleUnaryImpl((xi) => Math.ceil(xi));\nexport const ceil = unaryKernelFuncFromImpl(Ceil, ceilImpl);\n\nexport const ceilConfig: KernelConfig = {\n kernelName: Ceil,\n backendName: 'cpu',\n kernelFunc: ceil,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS

IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {backend_util, BackendValues, DataType, TypedArray, util} from '@tensorflow/tfjs-core';\n\nexport function concatImpl(\n inputs: Array<{vals: BackendValues, shape: number[]}>, outShape: number[],\n dtype: DataType, simplyConcat: boolean): TypedArray|string[] {\n const outVals = util.getArrayFromDType(dtype, util.sizeFromShape(outShape));\n\n if (simplyConcat && dtype !== 'string') {\n // Use built-in TypedArray.set() method for speed.\n let offset = 0;\n inputs.forEach(input => {\n const size = util.sizeFromShape(input.shape);\n\n (outVals as TypedArray).set(input.vals as TypedArray, offset);\n offset += size;\n });\n } else {\n let colOffset = 0;\n\n inputs.forEach(input => {\n const decodedData = dtype === 'string' ?\n backend_util.fromUint8ToStringArray(input.vals as Uint8Array[]) :\n input.vals as TypedArray;\n\n let tIdx = 0;\n\n for (let row = 0; row < input.shape[0]; ++row) {\n const resIdx = row * outShape[1] + colOffset;\n for (let col = 0; col < input.shape[1]; ++col) {\n outVals[resIdx + col] = decodedData[tIdx++];\n }\n }\n\n colOffset += input.shape[1];\n });\n }\n\n return outVals;\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the License);\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an AS IS BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {Exp, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createSimpleUnaryImpl} from '../utils/unary_impl';\nimport {unaryKernelFuncFromImpl} from '../utils/unary_utils';\n\nexport const expImpl = createSimpleUnaryImpl((xi) => Math.exp(xi));\nexport const exp = unaryKernelFuncFromImpl(Exp, expImpl);\n\nexport const expConfig: KernelConfig = {\n kernelName: Exp,\n backendName: 'cpu',\n kernelFunc: exp,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the License);\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an AS IS BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {Expm1, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createSimpleUnaryImpl} from '../utils/unary_impl';\nimport {unaryKernelFuncFromImpl} from '../utils/unary_utils';\n\nexport const expm1Impl = createSimpleUnaryImpl((xi) => Math.expm1(xi));\nexport const expm1 = unaryKernelFuncFromImpl(Expm1, expm1Impl);\n\nexport const expm1Config: KernelConfig = {\n kernelName: Expm1,\n backendName: 'cpu',\n kernelFunc: expm1,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the License);\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an AS IS BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {Floor, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createSimpleUnaryImpl} from '../utils/unary_impl';\nimport {unaryKernelFuncFromImpl} from '../utils/unary_utils';\n\nexport const floorImpl = createSimpleUnaryImpl((xi) => Math.floor(xi));\nexport const floor = unaryKernelFuncFromImpl(Floor,

floorImpl);\n\nexport const floorConfig: KernelConfig = {\n kernelName: Floor,\n backendName: 'cpu',\n kernelFunc: floor,\n};\n","/**\n
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*/\n\nimport {buffer, DataType, Rank, TensorBuffer} from '@tensorflow/tfjs-core';\n\nexport function gatherV2Impl<R extends Rank, D extends DataType>(\n   xBuf: TensorBuffer<R, D>, indicesBuf: TensorBuffer<R, D>,\n   flattenOutputShape: number[]): TensorBuffer<R, D> {\n const outBuf = buffer(flattenOutputShape, xBuf.dtype);\n for (let i = 0; i < outBuf.size; ++i) {\n   const newLoc = outBuf.indexToLoc(i);\n\n   const originalLoc: number[] = newLoc.slice();\n   const batchIdx = originalLoc[0];\n const indicesIdx = originalLoc[2];\n   const indicesIndex = indicesBuf.locToIndex([batchIdx, indicesIdx]);\n originalLoc[2] = indicesBuf.values[indicesIndex] as number;\n\n   const originalIndex = xBuf.locToIndex(originalLoc);\n   outBuf.values[i] = xBuf.values[originalIndex];\n }\n\n return outBuf as TensorBuffer<R, D>;\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on
 an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
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/\n\nimport {Greater, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {createSimpleBinaryKernelImpl} from '../utils/binary_impl';\nimport {binaryKernelFunc} from '../utils/binary_utils';\n\nexport const greaterImpl =\n createSimpleBinaryKernelImpl((a: number, b: number) => (a > b) ? 1 : 0);\nexport const greater =\n binaryKernelFunc(Greater, greaterImpl, null / complexImpl */, 'bool');\n\nexport const greaterConfig: KernelConfig = {\n kernelName: Greater,\n backendName: 'cpu',\n kernelFunc: greater\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance
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==========\n
/\n\nimport {KernelConfig, Less} from '@tensorflow/tfjs-core';\n\nimport {createSimpleBinaryKernelImpl} from '../utils/binary_impl';\nimport {binaryKernelFunc} from '../utils/binary_utils';\n\nexport const lessImpl =\n createSimpleBinaryKernelImpl((a: number, b: number) => (a < b) ? 1 : 0);\nexport const less =\n binaryKernelFunc(Less, lessImpl, null / complexImpl */, 'bool');\n\nexport const lessConfig: KernelConfig = {\n kernelName: Less,\n backendName:
 'cpu',\n kernelFunc: less\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing,

software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {TypedArray, util} from '@tensorflow/tfjs-core';\n\nexport function linSpaceImpl(\n start: number, stop: number, num: number): TypedArray {\n const step = (stop - start) / (num - 1);\n\n const values = util.makeZerosTypedArray(num,
'float32');\n values[0] = start;\n for (let i = 1; i < values.length; i++) {\n values[i] = values[i - 1] + step;\n }\n\n return values;\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the License);\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an AS IS BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {KernelConfig, Log} from '@tensorflow/tfjs-core';\n\nimport {createSimpleUnaryImpl} from '../utils/unary_impl';\nimport
{unaryKernelFuncFromImpl} from '../utils/unary_utils';\n\nexport const logImpl = createSimpleUnaryImpl((xi) => Math.log(xi));\nexport const log = unaryKernelFuncFromImpl(Log, logImpl);\n\nexport const logConfig: KernelConfig = {\n kernelName: Log,\n backendName: 'cpu',\n kernelFunc: log,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {DataType, NumericDataType, TypedArray, util} from '@tensorflow/tfjs-core';\n\nexport function maxImpl(\n aVals: TypedArray, reduceSize: number, outShape: number[],\n dtype: DataType): TypedArray {\n const vals = util.getTypedArrayFromDType(\n dtype as NumericDataType, util.sizeFromShape(outShape));\n\n for (let i = 0; i < vals.length; ++i) {\n const offset = i * reduceSize;\n let max = aVals[offset];\n for (let j = 0; j < reduceSize; ++j) {\n const value = aVals[offset + j];\n if (value > max) {\n max = value;\n }\n }\n vals[i] = max;\n }\n return vals;\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law
or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {KernelConfig, Maximum} from '@tensorflow/tfjs-core';\n\nimport {createSimpleBinaryKernelImpl} from '../utils/binary_impl';\nimport {binaryKernelFunc} from '../utils/binary_utils';\n\nexport const maximumImpl = createSimpleBinaryKernelImpl(\n ((aValue, bValue) => Math.max(aValue, bValue)));\nexport const maximum = binaryKernelFunc(Maximum, maximumImpl);\n\nexport const maximumConfig: KernelConfig = {\n kernelName: Maximum,\n backendName: 'cpu',\n kernelFunc: maximum\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n

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software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n
 * ===\n */\n\nimport {KernelConfig, NotEqual} from '@tensorflow/tfjs-core';\n\nimport {createSimpleBinaryKernelImpl} from '../utils/binary_impl';\nimport {binaryKernelFunc} from '../utils/binary_utils';\n\nexport const notEqualImpl =\n   createSimpleBinaryKernelImpl(((a, b) => (a !== b) ? 1 : 0));\nexport const notEqual =\n binaryKernelFunc(NotEqual, notEqualImpl, null /* complexOp */, 'bool');\n\nexport const notEqualConfig: KernelConfig = {\n kernelName: NotEqual,\n backendName: 'cpu',\n kernelFunc: notEqual\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed
 under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
 ===\n */\n\nimport {DataType, NumericDataType, TypedArray} from '@tensorflow/tfjs-core';\nimport {util} from '@tensorflow/tfjs-core';\n\nexport function transposeImpl(\n   xVals: TypedArray, xShape: number[], dtype: DataType, perm: number[],\n   newShape: number[]): TypedArray {\n const xRank = xShape.length;\n const xSize = util.sizeFromShape(xShape);\n const xStrides = util.computeStrides(xShape);\n const newStrides = util.computeStrides(newShape);\n\n const result = util.getTypedArrayFromDType(\n   dtype as NumericDataType, util.sizeFromShape(newShape));\n\n for (let i = 0; i < xSize; ++i) {\n   const loc = util.indexToLoc(i, xRank, xStrides);\n\n   // Permute
 location.\n   const newLoc: number[] = new Array(loc.length);\n   for (let i = 0; i < newLoc.length; i++) {\n newLoc[i] = loc[perm[i]];\n   }\n\n   const newIndex = util.locToIndex(newLoc, xRank, newStrides);\n result[newIndex] = xVals[i];\n }\n return result;\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
 ===\n
 */\n\nimport {KernelConfig, KernelFunc, TensorInfo, Transpose, TransposeAttrs, TransposeInputs, TypedArray} from '@tensorflow/tfjs-core';\n\nimport {MathBackendCPU} from '../backend_cpu';\nimport {assertNotComplex} from '../cpu_util';\n\nimport {transposeImpl} from './Transpose_impl';\n\nexport function transpose(args: {\n inputs: TransposeInputs,\n attrs: TransposeAttrs,\n backend: MathBackendCPU\n}): TensorInfo {\n const {inputs, attrs, backend} = args;\n const {x} = inputs;\n const {perm} = attrs;\n\n assertNotComplex(x, 'transpose');\n\n const xRank = x.shape.length;\n\n const newShape: number[] = new Array(xRank);\n for (let i = 0; i < newShape.length; i++) {\n   newShape[i] = x.shape[perm[i]];\n }\n\n const values = backend.data.get(x.dataId).values as TypedArray;\n const result = transposeImpl(values, x.shape, x.dtype, perm, newShape);\n\n const dataId = backend.write(result, newShape, x.dtype);\n return {dataId, shape: newShape, dtype: x.dtype};\n}\n\nexport
 const transposeConfig: KernelConfig = {\n kernelName: Transpose,\n backendName: 'cpu',\n kernelFunc: transpose as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing,

software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {backend_util, DataType, KernelConfig, KernelFunc, Prod, ProdAttrs, ProdInputs, TensorInfo, TypedArray, upcastType, util}
from '@tensorflow/tfjs-core';\n\nimport {MathBackendCPU} from '../backend_cpu';\nimport {assertNotComplex} from '../cpu_util';\nimport {transpose} from './Transpose';\n\nexport function prodImpl(\n xShape: number[], xDtype: DataType, xVals: TypedArray,\n reductionAxes: number[]):\n {outVals: TypedArray, outShape: number[], outDtype: DataType} {\n const [outShape, reduceShape] =\n backend_util.computeOutAndReduceShapes(xShape, reductionAxes);\n const outDtype = upcastType(xDtype, 'int32');\n const outVals = util.makeZerosTypedArray(\n util.sizeFromShape(outShape), outDtype) as TypedArray;\n const reduceSize = util.sizeFromShape(reduceShape);\n\n for (let i = 0; i < outVals.length; ++i) {\n const offset = i * reduceSize;\n let prod = 1;\n for (let j = 0; j < reduceSize; ++j) {\n prod *= xVals[offset + j];\n }\n outVals[i] = prod;\n }\n\n return {outVals, outShape, outDtype};\n}\n\nexport function prod(\n args: {inputs: ProdInputs,
backend: MathBackendCPU, attrs: ProdAttrs}):\n TensorInfo {\n const {inputs, backend, attrs} = args;\n const {x} = inputs;\n const {axis, keepDims} = attrs;\n\n assertNotComplex(x, 'prod');\n\n const xRank = x.shape.length;\n const axes = util.parseAxisParam(axis, x.shape);\n\n const permutation = backend_util.getAxesPermutation(axes, xRank);\n let reductionAxes = axes;\n let permutedX = x;\n const intermediateTensorInfos = [];\n if (permutation != null) {\n permutedX = transpose({inputs: {x}, backend, attrs: {perm: permutation}});\n intermediateTensorInfos.push(permutedX);\n reductionAxes = backend_util.getInnerMostAxes(reductionAxes.length, xRank);\n }\n\n const xVals = backend.data.get(permutedX.dataId).values as TypedArray;\n const {outVals, outShape, outDtype} =\n prodImpl(permutedX.shape, permutedX.dtype, xVals, reductionAxes);\n\n let resultShape = outShape;\n if (keepDims) {\n resultShape = backend_util.expandShapeToKeepDim(outShape, axes);\n }\n\n intermediateTensorInfos.forEach(\n t => backend.disposeIntermediateTensorInfo(t));\n\n return backend.makeTensorInfo(resultShape, outDtype, outVals);\n}\n\nexport const prodConfig: KernelConfig = {\n kernelName: Prod,\n backendName: 'cpu',\n kernelFunc: prod as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {DataTypeMap, util} from '@tensorflow/tfjs-core';\n\nexport function rangeImpl(\n start: number, stop: number, step: number,\n dtype: 'float32'|'int32'): DataTypeMap['float32' | 'int32'] {\n const sameStartStop = start === stop;\n const increasingRangeNegativeStep = start < stop && step < 0;\n const decreasingRangePositiveStep = stop < start && step > 1;\n\n if (sameStartStop || increasingRangeNegativeStep ||\n decreasingRangePositiveStep) {\n return util.makeZerosTypedArray(0, dtype);\n }\n\n const numElements = Math.abs(Math.ceil((stop - start) / step));\n const values = util.makeZerosTypedArray(numElements, dtype);\n\n if (stop < start && step === 1) {\n // Auto adjust the step's sign if it hasn't been set\n // (or was set to 1)\n step = -1;\n }\n\n values[0] = start;\n for (let i = 1; i < values.length; i++) {\n values[i] = values[i - 1] + step;\n }\n return values;\n}\n","/**\n * @license\n * Copyright
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==========\n */\n\nimport {KernelConfig, Rsqrt} from '@tensorflow/tfjs-core';\n\nimport {createSimpleUnaryImpl} from '../utils/unary_impl';\nimport {unaryKernelFuncFromImpl} from '../utils/unary_utils';\n\nexport const rsqrtImpl = createSimpleUnaryImpl((xi) => 1 / Math.sqrt(xi));\nexport const rsqrt = unaryKernelFuncFromImpl(Rsqrt, rsqrtImpl);\n\nexport const rsqrtConfig: KernelConfig = {\n kernelName: Rsqrt,\n backendName: 'cpu',\n kernelFunc: rsqrt,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {backend_util, BackendValues, buffer, DataType, KernelConfig, KernelFunc, Slice, slice_util, SliceAttrs, SliceInputs, TensorInfo,
 TypedArray, util} from '@tensorflow/tfjs-core';\n\nimport {MathBackendCPU} from '../backend_cpu';\nimport {assertNotComplex} from '../cpu_util';\n\nexport function sliceImpl(\n vals: BackendValues, begin: number[], size: number[], shape: number[],\n dtype: DataType): BackendValues {\n const isContinous = slice_util.isSliceContinous(shape, begin, size);\n const length = util.sizeFromShape(size);\n const xStrides = util.computeStrides(shape);\n\n if (isContinous) {\n const flatOffset = slice_util.computeFlatOffset(begin, xStrides);\n\n if (dtype === 'string') {\n return (vals as Uint8Array[]).slice(flatOffset, flatOffset + length);\n }\n\n return (vals as TypedArray).subarray(flatOffset, flatOffset + length);\n }\n\n const decodedData = dtype === 'string' ?\n backend_util.fromUint8ToStringArray(vals as Uint8Array[]) :\n vals as TypedArray;\n\n const inBuf = buffer(shape, dtype, decodedData);\n const outBuf = buffer(size, dtype);\n for (let i = 0; i < outBuf.size; ++i) {\n const outLoc = outBuf.indexToLoc(i);\n const inLoc = outLoc.map((idx: number, j) => idx + begin[j]);\n outBuf.set(inBuf.get(...inLoc), ...outLoc);\n }\n\n if (dtype === 'string') {\n return backend_util.fromStringArrayToUint8(outBuf.values as string[]);\n }\n return outBuf.values as TypedArray;\n}\n\nexport function slice(\n args: {inputs: SliceInputs, backend: MathBackendCPU, attrs: SliceAttrs}):\n TensorInfo {\n const {inputs, backend, attrs} = args;\n const {x} = inputs;\n const {begin, size} = attrs;\n\n assertNotComplex(x, 'slice');\n\n const [$begin, $size] = slice_util.parseSliceParams(x, begin, size);\n slice_util.assertParamsValid(x, $begin, $size);\n\n const vals = backend.data.get(x.dataId).values;\n const outVals = sliceImpl(vals, $begin, $size, x.shape, x.dtype);\n return backend.makeTensorInfo($size, x.dtype, outVals);\n}\n\nexport const sliceConfig: KernelConfig = {\n kernelName: Slice,\n backendName: 'cpu',\n kernelFunc: slice as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {KernelConfig, SquaredDifference} from '@tensorflow/tfjs-core';\n\nimport {createSimpleBinaryKernelImpl} from '../utils/binary_impl';\nimport {binaryKernelFunc} from '../utils/binary_utils';\n\nexport const squaredDifferenceImpl

= createSimpleBinaryKernelImpl(((a, b) => {\n const diff = a - b;\n return diff * diff;\n}));\nexport const squaredDifference =\n   binaryKernelFunc(SquaredDifference, squaredDifferenceImpl);\n\nexport const squaredDifferenceConfig: KernelConfig = {\n kernelName: SquaredDifference,\n backendName: 'cpu',\n kernelFunc: squaredDifference\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {buffer, Rank, TensorBuffer} from '@tensorflow/tfjs-core';\n\nexport function stridedSliceImpl<R extends Rank>(\n   outShape: number[], xBuf: TensorBuffer<R>, strides: number[],\n   begin: number[]): TensorBuffer<R> {\n const outBuf = buffer(outShape, xBuf.dtype);\n\n for (let i = 0; i < outBuf.size; i++) {\n   const loc = outBuf.indexToLoc(i);\n\n   const newLoc: number[] = new Array(loc.length);\n   for (let j = 0; j < newLoc.length; j++) {\n   newLoc[j] = loc[j] * strides[j] + begin[j];\n   }\n   outBuf.set(xBuf.get(...newLoc), ...loc);\n }\n\n return outBuf as TensorBuffer<R>;\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {KernelConfig, Sub} from '@tensorflow/tfjs-core';\n\nimport {createSimpleBinaryKernelImpl} from '../utils/binary_impl';\nimport {binaryKernelFunc, createComplexBinaryKernelImpl} from '../utils/binary_utils';\n\nexport const subImpl =\n   createSimpleBinaryKernelImpl(((aValue, bValue) => aValue - bValue));\nexport const subComplexImpl =\n   createComplexBinaryKernelImpl(((aReal, aImag, bReal, bImag) => {\n   return {real: aReal - bReal, imag: aImag - bImag};\n   }));\nexport const sub = binaryKernelFunc(Sub, subImpl, subComplexImpl);\n\nexport const subConfig: KernelConfig = {\n kernelName: Sub,\n backendName: 'cpu',\n kernelFunc: sub\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {buffer, DataType, Rank, TensorBuffer} from '@tensorflow/tfjs-core';\n\n/**\n * An implementation of the tile kernel shared between webgl and cpu for string\n * tensors only.\n */\n\nexport function tileImpl<R extends Rank>(\n   xBuf: TensorBuffer<R, DataType>,\n   reps: number[]): TensorBuffer<R, DataType> {\n const newShape: number[] = new Array(xBuf.rank);\n for (let i = 0; i < newShape.length; i++) {\n   newShape[i] = xBuf.shape[i] * reps[i];\n }\n const result = buffer(newShape, xBuf.dtype);\n for (let i = 0; i < result.values.length; ++i) {\n   const newLoc = result.indexToLoc(i);\n\n   const originalLoc: number[] = new Array(xBuf.rank);\n   for (let j = 0; j < originalLoc.length; j++) {\n   originalLoc[j] = newLoc[j] % xBuf.shape[j];\n   }\n\n   const originalIndex = xBuf.locToIndex(originalLoc);\n\n   result.values[i] = xBuf.values[originalIndex];\n }\n return result as TensorBuffer<R, DataType>;\n}\n","/**\n * @license\n *

Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\n/** An implementation of the TopK kernel shared between webgl and cpu. */\n\nimport {buffer, NumericDataType, Rank, ShapeMap, Tensor, TensorBuffer, TypedArray, util} from '@tensorflow/tfjs-core';\n\nexport function topKImpl<T extends Tensor, R extends Rank>(\n x: TypedArray, xShape: number[], xDtype: NumericDataType, k: number,\n sorted: boolean):\n [TensorBuffer<R, NumericDataType>, TensorBuffer<R, 'int32'>] {\n // Reshape into a 2d tensor [batch, lastDim] and compute topk along lastDim.\n const lastDim = xShape[xShape.length - 1];\n const [batch, size] = [x.length / lastDim, lastDim];\n const allTopKVals = util.getTypedArrayFromDType(xDtype, batch * k);\n const allTopKIndices = util.getTypedArrayFromDType('int32', batch * k);\n\n for (let b = 0; b < batch; b++) {\n const offset = b * size;\n const vals = x.subarray(offset, offset + size);\n const valAndInd: Array<{value: number, index: number}> = [];\n for (let i = 0; i < vals.length; i++) {\n valAndInd.push({value: vals[i], index: i});\n }\n valAndInd.sort((a, b) => b.value - a.value);\n\n const outOffset = b * k;\n const topKVals = allTopKVals.subarray(outOffset, outOffset + k);\n const topKIndices = allTopKIndices.subarray(outOffset, outOffset + k);\n for (let i = 0; i < k; i++) {\n topKVals[i] = valAndInd[i].value;\n topKIndices[i] = valAndInd[i].index;\n }\n }\n // Reshape back to the original input shape, except that the last\n // dimension is k.\n const outputShape = xShape.slice();\n outputShape[outputShape.length - 1] = k;\n\n return [\n buffer(outputShape as ShapeMap[R], xDtype, allTopKVals),\n buffer(outputShape as ShapeMap[R], 'int32', allTopKIndices)\n];\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {BackendValues, DataType, TensorBuffer, TypedArray, util} from '@tensorflow/tfjs-core';\n\nexport function uniqueImpl(\n values: BackendValues, axis: number, shape: number[], dtype: DataType): {\n outputValues: BackendValues,\n outputShape: number[],\n indices: BackendValues\n} {\n // Normalize and validate axis.\n const $axis = util.parseAxisParam(axis, shape)[0];\n\n // Calculate the new shape that is suitable for extracting data along the\n // given axis.\n //\n // The rank is 3.\n // The size of the 1st dimension is the size of all the axes < the given axis.\n // The size of the 2nd dimension is the same as the size of the given axis.\n // The size of the 3rd dimension is the size of all the axes > the given axis.\n //\n // For example, for a 4D tensor with shape=[2, 3, 5, 4] and axis=2, the\n // newShape would be: [2*3, 5, 4].\n //\n // Note that this is not the final output shape. This will be the shape for an\n // intermediate TensorBuffer (see inputBuffer below) to allow us to extract\n // values along the given axis. To demonstrate how it works, consider the\n // following example:\n //\n // Input: a 3D tensor, with shape [1, 2, 3]\n // [\n // [\n // [1,2,3],\n // [4,5,6]\n //]\n //]\n // Axis: 2 (the last axis).\n // Along axis 2, we expect to extract 3 tensors: [1,4], [2,5], [3,6].\n //\n // For this example, newShape would be: [2, 3, 1], where 2 is calculated from\n // 1*2. The re-shaped data would look like:\n //\n // [\n // [\n // [1], [2], [3]\n //],\n // [\n // [4], [5], [6]\n //]\n //]\n //\n // Then, we can construct a 3-level nested loop by the following dimension\n // order to extract the values along the axis (dimension1):\n // i: dimension1 // 0,1,2 (newShape[1])\n // m: dimension0 // 0,1 (newShape[0])\n // n: dimension2 // 0 (newShape[2])\n //\n // m, i, n\n // ---------\n // Iteration 0: data at [0, 0, 0] => \"1\"\n // Iteration 1:

data at [1, 0, 0] => \"4\"\n // We got [1,4].\n // Iteration 2: data at [0, 1, 0] => \"2\"\n // Iteration 3: data at [1, 1, 0] => \"5\"\n // We got [2,5].\n // Iteration 4: data at [0, 2, 0] => \"3\"\n // Iteration 5: data at [1, 2, 0] => \"6\"\n // We got [3,6].\n const newShape = [1, shape[0], 1];\n for (let i = 0; i < $axis; i++) {\n   newShape[0] *= shape[i];\n }\n newShape[1] = shape[$axis];\n for (let i = $axis + 1; i < shape.length; i++) {\n   newShape[2] *= shape[i];\n }\n\n // A map from unique elements (their string representations) to their values\n // in \"indices\" (below).\n const uniqueElements: {[key: string]: number} = {};\n // The indices of each unique element in the original tensor along the given\n // axis. It is 1D and has the same size as the given axis.\n const indices = new Int32Array(shape[$axis]);\n // Create a buffer so we can easily extract value at a given location.\n const inputBuffer = new TensorBuffer(newShape, dtype, values as TypedArray);\n // The indices along the given axis that have unique elements. This is a\n // de-duped version of \"indices\" above.\n const uniqueIndices: number[] = [];\n const is1DTensor = newShape[0] === 1 && newShape[2] === 1;\n for (let i = 0; i < shape[$axis]; i++) {\n   // Extract values along the axis.\n   let element: string;\n   if (is1DTensor) {\n   // Fast path for 1D tensor input.\n   element = values[i].toString();\n   } else {\n   const axisValues = [];\n   for (let m = 0; m < newShape[0]; m++) {\n   for (let n = 0; n < newShape[2]; n++) {\n   axisValues.push(inputBuffer.get(m, i, n));\n   }\n   }\n   element = axisValues.join(',');\n   }\n\n   // Dedup and update various indices.\n   if (uniqueElements[element] !== undefined) {\n   indices[i] = uniqueElements[element];\n   } else {\n   const uniqueIndex = Object.keys(uniqueElements).length;\n   uniqueElements[element] = uniqueIndex;\n   indices[i] = uniqueIndex;\n   uniqueIndices.push(i);\n   }\n }\n\n // Now we know where each of the unique elements are located along the axis\n // (uniqueIndices). Extract them from input buffer and store them in the\n // output buffer.\n const outputTmpShape = newShape.slice();\n outputTmpShape[1] = Object.keys(uniqueElements).length;\n const outputBuffer = new TensorBuffer(outputTmpShape, dtype);\n uniqueIndices.forEach((uniqueElementIndex, i) => {\n   for (let m = 0; m < newShape[0]; m++) {\n   for (let n = 0; n < newShape[2]; n++) {\n   outputBuffer.set(inputBuffer.get(m, uniqueElementIndex, n), m, i, n);\n   }\n   }\n });\n\n // The output shape can be calculated from the input shape with the size of\n // the given axis replaced by the number of unique elements along that axis.\n const outputShape = shape.slice();\n outputShape[$axis] = outputTmpShape[1];\n\n return {\n   outputValues: outputBuffer.values as BackendValues,\n   outputShape,\n   indices,\n };\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==\n */\n\n// Shared functionality among backends.\nexport {simpleAbsImpl} from './kernels/Abs';\nexport {addImpl} from './kernels/Add';\nexport {bincountImpl, bincountReduceImpl} from './kernels/Bincount_impl';\nexport {ceilImpl} from './kernels/Ceil';\nexport {concatImpl} from './kernels/Concat_impl';\nexport {expImpl} from './kernels/Exp';\nexport {expm1Impl} from './kernels/Expm1';\nexport {floorImpl} from './kernels/Floor';\nexport {gatherV2Impl} from './kernels/GatherV2_impl';\nexport {greaterImpl} from './kernels/Greater';\nexport {lessImpl} from './kernels/Less';\nexport {linSpaceImpl} from './kernels/LinSpace_impl';\nexport {logImpl} from './kernels/Log';\nexport {maxImpl} from './kernels/Max_impl';\nexport {maximumImpl} from './kernels/Maximum';\nexport {minimumImpl} from './kernels/Minimum';\nexport {multiplyImpl} from './kernels/Multiply';\nexport {negImpl} from './kernels/Neg';\nexport {notEqualImpl} from './kernels/NotEqual';\nexport {prodImpl} from './kernels/Prod';\nexport {rangeImpl} from './kernels/Range_impl';\nexport {rsqrtImpl} from './kernels/Rsqrt';\nexport {sliceImpl} from './kernels/Slice';\nexport {squaredDifferenceImpl} from './kernels/SquaredDifference';\nexport {stridedSliceImpl} from './kernels/StridedSlice_impl';\nexport {subImpl} from './kernels/Sub';\nexport

{tileImpl} from './kernels/Tile_impl';\nexport {topKImpl} from './kernels/TopK_impl';\nexport {transposeImpl} from './kernels/Transpose_impl';\nexport {uniqueImpl} from './kernels/Unique_impl';\nexport {ComplexBinaryKernelImpl, SimpleBinaryKernelImpl} from './utils/binary_types';\n","\n/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\n// Import shared functionality from tfjs-backend-cpu without triggering\n// side effects.\n// tslint:disable-next-line: no-imports-from-dist\nimport * as shared from '@tensorflow/tfjs-backend-cpu/dist/shared';\n// tslint:disable-next-line: no-imports-from-dist\nimport {SimpleBinaryKernelImpl} from '@tensorflow/tfjs-backend-cpu/dist/shared';\n// tslint:disable-next-line: no-imports-from-dist\nimport {SimpleUnaryImpl} from '@tensorflow/tfjs-backend-cpu/dist/utils/unary_types';\n\nexport type SimpleBinaryKernelImplCPU = SimpleBinaryKernelImpl;\nexport type SimpleUnaryKernelImplCPU = SimpleUnaryImpl;\nconst {\n addImpl: addImplCPU,\n bincountImpl: bincountImplCPU,\n bincountReduceImpl: bincountReduceImplCPU,\n ceilImpl: ceilImplCPU,\n concatImpl: concatImplCPU,\n expImpl: expImplCPU,\n expm1Impl: expm1ImplCPU,\n floorImpl: floorImplCPU,\n gatherV2Impl: gatherV2ImplCPU,\n greaterImpl: greaterImplCPU,\n lessImpl: lessImplCPU,\n linSpaceImpl: linSpaceImplCPU,\n logImpl: logImplCPU,\n maxImpl: maxImplCPU,\n maximumImpl: maximumImplCPU,\n minimumImpl: minimumImplCPU,\n multiplyImpl: multiplyImplCPU,\n negImpl: negImplCPU,\n prodImpl: prodImplCPU,\n rangeImpl: rangeImplCPU,\n rsqrtImpl: rsqrtImplCPU,\n simpleAbsImpl: simpleAbsImplCPU,\n sliceImpl: sliceImplCPU,\n stridedSliceImpl: stridedSliceImplCPU,\n subImpl: subImplCPU,\n tileImpl: tileImplCPU,\n topKImpl: topKImplCPU,\n transposeImpl: transposeImplCPU,\n uniqueImpl: uniqueImplCPU,\n} = shared;\n\nexport {\n addImplCPU,\n bincountImplCPU,\n bincountReduceImplCPU,\n ceilImplCPU,\n concatImplCPU,\n expImplCPU,\n expm1ImplCPU,\n floorImplCPU,\n gatherV2ImplCPU,\n greaterImplCPU,\n lessImplCPU,\n linSpaceImplCPU,\n logImplCPU,\n maxImplCPU,\n maximumImplCPU,\n minimumImplCPU,\n multiplyImplCPU,\n negImplCPU,\n prodImplCPU,\n simpleAbsImplCPU,\n sliceImplCPU,\n stridedSliceImplCPU,\n subImplCPU,\n rangeImplCPU,\n rsqrtImplCPU,\n tileImplCPU,\n topKImplCPU,\n transposeImplCPU,\n uniqueImplCPU,\n};\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nexport function getVecChannels(name: string, rank: number): string[] {\n return ['x', 'y', 'z', 'w', 'u', 'v'].slice(0, rank).map(d => `${name}.${d}`);\n}\n\nexport function getChannels(name: string, rank: number): string[] {\n if (rank === 1) {\n return [name];\n }\n return getVecChannels(name, rank);\n}\n\nexport function getSourceCoords(rank: number, dims: string[]): string {\n if (rank === 1) {\n return 'rc';\n }\n\n let coords = '';\n for (let i = 0; i < rank; i++) {\n coords += dims[i];\n if (i < rank - 1) {\n coords += ',';\n }\n }\n return coords;\n}","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or

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==========================================================================\n
*/\n\nimport {GPGPUProgram} from './gpgpu_math';\nimport {getChannels} from './packing_util';\nimport
{getCoordsDataType} from './shader_compiler';\n\nexport class PackProgram implements GPGPUProgram {\n
variableNames = ['A'];\n  outputShape: number[];\n  userCode: string;\n  packedInputs = false;\n  packedOutput =
true;\n\n  constructor(\n      outputShape:\n          number[]) {  //
TODO(https://github.com/tensorflow/tfjs/issues/893):\n                  // Only input / output 3D tensors.\n
this.outputShape = outputShape;\n    const rank = outputShape.length;\n\n    if (rank === 0) {\n      this.userCode =
`\n        void main() {\n          setOutput(vec4(getA(), 0., 0., 0.));\n        }\n      `;\n    } else {\n      const channels =
getChannels('rc', rank);\n      const dtype = getCoordsDataType(rank);\n      const outOfBoundsCondition =\n
getOutOfBoundsCondition(rank,
 outputShape, channels);\n      const setup = getSetup(\n          rank, outputShape[outputShape.length - 1],\n
outputShape[outputShape.length - 2], channels);\n      const output = getOutput(outputShape, channels);\n\n
this.userCode = `\n        void main() {\n          ${dtype} rc = getOutputCoords();\n\n
if(${outOfBoundsCondition}) {\n            setOutput(vec4(0));\n          } else {\n            ${setup}\n\n
setOutput(vec4(${output}));\n          }\n        }\n      `;\n    }\n  }\n}\n\nfunction getSourceCoordsArr(rank: number,
dims: string[]): string[] {\n  const coords = [];\n\n  for (let row = 0; row <= 1; row++) {\n    for (let col = 0; col <= 1;
col++) {\n      let coord = `${row === 0 ? 'r' : 'rp1'}, ${col === 0 ? 'c' : 'cp1'}`;\n\n      for (let d = 2; d < rank; d++)
{\n        coord = `${dims[dims.length - 1 - d]},` + coord;\n      }\n\n      coords.push(coord);\n    }\n  }\n  return
coords;\n}\n\nfunction getOutOfBoundsCondition(\n
    rank: number, shape: number[], dims: string[]): string {\n  if (rank === 1) {\n    return `rc > ${shape[0]}`;\n  }\n\n
let cond = '';\n  for (let i = rank - 2; i < rank; i++) {\n    cond += `${dims[i]} >= ${shape[i]}`;\n    if (i < rank - 1) {\n
  cond += '||';\n    }\n  }\n\n  return cond;\n}\n\nfunction getSetup(\n    rank: number, cols: number, rows: number,
dims: string[]): string {\n  if (rank === 1) {\n    return '';\n  }\n\n  const innerDims = dims.slice(-2);\n\n  return `\n
int r = ${innerDims[0]};\n    int c = ${innerDims[1]};\n    int rp1 = r + 1;\n    int cp1 = c + 1;\n\n    bool cEdge = cp1
>= ${cols};\n    bool rEdge = rp1 >= ${rows};\n  `;\n}\n\nfunction getOutput(shape: number[], dims: string[]):
string {\n  const rank = shape.length;\n  const sourceCoords = getSourceCoordsArr(rank, dims);\n  if (rank === 1)
{\n    return `getA(rc),\n            rc + 1 >= ${shape[0]} ? 0. : getA(rc + 1),\n            0, 0`;\n  }\n\n  return
`getA(${sourceCoords[0]}),\n
      cEdge ? 0. : getA(${sourceCoords[1]}),\n          rEdge ? 0. : getA(${sourceCoords[2]}),\n          rEdge || cEdge ?
0. : getA(${sourceCoords[3]})`;\n}\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n *
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OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language
governing permissions and\n * limitations under the License.\n *
==========================================================================\n
*/\n\nimport {GPGPUProgram} from './gpgpu_math';\nimport * as shader_util from
'./shader_compiler_util';\n\nexport class
 ReshapePackedProgram implements GPGPUProgram {\n  variableNames = ['A'];\n  packedInputs = true;\n
packedOutput = true;\n  outputShape: number[];\n  userCode: string;\n\n  constructor(outputShape: [number,
number, number], inputShape: [\n    number, number, number\n  ]) {\n    this.outputShape = outputShape;\n\n    let
mainLoop = ``;\n    for (let i = 0; i < 4; i++) {\n      let thisRC = `thisRC = rc;`;\n      if (i % 2 === 1) {\n        thisRC
+= `thisRC.z += 1;`;\n      }\n      if (i > 1) {\n        thisRC += `thisRC.y += 1;`;\n      }\n\n      mainLoop += `\n
${thisRC}\n        ${i > 0 ? `if(thisRC.y < rows && thisRC.z < cols){` : ''}\n          int flatIndex =
getFlatIndex(thisRC);\n\n          ivec3 inputRC = inputCoordsFromReshapedOutCoords(flatIndex);\n          vec2
```

```
inputRCInnerDims = vec2(float(inputRC.y),float(inputRC.z));\n\n          result[${i}] =\n getChannel(getA(inputRC.x, inputRC.y, inputRC.z), inputRCInnerDims);\n        ${i > 0 ? '}' : ''}\n    `;\n    }\n\n    this.userCode = `\n      ${getReshapedInputCoords(inputShape)}\n ${shader_util.getFlatIndexFrom3D(outputShape)}\n\n      void main() {\n        ivec3 rc = getOutputCoords();\n\n vec4 result = vec4(0.);\n\n        ivec3 thisRC;\n        int rows = ${outputShape[1]};\n        int cols = ${outputShape[2]};\n\n        ${mainLoop}\n\n        setOutput(result);\n      }\n    `;\n  }\n}\n\nfunction getReshapedInputCoords(shape: [number, number, number]): string {\n  const coordsFromIndexSnippet =\n shader_util.getLogicalCoordinatesFromFlatIndex(['r', 'c', 'd'], shape);\n\n  return `\n    ivec3 inputCoordsFromReshapedOutCoords(int index) {\n      ${coordsFromIndexSnippet}\n      return ivec3(r, c, d);\n }\n  `;\n}\n","/**\n * @license\n * Copyright 2017 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the
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==========================================================================\n
*/\n\nimport {env} from '@tensorflow/tfjs-core';\n\nimport {GPGPUContext} from './gpgpu_context';\nimport {getInternalFormatForFloat16MatrixTexture, getInternalFormatForFloat16PackedMatrixTexture, getInternalFormatForFloat32MatrixTexture, getInternalFormatForPackedMatrixTexture, getInternalFormatForUnsignedBytesMatrixTexture} from './gpgpu_util';\nimport {getPackedMatrixTextureShapeWidthHeight, getUnpackedMatrixTextureShapeWidthHeight, PhysicalTextureType, TextureConfig, TextureUsage} from './tex_util';\n\nexport class
 TextureManager {\n  private numUsedTextures = 0;\n  private numFreeTextures = 0;\n  private _numBytesAllocated = 0;\n  private _numBytesFree = 0;  // How many bytes that have been allocated\n      // are available for reuse.\n  private freeTextures: {[shape: string]: WebGLTexture[]} = {};\n  private logEnabled = false;\n  private usedTextures: {[shape: string]: WebGLTexture[]} = {};\n\n  constructor(private gpgpu: GPGPUContext) {}\n\n  acquireTexture(\n      shapeRC: [number, number], usage: TextureUsage,\n isPacked: boolean): WebGLTexture {\n    const physicalTexType = getPhysicalFromLogicalTextureType(usage, isPacked);\n\n    const shapeKey = getKeyFromTextureShape(shapeRC, physicalTexType, isPacked);\n    if (!(shapeKey in this.freeTextures)) {\n      this.freeTextures[shapeKey] = [];\n    }\n    if (!(shapeKey in this.usedTextures)) {\n      this.usedTextures[shapeKey] = [];\n    }\n\n    const texBytes = computeBytes(\n shapeRC, physicalTexType,
 this.gpgpu.gl, this.gpgpu.textureConfig,\n        isPacked);\n\n    if (this.freeTextures[shapeKey].length > 0) {\n this.numFreeTextures--;\n      this.numUsedTextures++;\n      this._numBytesFree -= texBytes;\n      this.log();\n const newTexture = this.freeTextures[shapeKey].shift();\n      this.usedTextures[shapeKey].push(newTexture);\n return newTexture;\n    }\n\n    let newTexture: WebGLTexture;\n    if (physicalTexType === PhysicalTextureType.PACKED_2X2_FLOAT32) {\n      newTexture = this.gpgpu.createPackedMatrixTexture(shapeRC[0], shapeRC[1]);\n    } else if (physicalTexType === PhysicalTextureType.PACKED_2X2_FLOAT16) {\n      newTexture =\n this.gpgpu.createFloat16PackedMatrixTexture(shapeRC[0], shapeRC[1]);\n    } else if (physicalTexType === PhysicalTextureType.UNPACKED_FLOAT32) {\n      newTexture =\n this.gpgpu.createFloat32MatrixTexture(shapeRC[0], shapeRC[1]);\n    } else if (physicalTexType === PhysicalTextureType.UNPACKED_FLOAT16) {\n
    newTexture =\n          this.gpgpu.createFloat16MatrixTexture(shapeRC[0], shapeRC[1]);\n    } else if (\n physicalTexType === PhysicalTextureType.PACKED_4X1_UNSIGNED_BYTE) {\n      newTexture =\n this.gpgpu.createUnsignedBytesMatrixTexture(shapeRC[0], shapeRC[1]);\n    }\n this.usedTextures[shapeKey].push(newTexture);\n\n    this.numUsedTextures++;\n    this._numBytesAllocated +=
```

```
texBytes;\n    this.log();\n\n    return newTexture;\n  }\n\n  releaseTexture(\n      texture: WebGLTexture, shape: [number, number],\n      logicalTexType: TextureUsage, isPacked: boolean): void {\n    if (this.freeTextures == null) {\n      // Already disposed.\n      return;\n    }\n    const physicalTexType =\n getPhysicalFromLogicalTextureType(logicalTexType, isPacked);\n    const shapeKey =
getKeyFromTextureShape(shape, physicalTexType, isPacked);\n    if (!(shapeKey in this.freeTextures)) {\n
this.freeTextures[shapeKey] = [];\n    }\n\n    const texBytes = computeBytes(\n
      shape, physicalTexType, this.gpgpu.gl, this.gpgpu.textureConfig,\n        isPacked);\n    const
deleteTexThreshold = env().get('WEBGL_DELETE_TEXTURE_THRESHOLD');\n    if (deleteTexThreshold !== -
1 &&\n        this._numBytesAllocated > deleteTexThreshold) {\n      this.gpgpu.deleteMatrixTexture(texture);\n
this._numBytesAllocated -= texBytes;\n    } else {\n      this.freeTextures[shapeKey].push(texture);\n
this.numFreeTextures++;\n      this._numBytesFree += texBytes;\n    }\n\n    this.numUsedTextures--;\n\n    const
texList = this.usedTextures[shapeKey];\n    const texIndex = texList.indexOf(texture);\n    if (texIndex < 0) {\n
throw new Error(\n          'Cannot release a texture that was never provided by this ' +\n          'texture manager');\n
}\n    texList.splice(texIndex, 1);\n    this.log();\n  }\n\n  private log() {\n    if (!this.logEnabled) {\n      return;\n
}\n    const total = this.numFreeTextures + this.numUsedTextures;\n    console.log(\n
      'Free/Used', `${this.numFreeTextures} / ${this.numUsedTextures}`,\n        `(${total})`);\n    const freeRatio =
this._numBytesFree / this._numBytesAllocated;\n    console.log(`Bytes allocated: ${this._numBytesAllocated}`);\n
console.log(`Bytes unused: ${this._numBytesFree} (${\n        Math.round(100 * freeRatio)}%)`);\n  }\n\n  get
numBytesAllocated(): number {\n    return this._numBytesAllocated;\n  }\n\n  get numBytesFree(): number {\n
return this._numBytesFree;\n  }\n\n  getNumUsedTextures(): number {\n    return this.numUsedTextures;\n  }\n\n
getNumFreeTextures(): number {\n    return this.numFreeTextures;\n  }\n\n  dispose() {\n    if (this.freeTextures ==
null) {\n      // Already disposed.\n      return;\n    }\n    for (const texShape in this.freeTextures) {\n
this.freeTextures[texShape].forEach(tex => {\n        this.gpgpu.deleteMatrixTexture(tex);\n      });\n    }\n    for
(const texShape in this.usedTextures) {\n      this.usedTextures[texShape].forEach(tex
 => {\n        this.gpgpu.deleteMatrixTexture(tex);\n      });\n    }\n    this.freeTextures = null;\n    this.usedTextures =
null;\n    this.numUsedTextures = 0;\n    this.numFreeTextures = 0;\n    this._numBytesAllocated = 0;\n
this._numBytesFree = 0;\n  }\n}\n\nfunction numBytesForInternalFormat(\n    gl: WebGLRenderingContext,
internalFormat: number): number {\n  // tslint:disable-next-line:no-any\n  const glany = gl as any;\n  if
(internalFormat === glany.R32F) {\n    return 4;\n  } else if (internalFormat === glany.R16F) {\n    return 2;\n  }
else if (internalFormat === glany.RGBA32F) {\n    return 16;\n  } else if (internalFormat === gl.RGBA) {\n
return 16;\n  } else if (internalFormat === glany.RGBA16F) {\n    return 8;\n  }\n  throw new Error(`Unknown
internal format ${internalFormat}`);\n}\n\nexport function computeBytes(\n    shape: [number, number],
physicalTexType: PhysicalTextureType,\n    gl: WebGLRenderingContext, textureConfig: TextureConfig,\n
isPacked:
 boolean): number {\n  // It is not possible to infer packed status from the texture type because\n  // depending on the
textureConfig, different  texture types may resolve to the\n  // same internal format (e.g. in WebGL1, the internal
format for\n  // UNPACKED_FLOAT16 textures is gl.RGBA). Therefore we pass in `isPacked`\n  // explicitly.\n
const internalFormat =\n      internalFormatForPhysicalTexType(physicalTexType, textureConfig);\n\n  let
numElements: number;\n  if (isPacked) {\n    const [packedWidth, packedHeight] =\n
getPackedMatrixTextureShapeWidthHeight(shape[0], shape[1]);\n    numElements = packedWidth *
packedHeight;\n\n  } else {\n    const [width, height] =\n
getUnpackedMatrixTextureShapeWidthHeight(shape[0], shape[1]);\n    numElements = width * height;\n  }\n\n
const bytesPerElement = numBytesForInternalFormat(gl, internalFormat);\n  return numElements *
bytesPerElement;\n}\n\nfunction internalFormatForPhysicalTexType(\n    physicalTexType:
PhysicalTextureType,\n
   textureConfig: TextureConfig): number {\n  switch (physicalTexType) {\n    case
PhysicalTextureType.PACKED_2X2_FLOAT32:\n      return
getInternalFormatForPackedMatrixTexture(textureConfig);\n    case
```

PhysicalTextureType.PACKED_2X2_FLOAT16:\n return getInternalFormatForFloat16PackedMatrixTexture(textureConfig);\n case PhysicalTextureType.UNPACKED_FLOAT32:\n return getInternalFormatForFloat32MatrixTexture(textureConfig);\n case PhysicalTextureType.UNPACKED_FLOAT16:\n return getInternalFormatForFloat16MatrixTexture(textureConfig);\n case PhysicalTextureType.PACKED_4X1_UNSIGNED_BYTE:\n return getInternalFormatForUnsignedBytesMatrixTexture(textureConfig);\n default:\n throw new Error(`Unknown physical texture type ${physicalTexType}`);\n }\n}\n\nfunction getPhysicalTextureForRendering(isPacked: boolean):\n PhysicalTextureType {\n if (env().getBool('WEBGL_RENDER_FLOAT32_ENABLED')) {\n if (isPacked) {\n return PhysicalTextureType.PACKED_2X2_FLOAT32;\n }\n return PhysicalTextureType.UNPACKED_FLOAT32;\n }\n\n if (isPacked) {\n return PhysicalTextureType.PACKED_2X2_FLOAT16;\n }\n return PhysicalTextureType.UNPACKED_FLOAT16;\n}\n\nfunction getPhysicalFromLogicalTextureType(\n logicalTexType: TextureUsage, isPacked: boolean): PhysicalTextureType {\n if (logicalTexType === TextureUsage.UPLOAD) {\n return PhysicalTextureType.PACKED_2X2_FLOAT32;\n } else if (logicalTexType === TextureUsage.RENDER || logicalTexType == null) {\n return getPhysicalTextureForRendering(isPacked);\n } else if (\n logicalTexType === TextureUsage.DOWNLOAD ||\n logicalTexType === TextureUsage.PIXELS) {\n return PhysicalTextureType.PACKED_4X1_UNSIGNED_BYTE;\n }\n throw new Error(`Unknown logical texture type ${logicalTexType}`);\n}\n\nfunction getKeyFromTextureShape(\n shapeRowsCol: [number, number], physicalTexType: PhysicalTextureType,\n isPacked: boolean): string {\n return `${shapeRowsCol[0]}_${shapeRowsCol[1]}_${physicalTexType}_${isPacked}`;\n}\n","/**\n * @license\n * Copyright 2017 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n*/\n\nimport {GPGPUProgram} from './gpgpu_math';\n\nexport class UnaryOpProgram implements GPGPUProgram {\n variableNames = ['A'];\n userCode: string;\n outputShape: number[];\n\n constructor(aShape: number[], opSnippet: string) {\n this.outputShape = aShape;\n this.userCode = `\n float unaryOperation(float x) {\n ${opSnippet}\n }\n\n void main() {\n float x = getAAtOutCoords();\n float y = unaryOperation(x);\n\n setOutput(y);\n }\n `;\n }\n}\n\nexport const CHECK_NAN_SNIPPET = `if (isnan(x)) return x;`;\n\nexport const LINEAR = `return x;`;\n\nexport const ABS = `return abs(x);`;\n\nexport function STEP(alpha = 0.0) {\n return CHECK_NAN_SNIPPET + `\n return x > 0.0 ? 1.0 : float(${alpha});\n `;\n}\n\nexport const ELU = `return (x >= 0.0) ? x : (exp(x) - 1.0);`;\n\nexport const RELU = CHECK_NAN_SNIPPET + `\n return (x < 0.0) ? 0.0 : x;\n`;\n\nexport const RELU6 = CHECK_NAN_SNIPPET + `\n return (x < 0.0) ? 0.0 : min(6.0, x);\n`;\n\nexport const CLONE = 'return x;';\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========

*/\n\nimport {GPGPUProgram} from './gpgpu_math';\n\nexport const LINEAR = `return x;`;\n\nexport const ELU = `\n  vec4 result;\n\n  result.r = (x.r >= 0.0) ? x.r : (exp(x.r) - 1.0);\n  result.g = (x.g >= 0.0) ? x.g : (exp(x.g) - 1.0);\n  result.b = (x.b >= 0.0) ? x.b : (exp(x.b) - 1.0);\n  result.a = (x.a >= 0.0) ? x.a : (exp(x.a) - 1.0);\n\n  return result;\n`;\n\nexport const RELU = `\n  vec4 result = x * vec4(greaterThanEqual(x, vec4(0.0)));\n  bvec4 isNaN = isnan(x);\n\n  result.r = isNaN.r ? x.r : result.r;\n  result.g = isNaN.g ? x.g : result.g;\n  result.b = isNaN.b ? x.b : result.b;\n  result.a = isNaN.a ? x.a : result.a;\n\n  return result;\n`;\n\nexport const RELU6 = `\n  vec4 result = min(x, vec4(6.)) * vec4(greaterThanEqual(x, vec4(0.0)));\n  bvec4 isNaN = isnan(x);\n\n  result.r = isNaN.r ? x.r : result.r;\n  result.g = isNaN.g ? x.g : result.g;\n  result.b = isNaN.b ? x.b : result.b;\n  result.a = isNaN.a ? x.a : result.a;\n\n  return result;\n`;\n\nexport class UnaryOpPackedProgram implements GPGPUProgram {\n variableNames = ['A'];\n userCode: string;\n outputShape: number[];\n packedInputs = true;\n packedOutput = true;\n\n constructor(aShape: number[], opSnippet: string) {\n   this.outputShape = aShape;\n   this.userCode = `\n   vec4 unaryOperation(vec4 x) {\n ${opSnippet}\n   }\n\n   void main() {\n   vec4 x = getAAtOutCoords();\n   vec4 y = unaryOperation(x);\n\n
  setOutput(y);\n   }\n   `;\n }\n}\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n
*/\n\nimport {GPGPUProgram} from './gpgpu_math';\nimport {getChannels, getSourceCoords} from './packing_util';\nimport {getCoordsDataType} from './shader_compiler';\n\nexport class UnpackProgram implements GPGPUProgram {\n variableNames
  = ['A'];\n packedInputs = true;\n packedOutput = false;\n outputShape: number[];\n userCode: string;\n\n
constructor(outputShape: number[]) {\n   this.outputShape = outputShape;\n   const rank = outputShape.length;\n\n
  const channels = getChannels('rc', rank);\n   const dtype = getCoordsDataType(rank);\n   const sourceCoords =
getSourceCoords(rank, channels);\n   const innerDims = channels.slice(-2);\n   const coords = rank <= 1 ? 'rc' :
`vec2(${innerDims.join(',')})`;\n\n   this.userCode = `\n   void main() {\n ${dtype} rc = getOutputCoords();\n
      vec4 packedInput = getA(${sourceCoords});\n\n   setOutput(getChannel(packedInput, ${coords}));\n   }\n
`;\n }\n}\n","/**\n * @license\n * Copyright 2017 Google LLC. All Rights Reserved.\n * Licensed under the
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distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either
express or implied.\n * See the License for the specific language governing permissions and\n * limitations under
the License.\n *
==\n
*/\n\n// Import webgl flags.\nimport './flags_webgl';\n\nimport * as tf from '@tensorflow/tfjs-core';\nimport
{backend_util, BackendValues, buffer, DataId, DataStorage, DataType, DataValues, engine, env, kernel_impls,
KernelBackend, MemoryInfo, NumericDataType, Rank, RecursiveArray, scalar, ShapeMap, Tensor, Tensor2D,
TensorBuffer, TensorInfo, tidy, TimingInfo, TypedArray, util} from '@tensorflow/tfjs-core';\n\nimport
{getWebGLContext} from './canvas_util';\nimport {DecodeMatrixProgram} from './decode_matrix_gpu';\nimport
{DecodeMatrixPackedProgram} from './decode_matrix_packed_gpu';\nimport
  {EncodeFloatProgram} from './encode_float_gpu';\nimport {EncodeFloatPackedProgram} from
'./encode_float_packed_gpu';\nimport {EncodeMatrixProgram} from './encode_matrix_gpu';\nimport
{EncodeMatrixPackedProgram} from './encode_matrix_packed_gpu';\nimport {GPGPUContext} from
'./gpgpu_context';\nimport * as gpgpu_math from './gpgpu_math';\nimport {GPGPUBinary, GPGPUProgram,

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TensorData} from './gpgpu_math';\nimport {simpleAbsImplCPU} from './kernel_utils/shared';\nimport
{PackProgram} from './pack_gpu';\nimport {ReshapePackedProgram} from './reshape_packed_gpu';\nimport * as
tex_util from './tex_util';\nimport {TextureData, TextureUsage} from './tex_util';\nimport {TextureManager} from
'./texture_manager';\nimport * as unary_op from './unaryop_gpu';\nimport {UnaryOpProgram} from
'./unaryop_gpu';\nimport {UnaryOpPackedProgram} from './unaryop_packed_gpu';\nimport {UnpackProgram} from
'./unpack_gpu';\nimport * as webgl_util from './webgl_util';\n\nconst whereImpl
 = kernel_impls.whereImpl;\n\nexport const EPSILON_FLOAT32 = 1e-7;\nexport const EPSILON_FLOAT16 =
1e-4;\n\ntype KernelInfo = {\n  name: string; query: Promise<number>;\n};\n\nexport type TimerNode =
RecursiveArray<KernelInfo>|KernelInfo;\nexport interface CPUTimerQuery {\n  startMs: number;\n  endMs?:
number;\n}\n\nexport interface WebGLMemoryInfo extends MemoryInfo {\n  numBytesInGPU: number;\n  //
Tracks the total number of bytes allocated on the GPU, accounting for the\n  // physical texture type.\n
numBytesInGPUAllocated: number;\n  // Tracks byte size of textures that were created and then made available
for\n  // reuse (disposed).\n  numBytesInGPUFree: number;\n  unreliable: boolean;\n}\n\nexport interface
WebGLTimingInfo extends TimingInfo {\n  uploadWaitMs: number;\n  downloadWaitMs: number;\n}\n\nconst
binaryCaches: {[webGLVersion: string]: {[key: string]: GPGPUBinary}} = {};\n\nexport function
getBinaryCache(webGLVersion: number) {\n  if (webGLVersion in binaryCaches)
 {\n    return binaryCaches[webGLVersion];\n  }\n  binaryCaches[webGLVersion] = {};\n  return
binaryCaches[webGLVersion];\n}\n\n// Empirically determined constant used to determine size threshold for
handing\n// off execution to the CPU.\nconst CPU_HANDOFF_SIZE_THRESHOLD = 128;\n\n// Empirically
determined constant used to decide the number of MB on GPU\n// before we warn about high memory use. The MB
are this constant * screen area\n// * dpi / 1024 / 1024.\nconst BEFORE_PAGING_CONSTANT = 600;\nfunction
numMBBeforeWarning(): number {\n  if (env().global.screen == null) {\n    return 1024;  // 1 GB.\n  }\n  return
(env().global.screen.height * env().global.screen.width *\n          window.devicePixelRatio) *\n
BEFORE_PAGING_CONSTANT / 1024 / 1024;\n}\n\nexport class MathBackendWebGL extends KernelBackend
{\n  texData: DataStorage<TextureData>;\n  gpgpu: GPGPUContext;\n\n  private static nextDataId = 0;\n  private
nextDataId(): number {\n    return MathBackendWebGL.nextDataId++;\n  }\n
  // Maps data ids that have a pending read operation, to list of subscribers.\n  private pendingRead = new
WeakMap<DataId, Array<(arr: TypedArray) => void>>();\n  // List of data ids that are scheduled for disposal, but
are waiting on a\n  // pending read operation.\n  private pendingDisposal = new WeakSet<DataId>();\n\n  // Used to
count the number of 'shallow' sliced tensors that point to the\n  // same data id.\n  dataRefCount = new
WeakMap<DataId, number>();\n  private numBytesInGPU = 0;\n\n  private canvas:
HTMLCanvasElement|OffscreenCanvas;\n\n  private programTimersStack: TimerNode[];\n  private activeTimers:
TimerNode[];\n  // Accumulated time spent (including blocking) in uploading data to webgl.\n  private
uploadWaitMs = 0;\n  // Accumulated time spent (including blocking in downloading data from webgl.\n  private
downloadWaitMs = 0;\n  private cpuBackend: KernelBackend;\n\n  // Number of bits of precision of this backend.\n
private floatPrecisionValue: 32|16;\n\n  private
 textureManager: TextureManager;\n  private binaryCache: {[key: string]: GPGPUBinary};\n  private
gpgpuCreatedLocally: boolean;\n  private numMBBeforeWarning: number;\n  private warnedAboutMemory =
false;\n  private warnedAboutCPUBackend = false;\n\n  constructor(gpgpu?: GPGPUContext) {\n    super();\n    if
(!env().getBool('HAS_WEBGL')) {\n      throw new Error('WebGL is not supported on this device');\n    }\n\n    if
(gpgpu == null) {\n      const gl = getWebGLContext(env().getNumber('WEBGL_VERSION'));\n
this.binaryCache = getBinaryCache(env().getNumber('WEBGL_VERSION'));\n      this.gpgpu = new
GPGPUContext(gl);\n      this.canvas = gl.canvas;\n      this.gpgpuCreatedLocally = true;\n    } else {\n      this.gpgpu
= gpgpu;\n      this.binaryCache = {};\n      this.gpgpuCreatedLocally = false;\n      this.canvas = gpgpu.gl.canvas;\n
}\n    this.textureManager = new TextureManager(this.gpgpu);\n    this.numMBBeforeWarning =
numMBBeforeWarning();\n\n    this.texData = new DataStorage(this,
 engine());\n  }\n\n  numDataIds() {\n    return this.texData.numDataIds() +\n        (this.cpuBackend ?
this.cpuBackend.numDataIds() : 0) -\n        this.pendingDeletes;\n  }\n\n  write(values: BackendValues, shape:
```

```
number[], dtype: DataType): DataId {\n    if (env().getBool('WEBGL_CHECK_NUMERICAL_PROBLEMS') ||\n
  env().getBool('DEBUG')) {\n      this.checkNumericalProblems(values);\n    }\n    if (dtype === 'complex64' &&
values != null) {\n      throw new Error(\n          `Cannot write to a complex64 dtype. ` +\n          `Please use
tf.complex(real, imag).`);\n    }\n    const dataId = {id: this.nextDataId()};\n    this.texData.set(\n        dataId,\n
{shape, dtype, values, usage: TextureUsage.UPLOAD, refCount: 1});\n    return dataId;\n  }\n\n  /** Return
refCount of a `TensorData`. */\n  refCount(dataId: DataId): number {\n    if (this.texData.has(dataId)) {\n      const
tensorData = this.texData.get(dataId);\n      return tensorData.refCount;\n    }\n
    return 0;\n  }\n\n  /** Increase refCount of a `TextureData`. */\n  incRef(dataId: DataId): void {\n    const texData
= this.texData.get(dataId);\n    texData.refCount++;\n  }\n\n  /** Decrease refCount of a `TextureData`. */\n
decRef(dataId: DataId): void {\n    if (this.texData.has(dataId)) {\n      const texData = this.texData.get(dataId);\n
texData.refCount--;\n    }\n  }\n\n  move(\n      dataId: DataId, values: BackendValues, shape: number[], dtype:
DataType,\n      refCount: number): void {\n    if (env().getBool('DEBUG')) {\n
this.checkNumericalProblems(values);\n    }\n    if (dtype === 'complex64') {\n      throw new Error(\n          `Cannot
write to a complex64 dtype. ` +\n          `Please use tf.complex(real, imag).`);\n    }\n    this.texData.set(\n
dataId, {shape, dtype, values, usage: TextureUsage.UPLOAD, refCount});\n  }\n\n
disposeIntermediateTensorInfo(tensorInfo: TensorInfo): void {\n    this.disposeData(tensorInfo.dataId);\n  }\n\n
readSync(dataId:
 DataId): BackendValues {\n    const texData = this.texData.get(dataId);\n    const {values, dtype,
complexTensorInfos, slice, shape, isPacked} = texData;\n\n    // The presence of `slice` indicates this tensor is a
shallow slice of a\n    // different tensor, and is using that original tensor's texture. Run\n    // `clone` in order to copy
that texture and read from it.\n    if (slice != null) {\n      let program;\n      if (isPacked) {\n        program = new
UnaryOpPackedProgram(shape, unary_op.CLONE);\n      } else {\n        program = new UnaryOpProgram(shape,
unary_op.CLONE);\n      }\n      const res =\n          this.runWebGLProgram(program, [{dataId, shape, dtype}],
dtype);\n      const data = this.readSync(res.dataId);\n      this.disposeIntermediateTensorInfo(res);\n      return data;\n
  }\n    if (values != null) {\n      return this.convertAndCacheOnCPU(dataId);\n    }\n    if (dtype === 'string') {\n
return values;\n    }\n    const shouldTimeProgram = this.activeTimers
 != null;\n    let start: number;\n    if (shouldTimeProgram) {\n      start = util.now();\n    }\n\n    let result:
Float32Array;\n    if (dtype === 'complex64') {\n      const realValues =\n
this.readSync(complexTensorInfos.real.dataId) as Float32Array;\n      const imagValues =\n
this.readSync(complexTensorInfos.imag.dataId) as Float32Array;\n      result =
backend_util.mergeRealAndImagArrays(realValues, imagValues);\n    } else {\n      result =
this.getValuesFromTexture(dataId);\n    }\n\n    if (shouldTimeProgram) {\n      this.downloadWaitMs += util.now()
- start;\n    }\n    return this.convertAndCacheOnCPU(dataId, result);\n  }\n\n  async read(dataId: DataId):
Promise<BackendValues> {\n    if (this.pendingRead.has(dataId)) {\n      const subscribers =
this.pendingRead.get(dataId);\n      return new Promise<TypedArray>(resolve => subscribers.push(resolve));\n    }\n
  const texData = this.texData.get(dataId);\n    const {values, shape, slice, dtype,
 complexTensorInfos, isPacked} = texData;\n\n    // The presence of `slice` indicates this tensor is a shallow slice of
a\n    // different tensor, and is using that original tensor's texture. Run\n    // `clone` in order to copy that texture and
read from it.\n    if (slice != null) {\n      let program;\n      if (isPacked) {\n        program = new
UnaryOpPackedProgram(shape, unary_op.CLONE);\n      } else {\n        program = new UnaryOpProgram(shape,
unary_op.CLONE);\n      }\n      const res =\n          this.runWebGLProgram(program, [{dataId, shape, dtype}],
dtype);\n      const data = this.read(res.dataId);\n      this.disposeIntermediateTensorInfo(res);\n      return data;\n
}\n\n    if (values != null) {\n      return this.convertAndCacheOnCPU(dataId);\n    }\n\n    if
(!env().getBool('WEBGL_DOWNLOAD_FLOAT_ENABLED') &&\n
env().getNumber('WEBGL_VERSION') === 2) {\n      throw new Error(\n          `tensor.data() with
WEBGL_DOWNLOAD_FLOAT_ENABLED=false and ` +\n
      `WEBGL_VERSION=2 not yet supported.`);\n    }\n\n    let buffer = null;\n    let tmpDownloadTarget:
TensorInfo;\n\n    if (dtype !== 'complex64' && env().get('WEBGL_BUFFER_SUPPORTED')) {\n      // Possibly
```

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copy the texture into a buffer before inserting a fence.\n      tmpDownloadTarget = this.decode(dataId);\n      const
tmpData = this.texData.get(tmpDownloadTarget.dataId);\n\n      buffer = this.gpgpu.createBufferFromTexture(\n
  tmpData.texture, ...tex_util.getDenseTexShape(shape));\n    }\n\n    this.pendingRead.set(dataId, []);\n\n    if (dtype
!== 'complex64') {\n      // Create a fence and wait for it to resolve.\n      await
this.gpgpu.createAndWaitForFence();\n    }\n\n    // Download the values from the GPU.\n    let vals:
Float32Array;\n    if (dtype === 'complex64') {\n      const ps = await Promise.all([\n
this.read(complexTensorInfos.real.dataId),\n        this.read(complexTensorInfos.imag.dataId)\n      ]);\n\n      const
realValues = ps[0];\n      const
 imagValues = ps[1];\n      vals = backend_util.mergeRealAndImagArrays(\n          realValues as Float32Array,
imagValues as Float32Array);\n    } else if (buffer == null) {\n      vals = this.getValuesFromTexture(dataId);\n    }
else {\n      const size = util.sizeFromShape(shape);\n      vals =
this.gpgpu.downloadFloat32MatrixFromBuffer(buffer, size);\n    }\n    if (tmpDownloadTarget != null) {\n
this.disposeIntermediateTensorInfo(tmpDownloadTarget);\n    }\n    const dTypeVals =
this.convertAndCacheOnCPU(dataId, vals);\n\n    const subscribers = this.pendingRead.get(dataId);\n
this.pendingRead.delete(dataId);\n\n    // Notify all pending reads.\n    subscribers.forEach(resolve =>
resolve(dTypeVals));\n    if (this.pendingDisposal.has(dataId)) {\n      this.pendingDisposal.delete(dataId);\n      if
(this.disposeData(dataId)) {\n        engine().removeDataId(dataId, this);\n      }\n      this.pendingDeletes--;\n    }\n
return dTypeVals;\n  }\n\n  bufferSync<R extends Rank>(t:
 TensorInfo): TensorBuffer<R> {\n    const data = this.readSync(t.dataId);\n    let decodedData = data as
DataValues;\n    if (t.dtype === 'string') {\n      try {\n        // Decode the bytes into string.\n        decodedData = (data
as Uint8Array[]).map(d => util.decodeString(d));\n      } catch {\n        throw new Error('Failed to decode encoded
string bytes into utf-8');\n      }\n    }\n    return buffer(t.shape as ShapeMap[R], t.dtype, decodedData) as\n
TensorBuffer<R>;\n  }\n\n  private checkNumericalProblems(values: BackendValues): void {\n    if (values == null)
{\n      return;\n    }\n    for (let i = 0; i < values.length; i++) {\n      const num = values[i] as number;\n      if
(!webgl_util.canBeRepresented(num)) {\n        if (env().getBool('WEBGL_RENDER_FLOAT32_CAPABLE')) {\n
      throw Error(\n            `The value ${num} cannot be represented with your ` +\n            `current settings.
Consider enabling float32 rendering: ` +\n            `'tf.env().set('WEBGL_RENDER_FLOAT32_ENABLED',
 true);'`);\n        }\n        throw Error(`The value ${num} cannot be represented on this device.`);\n      }\n    }\n  }\n\n
private getValuesFromTexture(dataId: DataId): Float32Array {\n    const {shape, dtype, isPacked} =
this.texData.get(dataId);\n    const size = util.sizeFromShape(shape);\n    if
(env().getBool('WEBGL_DOWNLOAD_FLOAT_ENABLED')) {\n      const tmpTarget = this.decode(dataId);\n
const tmpData = this.texData.get(tmpTarget.dataId);\n      const vals = this.gpgpu\n
.downloadMatrixFromPackedTexture(\n                tmpData.texture, ...tex_util.getDenseTexShape(shape))\n
            .subarray(0, size);\n\n      this.disposeIntermediateTensorInfo(tmpTarget);\n\n      return vals;\n    }\n\n
const shouldUsePackedProgram =\n        env().getBool('WEBGL_PACK') && isPacked === true;\n    const
outputShape =\n        shouldUsePackedProgram ? webgl_util.getShapeAs3D(shape) : shape;\n
    const program = shouldUsePackedProgram ?\n        new EncodeFloatPackedProgram(outputShape as [number,
number, number]) :\n        new EncodeFloatProgram(outputShape);\n    const output = this.runWebGLProgram(\n
 program, [{shape: outputShape, dtype, dataId}], 'float32');\n    const tmpData = this.texData.get(output.dataId);\n
const vals =\n        this.gpgpu\n            .downloadByteEncodedFloatMatrixFromOutputTexture(\n
tmpData.texture, tmpData.texShape[0], tmpData.texShape[1])\n            .subarray(0, size);\n
this.disposeIntermediateTensorInfo(output);\n\n    return vals;\n  }\n\n  timerAvailable(): boolean {\n    return
env().getNumber('WEBGL_DISJOINT_QUERY_TIMER_EXTENSION_RELIABLE') > 0;\n  }\n\n  async time(f:
() => void): Promise<WebGLTimingInfo> {\n    const oldActiveTimers = this.activeTimers;\n    const
newActiveTimers: TimerNode[] = [];\n\n    let outerMostTime = false;\n    if (this.programTimersStack == null) {\n
  this.programTimersStack
 = newActiveTimers;\n      outerMostTime = true;\n    } else {\n      this.activeTimers.push(newActiveTimers);\n
}\n    this.activeTimers = newActiveTimers;\n\n    f();\n\n    // needing to split these up because util.flatten only
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accepts certain types\n    const flattenedActiveTimerQueries =\n        util.flatten(this.activeTimers.map((d:
KernelInfo) => d.query))\n            .filter(d => d != null);\n    const flattenedActiveTimerNames =\n
util.flatten(this.activeTimers.map((d: KernelInfo) => d.name))\n            .filter(d => d != null);\n\n
this.activeTimers = oldActiveTimers;\n\n    if (outerMostTime) {\n      this.programTimersStack = null;\n    }\n\n
const res: WebGLTimingInfo = {\n      uploadWaitMs: this.uploadWaitMs,\n      downloadWaitMs:
this.downloadWaitMs,\n      kernelMs: null,\n      wallMs: null  // will be filled by the engine\n    };\n\n    if
(env().getNumber('WEBGL_DISJOINT_QUERY_TIMER_EXTENSION_RELIABLE') > 0) {\n      const kernelMs
= await Promise.all(flattenedActiveTimerQueries);\n\n
      res['kernelMs'] = util.sum(kernelMs);\n      res['getExtraProfileInfo'] = () =>\n        kernelMs.map((d, i) =>
({name: flattenedActiveTimerNames[i], ms: d}))\n            .map(d => `${d.name}: ${d.ms}`)\n            .join(', ');\n
    } else {\n      res['kernelMs'] = {\n        error: 'WebGL query timers are not supported in this environment.'\n      };\n
    }\n\n    this.uploadWaitMs = 0;\n    this.downloadWaitMs = 0;\n    return res;\n  }\n  memory():
WebGLMemoryInfo {\n    return {\n      unreliable: false,\n      numBytesInGPU: this.numBytesInGPU,\n
numBytesInGPUAllocated: this.textureManager.numBytesAllocated,\n      numBytesInGPUFree:
this.textureManager.numBytesFree\n    } as WebGLMemoryInfo;\n  }\n\n  private startTimer():
WebGLQuery|CPUTimerQuery {\n    if
(env().getNumber('WEBGL_DISJOINT_QUERY_TIMER_EXTENSION_RELIABLE') > 0) {\n      return
this.gpgpu.beginQuery();\n    }\n    return {startMs: util.now(), endMs: null};\n
  }\n\n  private endTimer(query: WebGLQuery|CPUTimerQuery): WebGLQuery|CPUTimerQuery {\n    if
(env().getNumber('WEBGL_DISJOINT_QUERY_TIMER_EXTENSION_RELIABLE') > 0) {\n
this.gpgpu.endQuery();\n      return query;\n    }\n    (query as CPUTimerQuery).endMs = util.now();\n    return
query;\n  }\n\n  private async getQueryTime(query: WebGLQuery|CPUTimerQuery): Promise<number> {\n    if
(env().getNumber('WEBGL_DISJOINT_QUERY_TIMER_EXTENSION_RELIABLE') > 0) {\n      return
this.gpgpu.waitForQueryAndGetTime(query as WebGLQuery);\n    }\n    const timerQuery = query as
CPUTimerQuery;\n    return timerQuery.endMs - timerQuery.startMs;\n  }\n\n  private pendingDeletes = 0;\n\n
/**\n   * Decrease the RefCount on the dataId and dispose the memory if the dataId\n   * has 0 refCount. If there are
pending read on the data, the disposal would\n   * added to the pending delete queue. Return true if the dataId is
removed\n   * from backend or the backend does not contain the dataId, false if
 the\n   * dataId is not removed. Memory may or may not be released even when dataId\n   * is removed, which also
depends on dataRefCount, see `releaseGPU`.\n   * @param dataId\n   * @oaram force Optional, remove the data
regardless of refCount\n   */\n  disposeData(dataId: DataId, force = false): boolean {\n    if
(this.pendingDisposal.has(dataId)) {\n      return false;\n    }\n\n    // No-op if already disposed.\n    if
(!this.texData.has(dataId)) {\n      return true;\n    }\n\n    // if force flag is set, change refCount to 0, this would
ensure disposal\n    // when added to the pendingDisposal queue. Memory may or may not be\n    // released, which
also depends on dataRefCount, see `releaseGPU`.\n    if (force) {\n      this.texData.get(dataId).refCount = 0;\n    }
else {\n      this.texData.get(dataId).refCount--;\n    }\n\n    if (!force && this.texData.get(dataId).refCount > 0) {\n
 return false;\n    }\n\n    if (this.pendingRead.has(dataId)) {\n      this.pendingDisposal.add(dataId);\n
      this.pendingDeletes++;\n      return false;\n    }\n\n    this.releaseGPUData(dataId);\n    const
{complexTensorInfos} = this.texData.get(dataId);\n    if (complexTensorInfos != null) {\n
this.disposeData(complexTensorInfos.real.dataId, force);\n      this.disposeData(complexTensorInfos.imag.dataId,
force);\n    }\n\n    this.texData.delete(dataId);\n\n    return true;\n  }\n\n  private releaseGPUData(dataId: DataId):
void {\n    const {texture, dtype, texShape, usage, isPacked, slice} =\n        this.texData.get(dataId);\n    const key =
slice && slice.origDataId || dataId;\n    const refCount = this.dataRefCount.get(key);\n\n    if (refCount > 1) {\n
this.dataRefCount.set(key, refCount - 1);\n    } else {\n      this.dataRefCount.delete(key);\n      if (texture != null) {\n
      this.numBytesInGPU -= this.computeBytes(texShape, dtype);\n        this.textureManager.releaseTexture(texture,
texShape, usage, isPacked);\n      }\n    }\n\n    const texData
 = this.texData.get(dataId);\n    texData.texture = null;\n    texData.texShape = null;\n    texData.isPacked = false;\n
texData.slice = null;\n  }\n\n  getTexture(dataId: DataId): WebGLTexture {\n    this.uploadToGPU(dataId);\n
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return this.texData.get(dataId).texture;\n }\n\n /**\n   * Returns internal information for the specific data bucket. Used in unit\n   * tests.\n   */\n getDataInfo(dataId: DataId): TextureData {\n   return this.texData.get(dataId);\n }\n\n private getCPUBackend(): KernelBackend|null {\n   if (!env().getBool('WEBGL_CPU_FORWARD')) {\n   return null;\n   }\n\n   if (this.cpuBackend == null) {\n   this.cpuBackend = engine().findBackend('cpu');\n   }\n\n   return this.cpuBackend;\n }\n\n /*\n Tests whether all the inputs to an op are small and on the CPU. This heuristic\n determines when it would be faster to execute a kernel on the CPU. WebGL\n kernels opt into running this check and forwarding when appropriate.\n TODO(https://github.com/tensorflow/tfjs/issues/872): Develop a more\n sustainable strategy for optimizing backend execution of ops.\n   */\n shouldExecuteOnCPU(\n   inputs: TensorInfo[],\n   sizeThreshold = CPU_HANDOFF_SIZE_THRESHOLD): boolean {\n   const cpuBackend = this.getCPUBackend();\n   if (!env().getBool('IS_TEST') && !this.warnedAboutCPUBackend &&\n   cpuBackend == null) {\n   console.warn(\n   'Your application contains ops that are small enough to be ' +\n   'executed on the CPU backend, however the CPU backend cannot ' +\n   'be found. Consider importing the CPU backend ' +\n   '(@tensorflow/tfjs-backend-cpu) for better performance.');\n\n   this.warnedAboutCPUBackend = true;\n   }\n\n   return cpuBackend != null &&\n   inputs.every(\n   input => this.texData.get(input.dataId).texture == null &&\n   util.sizeFromShape(input.shape) < sizeThreshold);\n }\n\n getGPGPUContext(): GPGPUContext {\n   return this.gpgpu;\n }\n\n where(condition: Tensor): Tensor2D {\n   backend_util.warn(\n   'tf.where() in webgl locks the UI thread. ' +\n   'Call tf.whereAsync() instead');\n   const condVals = condition.dataSync();\n   return whereImpl(condition.shape, condVals);\n }\n\n private packedUnaryOp(x: TensorInfo, op: string, dtype: DataType) {\n   const program = new UnaryOpPackedProgram(x.shape, op);\n   const outInfo = this.compileAndRun(program, [x], dtype);\n   return engine().makeTensorFromDataId(\n   outInfo.dataId, outInfo.shape, outInfo.dtype);\n }\n\n // TODO(msoulanille) remove this once the backend has been modularized\n // a copy is needed here to break a circular dependency.\n // Also remove the op from unary_op.\n abs<T extends Tensor>(x: T): T {\n   // TODO: handle cases when x is complex.\n   if (this.shouldExecuteOnCPU([x]) &&\n   x.dtype !== 'complex64') {\n   const outValues =\n   simpleAbsImplCPU(this.texData.get(x.dataId).values as TypedArray);\n\n   return this.makeOutput(x.shape, x.dtype, outValues);\n   }\n\n   if (env().getBool('WEBGL_PACK_UNARY_OPERATIONS')) {\n   return this.packedUnaryOp(x, unary_op.ABS, x.dtype) as T;\n   }\n\n   const program = new UnaryOpProgram(x.shape, unary_op.ABS);\n   const outInfo = this.compileAndRun(program, [x]);\n   return engine().makeTensorFromDataId(\n   outInfo.dataId, outInfo.shape, outInfo.dtype) as T;\n }\n\n makeTensorInfo(\n   shape: number[], dtype: DataType,\n   values?: BackendValues|string[]): TensorInfo {\n   let dataId;\n   if (dtype === 'string' && values != null && values.length > 0 &&\n   util.isString(values[0])) {\n   const encodedValues =\n   (values as {} as string[]).map(d => util.encodeString(d));\n\n   dataId = this.write(encodedValues, shape, dtype);\n   } else {\n   dataId = this.write(values as TypedArray, shape, dtype);\n   }\n\n   this.texData.get(dataId).usage = null;\n   return {dataId, shape, dtype};\n }\n\n private makeOutput<T extends Tensor>(\n   shape: number[], dtype: DataType, values?: BackendValues): T {\n   const {dataId} = this.makeTensorInfo(shape, dtype, values);\n   return engine().makeTensorFromDataId(dataId, shape, dtype, this) as T;\n }\n\n private unpackTensor(input: TensorInfo): TensorInfo {\n   const program = new UnpackProgram(input.shape);\n   return this.runWebGLProgram(program, [input], input.dtype);\n }\n\n private packTensor(input: TensorInfo): TensorInfo {\n   const program = new PackProgram(input.shape);\n   const preventEagerUnpackingOutput = true;\n   return this.runWebGLProgram(\n   program, [input], input.dtype, null /* customSetup */,\n   preventEagerUnpackingOutput);\n }\n\n private packedReshape(input: TensorInfo, afterShape: number[]): TensorInfo {\n   const input3DShape = [\n   webgl_util.getBatchDim(input.shape),\n   ...webgl_util.getRowsCols(input.shape)\n   ] as [number, number, number];\n   const input3D: TensorInfo = {\n   dtype: input.dtype,\n   shape: input3DShape,\n   dataId: input.dataId\n   };\n   const afterShapeAs3D = [\n   webgl_util.getBatchDim(afterShape), ...webgl_util.getRowsCols(afterShape)\n   ] as [number, number, number];\n\n   const program = new ReshapePackedProgram(afterShapeAs3D, input3DShape);\n   const

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preventEagerUnpackingOfOutput = true;\n    const output = this.runWebGLProgram(\n        program, [input3D],
input.dtype, null /* customSetup */,\n        preventEagerUnpackingOfOutput);\n    return {dataId: output.dataId,
shape: afterShape, dtype: output.dtype};\n  }\n\n  private decode(dataId: DataId): TensorInfo {\n    const texData =
this.texData.get(dataId);\n    const {isPacked, shape, dtype} = texData;\n    const shapeAs3D =\n
webgl_util.getShapeAs3D(shape) as [number, number, number];\n    let program;\n    if (isPacked) {\n      program =
new DecodeMatrixPackedProgram(shapeAs3D);\n    } else {\n      program = new
DecodeMatrixProgram(shapeAs3D);\n
    }\n    const preventEagerUnpackingOfOutput = true;\n    const out = this.runWebGLProgram(\n        program,
[{shape: shapeAs3D, dtype, dataId}], dtype,\n        null /* customSetup */, preventEagerUnpackingOfOutput);\n
return {dtype, shape, dataId: out.dataId};\n  }\n\n  runWebGLProgram(\n      program: GPGPUProgram, inputs:
TensorInfo[], outputDtype: DataType,\n      customSetup?: (gpgpu: GPGPUContext, webGLProgram:
WebGLProgram) => void,\n      preventEagerUnpackingOfOutput = false): TensorInfo {\n    const output =
this.makeTensorInfo(program.outputShape, outputDtype);\n    const outData = this.texData.get(output.dataId);\n    if
(program.packedOutput) {\n      outData.isPacked = true;\n    }\n    if (program.outPackingScheme ===
tex_util.PackingScheme.DENSE) {\n      const texelShape = tex_util.getDenseTexShape(program.outputShape);\n
// For a densely packed output, we explicitly set texShape\n      // so it doesn't get assigned later according to our
typical packing\n
      // scheme wherein a single texel can only contain values from adjacent\n      // rows/cols.\n      outData.texShape
= texelShape.map(d => d * 2) as [number, number];\n    }\n    if (program.outTexUsage != null) {\n
outData.usage = program.outTexUsage;\n    }\n    if (util.sizeFromShape(output.shape) === 0) {\n      // Short-circuit
the computation since the result is empty (has 0 in its\n      // shape).\n      outData.values =\n
util.getTypedArrayFromDType(output.dtype as 'float32', 0);\n      return output;\n    }\n\n    const dataToDispose:
TensorInfo[] = [];\n    const inputsData: TensorData[] = inputs.map(input => {\n      if (input.dtype === 'complex64')
{\n        throw new Error(\n            `GPGPUProgram does not support complex64 input. For complex64 ` +\n
`dtypes, please separate the program into real and imaginary ` +\n            `parts.`);\n      }\n\n      let texData =
this.texData.get(input.dataId);\n\n      if (texData.texture ==
 null) {\n        if (!program.packedInputs &&\n            util.sizeFromShape(input.shape) <=\n
env().getNumber('WEBGL_SIZE_UPLOAD_UNIFORM')) {\n          // Upload small tensors that live on the CPU
as uniforms, not as\n          // textures. Do this only when the environment supports 32bit floats\n          // due to
problems when comparing 16bit floats with 32bit floats.\n          //
TODO(https://github.com/tensorflow/tfjs/issues/821): Make it\n          // possible for packed shaders to sample from
uniforms.\n          return {\n            shape: input.shape,\n            texData: null,\n            isUniform: true,\n
uniformValues: texData.values as TypedArray\n          };\n        }\n\n        // This ensures that if a packed program's
inputs have not yet been\n        // uploaded to the GPU, they get uploaded as packed right off the bat.\n        if
(program.packedInputs) {\n          texData.isPacked = true;\n          texData.shape = input.shape;\n
        }\n      } else if (!!texData.isPacked !== !!program.packedInputs) {\n        input = texData.isPacked ?
this.unpackTensor(input) :\n                                this.packTensor(input);\n        dataToDispose.push(input);\n
texData = this.texData.get(input.dataId);\n      } else if (\n          texData.isPacked &&\n
!webgl_util.isReshapeFree(texData.shape, input.shape)) {\n        // This is a special case where a texture exists for a
tensor\n        // but the shapes are incompatible (due to packing constraints) because\n        // the tensor did not have
a chance to go through the packed reshape\n        // shader. This only happens when we reshape the *same* tensor to
form\n        // *distinct* inputs to an op, e.g. dotting a vector with itself. This\n        // case will disappear once
packed uploading is the default.\n\n        const savedInput = input;\n        const targetShape = input.shape;\n\n
input.shape = texData.shape;\n        input =
 this.packedReshape(input as Tensor, targetShape);\n        dataToDispose.push(input);\n        texData =
this.texData.get(input.dataId);\n\n        savedInput.shape = targetShape;\n      }\n\n
this.uploadToGPU(input.dataId);\n      return {shape: input.shape, texData, isUniform: false};\n    });\n\n
this.uploadToGPU(output.dataId);\n    const outputData:\n        TensorData = {shape: output.shape, texData:
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outData, isUniform: false};\n    const key = gpgpu_math.makeShaderKey(program, inputsData, outputData);\n
const binary = this.getAndSaveBinary(key, () => {\n      return gpgpu_math.compileProgram(\n          this.gpgpu,
program, inputsData, outputData);\n    });\n    const shouldTimeProgram = this.activeTimers != null;\n    let query:
WebGLQuery|CPUTimerQuery;\n    if (shouldTimeProgram) {\n      query = this.startTimer();\n    }\n\n
gpgpu_math.runProgram(\n        this.gpgpu, binary, inputsData, outputData, customSetup);\n\n
dataToDispose.forEach(info => this.disposeIntermediateTensorInfo(info));\n\n
   if (shouldTimeProgram) {\n      query = this.endTimer(query);\n      this.activeTimers.push(\n          {name:
program.constructor.name, query: this.getQueryTime(query)});\n    }\n\n    if
(!env().getBool('WEBGL_LAZILY_UNPACK') && outData.isPacked &&\n        preventEagerUnpackingOfOutput
=== false) {\n      const unpacked = this.unpackTensor(output);\n      this.disposeIntermediateTensorInfo(output);\n
 return unpacked;\n    }\n    return output;\n  }\n\n  compileAndRun(\n      program: GPGPUProgram, inputs:
TensorInfo[], outputDtype?: DataType,\n      customSetup?: (gpgpu: GPGPUContext, webGLProgram:
WebGLProgram) => void,\n      preventEagerUnpackingOfOutput = false): TensorInfo {\n    outputDtype =
outputDtype || inputs[0].dtype;\n    const outInfo = this.runWebGLProgram(\n        program, inputs, outputDtype,
customSetup,\n        preventEagerUnpackingOfOutput);\n    return outInfo;\n  }\n\n  private getAndSaveBinary(key:
string, getBinary:
 () => GPGPUBinary):\n      GPGPUBinary {\n    if (!(key in this.binaryCache)) {\n      this.binaryCache[key] =
getBinary();\n    }\n    return this.binaryCache[key];\n  }\n\n  getTextureManager(): TextureManager {\n    return
this.textureManager;\n  }\n\n  private disposed = false;\n\n  dispose() {\n    if (this.disposed) {\n      return;\n    }\n
// Avoid disposing the compiled webgl programs during unit testing because\n    // it slows down test execution.\n
if (!env().getBool('IS_TEST')) {\n      const allKeys = Object.keys(this.binaryCache);\n      allKeys.forEach(key =>
{\n        this.gpgpu.deleteProgram(this.binaryCache[key].webGLProgram);\n        delete this.binaryCache[key];\n
});\n    }\n    this.textureManager.dispose();\n    if (this.canvas != null &&\n        (typeof (HTMLCanvasElement)
!== 'undefined' &&\n        this.canvas instanceof HTMLCanvasElement)) {\n      this.canvas.remove();\n    } else
{\n      this.canvas = null;\n    }\n    if (this.gpgpuCreatedLocally)
 {\n      this.gpgpu.program = null;\n      this.gpgpu.dispose();\n    }\n    this.disposed = true;\n  }\n\n
floatPrecision(): 16|32 {\n    if (this.floatPrecisionValue == null) {\n      this.floatPrecisionValue = tidy(() => {\n
if (!env().get('WEBGL_RENDER_FLOAT32_ENABLED')) {\n        // Momentarily switching DEBUG flag to
false so we don't throw an\n        // error trying to upload a small value.\n        const debugFlag =
env().getBool('DEBUG');\n        env().set('DEBUG', false);\n        const underflowCheckValue =
this.abs(scalar(1e-8)).dataSync()[0];\n        env().set('DEBUG', debugFlag);\n\n        if (underflowCheckValue >
0) {\n          return 32;\n        }\n      }\n      return 16;\n    });\n    }\n    return this.floatPrecisionValue;\n  }\n\n
/** Returns the smallest representable number.  */\n  epsilon(): number {\n    return this.floatPrecision() === 32 ?
EPSILON_FLOAT32 : EPSILON_FLOAT16;\n  }\n\n  uploadToGPU(dataId: DataId):
 void {\n    const texData = this.texData.get(dataId);\n    const {shape, dtype, values, texture, usage, isPacked} =
texData;\n\n    if (texture != null) {\n      // Array is already on GPU. No-op.\n      return;\n    }\n    const
shouldTimeProgram = this.activeTimers != null;\n    let start: number;\n    if (shouldTimeProgram) {\n      start =
util.now();\n    }\n\n    let texShape = texData.texShape;\n    if (texShape == null) {\n      texShape =
webgl_util.getTextureShapeFromLogicalShape(shape, isPacked);\n      texData.texShape = texShape;\n    }\n\n    if
(values != null) {\n      const shapeAs3D = webgl_util.getShapeAs3D(shape);\n\n      let program;\n      let width =
texShape[1], height = texShape[0];\n      const isByteArray = values instanceof Uint8Array;\n\n      if (isPacked) {\n
   [width, height] = tex_util.getPackedMatrixTextureShapeWidthHeight(\n          texShape[0], texShape[1]);\n
program = new EncodeMatrixPackedProgram(\n          shapeAs3D, [height,
 width], isByteArray);\n      } else {\n        program =\n            new EncodeMatrixProgram(shapeAs3D, [height,
width], isByteArray);\n      }\n\n      const tempDenseInputHandle = this.makeTensorInfo([height, width], dtype);\n
 if (isByteArray) {\n        this.texData.get(tempDenseInputHandle.dataId).usage =\n            TextureUsage.PIXELS;\n
   } else {\n        this.texData.get(tempDenseInputHandle.dataId).usage =\n            TextureUsage.UPLOAD;\n
}\n      this.gpgpu.uploadDenseMatrixToTexture(\n          this.getTexture(tempDenseInputHandle.dataId), width,
```

height,\n values as TypedArray);\n\n // We want the output to remain packed regardless of the value of\n // WEBGL_PACK.\n const preventEagerUnpacking = true;\n const encodedOutputTarget = this.runWebGLProgram(\n program, [tempDenseInputHandle], dtype, null, preventEagerUnpacking);\n\n // Have the original texture assume the identity of the encoded output.\n const outputTexData = this.texData.get(encodedOutputTarget.dataId);\n texData.texture = outputTexData.texture;\n texData.texShape = outputTexData.texShape;\n texData.isPacked = outputTexData.isPacked;\n texData.usage = outputTexData.usage;\n\n this.disposeIntermediateTensorInfo(tempDenseInputHandle);\n this.texData.delete(encodedOutputTarget.dataId);\n\n // Once uploaded, don't store the values on cpu.\n texData.values = null;\n if (shouldTimeProgram) {\n this.uploadWaitMs += util.now() - start;\n }\n } else {\n const newTexture = this.acquireTexture(texShape, usage, dtype, isPacked);\n texData.texture = newTexture;\n }\n }\n\n private convertAndCacheOnCPU(dataId: DataId, float32Values?: Float32Array):\n TypedArray {\n const texData = this.texData.get(dataId);\n const {dtype} = texData;\n\n this.releaseGPUData(dataId);\n\n if (float32Values != null) {\n texData.values = float32ToTypedArray(float32Values, dtype as 'float32');\n }\n return texData.values as TypedArray;\n }\n\n private acquireTexture(\n texShape: [number, number], texType: TextureUsage, dtype: DataType,\n isPacked: boolean): WebGLTexture {\n this.numBytesInGPU += this.computeBytes(texShape, dtype);\n if (!this.warnedAboutMemory &&\n this.numBytesInGPU > this.numMBBeforeWarning * 1024 * 1024) {\n const mb = (this.numBytesInGPU / 1024 / 1024).toFixed(2);\n this.warnedAboutMemory = true;\n console.warn(\n `High memory usage in GPU: ${mb} MB, ` +\n `most likely due to a memory leak`);\n }\n return this.textureManager.acquireTexture(texShape, texType, isPacked);\n }\n\n private computeBytes(shape: [number, number], dtype: DataType) {\n return shape[0] * shape[1] * util.bytesPerElement(dtype);\n }\n}\n\nfunction float32ToTypedArray<D extends NumericDataType>(\n a: Float32Array, dtype: D): tf.DataTypeMap[D] {\n if (dtype === 'float32' || dtype === 'complex64') {\n return a as tf.DataTypeMap[D];\n } else if (dtype === 'int32' || dtype === 'bool') {\n const result = (dtype === 'int32') ? new Int32Array(a.length) :\n new Uint8Array(a.length);\n for (let i = 0; i < result.length; ++i) {\n result[i] = Math.round(a[i]);\n }\n return result as tf.DataTypeMap[D];\n } else {\n throw new Error(`Unknown dtype ${dtype}`);\n }\n}\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==\n */\n\nimport {env} from '@tensorflow/tfjs-core';\n\nimport * as gpgpu_util from './gpgpu_util';\nimport * as webgl_util from './webgl_util';\n\nexport {MathBackendWebGL, WebGLMemoryInfo, WebGLTimingInfo} from './backend_webgl';\nexport {setWebGLContext} from './canvas_util';\nexport {GPGPUContext} from './gpgpu_context';\nexport {GPGPUProgram} from './gpgpu_math';\n// WebGL specific utils.\nexport {gpgpu_util, webgl_util};\n\n/**\n * Enforce use of half precision textures if available on the platform.\n *\n * @doc {heading: 'Environment', namespace: 'webgl'}\n */\nexport function forceHalfFloat(): void {\n env().set('WEBGL_FORCE_F16_TEXTURES', true);\n}\n","/**\n * @license\n * Copyright 2017 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *

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==========================================================================\n
*/\n\nimport {backend_util} from '@tensorflow/tfjs-core';\n\nimport {GPGPUProgram} from
'./gpgpu_math';\n\nexport const CHECK_NAN_SNIPPET = `\n  if (isnan(a)) return a;\n  if (isnan(b)) return
b;\n`;\n\nexport const SQUARED_DIFFERENCE = 'return (a - b) * (a - b);';\nexport class BinaryOpProgram
implements GPGPUProgram {\n  variableNames = ['A', 'B'];\n  outputShape: number[];\n  userCode: string;\n\n
constructor(op: string, aShape: number[],
 bShape: number[]) {\n    this.outputShape = backend_util.assertAndGetBroadcastShape(aShape, bShape);\n
this.userCode = `\n      float binaryOperation(float a, float b) {\n        ${op}\n      }\n\n      void main() {\n        float a
= getAAtOutCoords();\n        float b = getBAtOutCoords();\n        setOutput(binaryOperation(a, b));\n      }\n    `;\n
}\n}\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache
License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You
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BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the
License for the specific language governing permissions and\n * limitations under the
 License.\n *
==========================================================================\n
*/\n\nimport {backend_util, util} from '@tensorflow/tfjs-core';\n\nimport {GPGPUProgram} from
'./gpgpu_math';\nimport {getChannels} from './packing_util';\nimport {getCoordsDataType} from
'./shader_compiler';\n\nexport const CHECK_NAN_SNIPPET = `\n  result.r = isNaN.r > 0. ? NAN : result.r;\n
result.g = isNaN.g > 0. ? NAN : result.g;\n  result.b = isNaN.b > 0. ? NAN : result.b;\n  result.a = isNaN.a > 0. ?
NAN : result.a;\n`;\n\nexport const ELU_DER = `\n  vec4 bGTEZero = vec4(greaterThanEqual(b, vec4(0.)));\n
return (bGTEZero * a) + ((vec4(1.0) - bGTEZero) * (a * (b + vec4(1.0))));\n`;\n\nexport const NOT_EQUAL = `\n
return vec4(notEqual(a, b));\n`;\n\nexport class BinaryOpPackedProgram implements GPGPUProgram {\n
variableNames = ['A', 'B'];\n  outputShape: number[];\n  userCode: string;\n  supportsBroadcasting = true;\n
packedInputs = true;\n  packedOutput = true;\n\n  constructor(\n
    op: string, aShape: number[], bShape: number[],\n    checkOutOfBounds = false) {\n    this.outputShape =
backend_util.assertAndGetBroadcastShape(aShape, bShape);\n    const rank = this.outputShape.length;\n    let
checkOutOfBoundsString = '';\n    if (checkOutOfBounds) {\n      if (rank === 0 ||
util.sizeFromShape(this.outputShape) === 1) {\n        checkOutOfBoundsString = `\n          result.y = 0.;\n
result.z = 0.;\n          result.w = 0.;\n        `;\n      } else {\n        const dtype = getCoordsDataType(rank);\n
checkOutOfBoundsString = `\n          ${dtype} coords = getOutputCoords();\n        `;\n        if (rank === 1) {\n
checkOutOfBoundsString += `\n            result.y = (coords + 1) >= ${this.outputShape[0]} ? 0. : result.y;\n
result.z = 0.;\n            result.w = 0.;\n          `;\n        } else {\n          const channels = getChannels('coords', rank);\n
    checkOutOfBoundsString += `\n            bool nextRowOutOfBounds
 =\n              (${channels[rank - 2]} + 1) >= ${this.outputShape[rank - 2]};\n            bool nextColOutOfBounds =\n
          (${channels[rank - 1]} + 1) >= ${this.outputShape[rank - 1]};\n            result.y = nextColOutOfBounds ? 0. :
result.y;\n            result.z = nextRowOutOfBounds ? 0. : result.z;\n            result.w = nextColOutOfBounds ||
nextRowOutOfBounds ? 0. : result.w;\n          `;\n        }\n      }\n    }\n\n    this.userCode = `\n      vec4
binaryOperation(vec4 a, vec4 b) {\n        ${op}\n      }\n\n      void main() {\n        vec4 a = getAAtOutCoords();\n
  vec4 b = getBAtOutCoords();\n\n        vec4 result = binaryOperation(a, b);\n        ${checkOutOfBoundsString}\n\n
    setOutput(result);\n      }\n    `;\n  }\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights
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BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the
License for the specific language governing permissions and\n * limitations under the License.\n *
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==========\n*/\n\nimport {env, KernelConfig, KernelFunc, LeakyRelu, LeakyReluAttrs, LeakyReluInputs, TensorInfo, util} from '@tensorflow/tfjs-core';\nimport {MathBackendWebGL} from '../backend_webgl';\nimport {BinaryOpProgram} from '../binaryop_gpu';\nimport {BinaryOpPackedProgram} from '../binaryop_packed_gpu';\n\nexport const LEAKYRELU = `return (a < 0.) ? b * a : a;`;\nexport const LEAKYRELU_PACKED = `\n  vec4 aLessThanZero = vec4(lessThan(a, vec4(0.)));\n  return (aLessThanZero * (b * a)) + ((vec4(1.0) - aLessThanZero)
 * a);\n`;\n\nexport function leakyRelu(args: {\n  inputs: LeakyReluInputs,\n  backend: MathBackendWebGL,\n  attrs: LeakyReluAttrs\n}): TensorInfo {\n  const {inputs, backend, attrs} = args;\n  const {x} = inputs;\n  const {alpha} = attrs;\n\n  const $alpha = backend.makeTensorInfo(\n      [], 'float32',\n      util.createScalarValue(alpha as {} as 'float32', 'float32'));\n\n  const program = env().getBool('WEBGL_PACK_BINARY_OPERATIONS') ?\n      new BinaryOpPackedProgram(LEAKYRELU_PACKED, x.shape, $alpha.shape) :\n      new BinaryOpProgram(LEAKYRELU, x.shape, $alpha.shape);\n  const result = backend.runWebGLProgram(program, [x, $alpha], x.dtype);\n\n  backend.disposeIntermediateTensorInfo($alpha);\n\n  return result;\n}\n\nexport const leakyReluConfig: KernelConfig = {\n  kernelName: LeakyRelu,\n  backendName: 'webgl',\n  kernelFunc: leakyRelu as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License,
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==========\n*/\n\nimport {env, KernelConfig, KernelFunc, Prelu, PreluInputs, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL} from '../backend_webgl';\nimport {BinaryOpProgram} from '../binaryop_gpu';\nimport {BinaryOpPackedProgram} from '../binaryop_packed_gpu';\n\nexport const PRELU = `return (a < 0.) ? b * a : a;`;\nexport const PRELU_PACKED = `\n  vec4 aLessThanZero = vec4(lessThan(a,
 vec4(0.)));\n  return (aLessThanZero * (b * a)) + ((vec4(1.0) - aLessThanZero) * a);\n`;\n\nexport function prelu(args: {inputs: PreluInputs, backend: MathBackendWebGL}):\n    TensorInfo {\n  const {inputs, backend} = args;\n  const {x, alpha} = inputs;\n\n  const program = env().getBool('WEBGL_PACK_BINARY_OPERATIONS') ?\n      new BinaryOpPackedProgram(PRELU_PACKED, x.shape, alpha.shape) :\n      new BinaryOpProgram(PRELU, x.shape, alpha.shape);\n  return backend.runWebGLProgram(program, [x, alpha], x.dtype);\n}\n\nexport const preluConfig: KernelConfig = {\n  kernelName: Prelu,\n  backendName: 'webgl',\n  kernelFunc: prelu as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required
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==========\n*/\n\nimport {backend_util, BinaryInputs, DataType, env, KernelFunc, TypedArray, UnaryInputs, upcastType} from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL} from '../backend_webgl';\nimport {BinaryOpProgram} from '../binaryop_gpu';\nimport {BinaryOpPackedProgram} from '../binaryop_packed_gpu';\nimport {complex} from '../kernels/Complex';\nimport {LEAKYRELU, LEAKYRELU_PACKED} from '../kernels/LeakyRelu';\nimport {PRELU, PRELU_PACKED} from '../kernels/Prelu';\nimport * as unary_op from '../unaryop_gpu';\nimport {UnaryOpProgram} from '../unaryop_gpu';\nimport * as unary_packed_op from '../unaryop_packed_gpu';\nimport
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{UnaryOpPackedProgram} from '../unaryop_packed_gpu';\n\nimport {SimpleBinaryKernelImplCPU, SimpleUnaryKernelImplCPU} from './shared';\n\nexport const CHECK_NAN_SNIPPET_UNARY = `if (isnan(x)) return x;`;\n\nexport const CHECK_NAN_SNIPPET_BINARY = `\n  if (isnan(a)) return a;\n  if (isnan(b)) return b;\n`;\n\nexport const CHECK_NAN_SNIPPET_BINARY_PACKED = `\n  result.r = isNaN.r > 0. ? NAN : result.r;\n  result.g = isNaN.g > 0. ? NAN : result.g;\n  result.b = isNaN.b > 0. ? NAN : result.b;\n  result.a = isNaN.a > 0. ? NAN : result.a;\n`;\n\ntype UnaryKernelFuncConfig = {\n opSnippet: string,\n packedOpSnippet?: string,\n cpuKernelImpl?: SimpleUnaryKernelImplCPU,\n dtype?: DataType\n};\n\n/**\n * Template that creates a `KernelFunc` for unary ops.\n * @param opSnippet Op snippet to create `UnaryOpProgram`.\n * @param packedOpSnippet Op snippet to create `UnaryOpPackedProgram`.\n * @param dtype Optional. If set, the result has this dtype. Otherwise, the\n *
result has the same dtype as the first input. This is mainly used in\n *   comparison kernels, such as Equal, Less, Greater, etc.\n */\nexport function unaryKernelFunc(\n   {opSnippet, packedOpSnippet, cpuKernelImpl, dtype}: UnaryKernelFuncConfig):\n   KernelFunc {\n return ({inputs, backend}) => {\n   const {x} = inputs as UnaryInputs;\n   const webglBackend = backend as MathBackendWebGL;\n\n   const $dtype = dtype || x.dtype;\n   if (webglBackend.shouldExecuteOnCPU([x]) && cpuKernelImpl != null) {\n   const xData = webglBackend.texData.get(x.dataId);\n   const outValues = cpuKernelImpl(xData.values as TypedArray, $dtype);\n   return webglBackend.makeTensorInfo(x.shape, $dtype, outValues);\n   }\n\n   const shouldUsePackedProgram =\n   env().getBool('WEBGL_PACK_UNARY_OPERATIONS') && packedOpSnippet != null;\n   let program: UnaryOpProgram|UnaryOpPackedProgram;\n   if (shouldUsePackedProgram) {\n   program = new UnaryOpPackedProgram(x.shape, packedOpSnippet);\n   } else {\n   program = new UnaryOpProgram(x.shape, opSnippet);\n   }\n\n   return webglBackend.runWebGLProgram(program, [x], $dtype);\n };\n}\n\ntype BinaryKernelFuncConfig = {\n opSnippet: string,\n packedOpSnippet?: string,\n checkOutOfBounds?: boolean,\n supportsComplex?: boolean,\n cpuKernelImpl?: SimpleBinaryKernelImplCPU,\n dtype?: DataType\n};\n\n/**\n * Template that creates a `KernelFunc` for binary ops.\n * @param opSnippet Op snippet to create `BinaryOpProgram`.\n * @param packedOpSnippet Op snippet to create `BinaryOpPackedProgram`.\n * @param checkOutOfBoundsForPackedProgram Whether to set checkOutOfBounds=true\n *   when creating BinaryOpPackedProgram.\n * @param dtype Optional. If set, the result has this dtype. Otherwise, the\n *   result has the same dtype as the first input. This is mainly used in\n *   comparison kernels, such as Equal, Less, Greater, etc.\n */\nexport function binaryKernelFunc({\n opSnippet,\n packedOpSnippet,\n checkOutOfBounds = false,\n supportsComplex = false,\n cpuKernelImpl,\n dtype\n}: BinaryKernelFuncConfig): KernelFunc {\n return ({inputs, backend}) => {\n   const {a, b} = inputs as BinaryInputs;\n   const webglBackend = backend as MathBackendWebGL;\n\n   if (supportsComplex && a.dtype === 'complex64') {\n   const aData = webglBackend.texData.get(a.dataId);\n   const bData = webglBackend.texData.get(b.dataId);\n\n   const [real, imag] = [\n   [aData.complexTensorInfos.real, bData.complexTensorInfos.real],\n   [aData.complexTensorInfos.imag, bData.complexTensorInfos.imag]\n   ].map(complexParts => {\n   const [aPart, bPart] = complexParts;\n\n   const aHandle = {\n   dataId: aPart.dataId,\n   dtype: aPart.dtype,\n   shape: a.shape\n   };\n   const bHandle = {\n   dataId: bPart.dataId,\n   dtype: bPart.dtype,\n   shape: b.shape\n   };\n\n   const program = new BinaryOpProgram(opSnippet, a.shape, b.shape);\n   return webglBackend.runWebGLProgram(\n   program, [aHandle, bHandle], upcastType(aPart.dtype, bPart.dtype));\n   });\n\n   const complexOutput =\n   complex({inputs: {real, imag}, backend: webglBackend});\n\n   webglBackend.disposeIntermediateTensorInfo(real);\n   webglBackend.disposeIntermediateTensorInfo(imag);\n\n   // TODO(annxingyuan): Implement CPU forwarding for complex inputs.\n\n   return complexOutput;\n   }\n\n   const $dtype = dtype || upcastType(a.dtype, b.dtype);\n   if (webglBackend.shouldExecuteOnCPU([a, b]) && cpuKernelImpl != null) {\n   const aData = webglBackend.texData.get(a.dataId);\n   const bData = webglBackend.texData.get(b.dataId);\n   const [outValues, outShape] = cpuKernelImpl(\n   a.shape, b.shape, aData.values as TypedArray,\n   bData.values as TypedArray, $dtype);\n\n   const out = webglBackend.makeTensorInfo(outShape, $dtype);\n   const outData

= webglBackend.texData.get(out.dataId);\n
outData.values = outValues;\n return out;\n }\n\n const shouldUsePackedProgram =\n env().getBool('WEBGL_PACK_BINARY_OPERATIONS') &&\n packedOpSnippet != null;\n let program: BinaryOpProgram|BinaryOpPackedProgram;\n if (shouldUsePackedProgram) {\n program = new BinaryOpPackedProgram(\n packedOpSnippet, a.shape, b.shape, checkOutOfBounds);\n } else {\n program = new BinaryOpProgram(opSnippet, a.shape, b.shape);\n }\n\n return webglBackend.runWebGLProgram(program, [a, b], $dtype);\n };\n}\n\nexport function mapActivationToShaderProgram(\n activation: backend_util.Activation, packed = false): string {\n if (activation === 'linear') {\n if (packed) {\n return unary_packed_op.LINEAR;\n }\n return unary_op.LINEAR;\n } else if (activation === 'relu') {\n if (packed) {\n return unary_packed_op.RELU;\n }\n return unary_op.RELU;\n } else if (activation === 'elu') {\n if (packed) {\n return unary_packed_op.ELU;\n }\n return unary_op.ELU;\n } else if (activation === 'relu6') {\n if (packed) {\n return unary_packed_op.RELU6;\n }\n return unary_op.RELU6;\n } else if (activation === 'prelu') {\n if (packed) {\n return PRELU_PACKED;\n }\n return PRELU;\n } else if (activation === 'leakyrelu') {\n if (packed) {\n return LEAKYRELU_PACKED;\n }\n return LEAKYRELU;\n }\n throw new Error(`Activation ${\n activation} has not been implemented for the WebGL backend.`);\n}\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==\n */\n\nimport {GPGPUProgram} from './gpgpu_math';\n\nexport class MatMulPackedProgram implements GPGPUProgram {\n variableNames = ['matrixA', 'matrixB'];\n packedInputs = true;\n packedOutput = true;\n outputShape: number[];\n userCode: string;\n\n constructor(\n aShape: [number, number, number], bShape: [number, number, number],\n outputShape: [number, number, number], transposeA = false,\n transposeB = false, addBias = false, activation: string = null,\n hasPreluActivation = false, hasLeakyreluActivation = false) {\n this.outputShape = outputShape;\n\n const sharedDim = transposeA ? aShape[1] : aShape[2];\n const sharedDimensionPacked = Math.ceil(sharedDim / 2);\n\n const aSample = transposeA ? 'i * 2, rc.y' : 'rc.y, i * 2';\n const bSample = transposeB ? 'rc.z, i * 2' : 'i * 2, rc.z';\n const aSwizzle = transposeA ? ['a.xxyy', 'a.zzww'] : ['a.xxzz', 'a.yyww'];\n const bSwizzle = transposeB ? ['b.xzxz', 'b.ywyw'] : ['b.xyxy', 'b.zwzw'];\n\n let activationSnippet = '', applyActivationSnippet = '';\n if (activation) {\n if (hasPreluActivation) {\n activationSnippet = `vec4 activation(vec4 a) {\n vec4 b = getPreluActivationWeightsAtOutCoords();\n ${activation}\n }`;\n } else if (hasLeakyreluActivation) {\n activationSnippet = `vec4 activation(vec4 a) {\n vec4 b = getLeakyreluAlphaAtOutCoords();\n ${activation}\n }`;\n } else {\n activationSnippet = `vec4 activation(vec4 x) {\n ${activation}\n }`;\n }\n\n applyActivationSnippet = `result = activation(result);`;\n }\n\n const addBiasSnippet = addBias ? 'result += getBiasAtOutCoords();'\n : '';\n if (addBias) {\n this.variableNames.push('bias');\n }\n\n if (hasPreluActivation) {\n this.variableNames.push('preluActivationWeights');\n }\n\n if (hasLeakyreluActivation) {\n this.variableNames.push('leakyreluAlpha');\n }\n\n let batchASnippet = 'rc.x';\n let batchBSnippet = 'rc.x';\n if (aShape[0] < bShape[0]) {\n batchASnippet = `int(min(float(rc.x), ${aShape[0] - 1}.))`;\n } else if (bShape[0] < aShape[0]) {\n batchBSnippet = `int(min(float(rc.x), ${bShape[0] - 1}.))`;\n }\n\n this.userCode = `\n ${activationSnippet}\n\n const float sharedDimension = ${sharedDimensionPacked}.0;\n\n vec4 dot2x2ARowBCol(ivec3 rc) {\n vec4 result = vec4(0);\n for (int i = 0; i < ${sharedDimensionPacked}; i++) {\n int batchA = ${batchASnippet};\n int batchB = ${batchBSnippet};\n vec4 a = getMatrixA(batchA, ${aSample});\n vec4 b = getMatrixB(batchB, ${bSample});\n\n

```
// These swizzled products need to be separately added.\n // See:
https://github.com/tensorflow/tfjs/issues/1735\n result += (${aSwizzle[0]} * ${bSwizzle[0]});\n result
+= (${aSwizzle[1]} * ${bSwizzle[1]});\n }\n return result;\n }\n\n void main() {\n ivec3 rc =
getOutputCoords();\n vec4 result = dot2x2ARowBCol(rc);\n\n ${addBiasSnippet}\n\n
${applyActivationSnippet}\n\n setOutput(result);\n }\n `;\n }\n}\n","/**\n * @license\n * Copyright 2018
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http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing,
software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES
OR CONDITIONS
 OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions
and\n * limitations under the License.\n *
==========================================================================\n
*/\n\nimport {backend_util} from '@tensorflow/tfjs-core';\nimport {GPGPUProgram} from './gpgpu_math';\n\n//
(Ar + Ai)(Br + Bi) =\n// ArBr + ArBi + AiBr + AiBi = ArBr - AB + ArBi + AiBr\n// Yr = ArBr - AB\n// Yi = ArBi
+ AiBr\nexport const COMPLEX_MULTIPLY = {\n REAL: 'return areal * breal - aimag * bimag;',\n IMAG:
'return areal * bimag + aimag * breal;'\n};\n\nexport class BinaryOpComplexProgram implements GPGPUProgram
{\n variableNames = ['AReal', 'AImag', 'BReal', 'BImag'];\n userCode: string;\n outputShape: number[];\n\n
constructor(op: string, aShape: number[], bShape: number[]) {\n this.outputShape =
backend_util.assertAndGetBroadcastShape(aShape, bShape);\n\n this.userCode = `\n float
binaryOpComplex(\n float areal, float
 aimag, float breal, float bimag) {\n ${op}\n }\n\n void main() {\n float areal =
getARealAtOutCoords();\n float aimag = getAImagAtOutCoords();\n float breal =
getBRealAtOutCoords();\n float bimag = getBImagAtOutCoords();\n setOutput(binaryOpComplex(areal,
aimag, breal, bimag));\n }\n `;\n }\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights
Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file
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http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing,
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OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language
governing permissions and\n * limitations under the License.\n
 * ==========================================================================\n
*/\n\nimport {TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL} from
'../backend_webgl';\nimport {ReshapePackedProgram} from '../reshape_packed_gpu';\nimport {getBatchDim,
getRowsCols} from '../webgl_util';\n\nexport function packedReshape(\n input: TensorInfo, afterShape:
number[],\n backend: MathBackendWebGL): TensorInfo {\n const input3DShape =\n
[getBatchDim(input.shape),\n ...getRowsCols(input.shape)] as [number, number, number];\n const input3D:
TensorInfo = {\n dtype: input.dtype,\n shape: input3DShape,\n dataId: input.dataId\n };\n const
afterShapeAs3D =\n [getBatchDim(afterShape),\n ...getRowsCols(afterShape)] as [number, number,
number];\n\n const program = new ReshapePackedProgram(afterShapeAs3D, input3DShape);\n const
preventEagerUnpackingOfOutput = true;\n const output = backend.runWebGLProgram(\n program, [input3D],
input.dtype,
 null /* customSetup */,\n preventEagerUnpackingOfOutput);\n return {dataId: output.dataId, shape: afterShape,
dtype: output.dtype};\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed
under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the
License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n *
Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed
on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or
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implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n==========\n*/\n\nimport {KernelConfig, KernelFunc, Reshape, ReshapeAttrs, ReshapeInputs, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL} from '../backend_webgl';\nimport {packedReshape} from '../kernel_utils/reshape';\nimport {isReshapeFree} from '../webgl_util';\n\nexport function reshape(args: {\n inputs: ReshapeInputs,\n backend: MathBackendWebGL,\n attrs: ReshapeAttrs\n}): TensorInfo {\n const {inputs, backend, attrs} = args;\n const {x} = inputs;\n const {shape} = attrs;\n const webglBackend = backend;\n\n const xSize = util.sizeFromShape(x.shape);\n const $shape = util.inferFromImplicitShape(shape, xSize);\n const $xSize = util.sizeFromShape($shape);\n\n util.assert(\n xSize === $xSize,\n () => `The new shape (${$shape}) has ${$xSize} elements and the old ` +\n `shape (${x.shape}) has ${xSize} elements. The new shape and old ` +\n `shape must have the same number of elements.`);\n\n const xTexData = webglBackend.texData.get(x.dataId);\n if (xTexData.isPacked && !isReshapeFree(x.shape, $shape) &&\n !(xTexData.texture !== null && isReshapeFree(xTexData.shape, $shape))) {\n return packedReshape(x, $shape, webglBackend);\n }\n\n webglBackend.incRef(x.dataId);\n\n return {dataId: x.dataId, shape: $shape, dtype: x.dtype};\n}\n\nexport const reshapeConfig: KernelConfig = {\n kernelName: Reshape,\n backendName: 'webgl',\n kernelFunc: reshape as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n==========\n */\n\nimport {backend_util, util} from '@tensorflow/tfjs-core';\nimport {GPGPUProgram} from './gpgpu_math';\n\nexport class MeanProgram implements GPGPUProgram {\n variableNames = ['x'];\n outputShape: number[];\n userCode: string;\n\n constructor(reduceInfo: backend_util.ReduceInfo, divisor?: number) {\n const {windowSize, batchSize, inSize, outSize} = reduceInfo;\n this.outputShape = [batchSize, outSize];\n\n const windowSizeNearestVec4 = Math.floor(windowSize / 4) * 4;\n const windowSizeVec4Remainder = windowSize % 4;\n\n let updateSnippet = `sumValue += dot(values, ones);`;\n if (divisor != null) {\n const denominator = 1 / divisor;\n updateSnippet = `sumValue += dot(values * ${\n util.isInt(denominator) ? denominator.toPrecision(2) :\n denominator}, ones);`;\n }\n\n let checkOutOfBounds = '';\n if (inSize % windowSize > 0) {\n checkOutOfBounds = `\n if (inIdx < 0 || inIdx >= ${inSize}) {\n return 0.0;\n }\n `;\n }\n\n this.userCode = `\n const vec4 ones = vec4(1.0, 1.0, 1.0, 1.0);\n\n float getValue(int batch, int inIdx) {\n ${checkOutOfBounds}\n return getX(batch, inIdx);\n }\n\n void main() {\n ivec2 coords = getOutputCoords();\n int batch = coords[0];\n int outIdx = coords[1];\n int inOffset = outIdx * ${windowSize};\n\n float sumValue = 0.0;\n\n for (int i = 0; i < ${windowSizeNearestVec4}; i += 4) {\n int inIdx = inOffset + i;\n vec4 values = vec4(\n getValue(batch, inIdx),\n getValue(batch, inIdx + 1),\n getValue(batch, inIdx + 2),\n getValue(batch, inIdx + 3)\n);\n\n ${updateSnippet}\n }\n\n int inIdx = inOffset + ${windowSizeNearestVec4};\n if (${windowSizeVec4Remainder === 1}) {\n vec4 values = vec4(getValue(batch, inIdx), 0.0, 0.0, 0.0);\n\n ${updateSnippet}\n } else if (${windowSizeVec4Remainder === 2}) {\n vec4 values = vec4(\n getValue(batch, inIdx),\n getValue(batch, inIdx + 1), 0.0, 0.0);\n\n ${updateSnippet}\n } else if (${windowSizeVec4Remainder === 3}) {\n vec4 values = vec4(\n getValue(batch, inIdx),\n getValue(batch, inIdx + 1),\n getValue(batch, inIdx + 2), 0.0);\n\n ${updateSnippet}\n }\n setOutput(sumValue);\n }\n `;\n

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==========================================================================\n
*/\n\nimport {backend_util} from '@tensorflow/tfjs-core';\nimport {GPGPUProgram} from
'./gpgpu_math';\n\nexport class ReduceProgram implements GPGPUProgram {\n  variableNames = ['x'];\n
outputShape: number[];\n  userCode: string;\n\n  constructor(\n      reduceInfo: backend_util.ReduceInfo,\n
reduceType: 'all'|'any'|'max'|'min'|'sum'|'prod') {\n    const {windowSize, batchSize, inSize, outSize} = reduceInfo;\n
this.outputShape = [batchSize, outSize];\n\n    let initializationValue = '0.0';\n    let compareOp = ``;\n\n    if
(reduceType === 'prod') {\n      initializationValue = '1.0';\n    } else if (reduceType === 'min') {\n      // WebGL on
Firefox Linux can't compile
 1/0 so we do 1/eps.\n      initializationValue = '1.0 / 1e-20';\n      compareOp = `min`;\n    } else if (reduceType ===
'max') {\n      // WebGL on Firefox Linux can't compile 1/0 so we do 1/eps.\n      initializationValue = '-1.0 / 1e-
20';\n      compareOp = `max`;\n    }\n\n    let returnValue = `${reduceType}(${reduceType}(${reduceType}(` +\n
  'minMaxValue[0], minMaxValue[1]), minMaxValue[2]), minMaxValue[3])';\n\n    if (reduceType === 'sum') {\n
  returnValue = `sumValue`;\n    } else if (reduceType === 'prod') {\n      returnValue = `prodValue`;\n    } else if
(reduceType === 'all') {\n      returnValue = `allValue`;\n    } else if (reduceType === 'any') {\n      returnValue =
`anyValue`;\n    }\n\n    const windowSizeNearestVec4 = Math.floor(windowSize / 4) * 4;\n    const
windowSizeVec4Remainder = windowSize % 4;\n\n    let updateSnippet = `\n      if (${reduceType === 'sum'}) {\n
    sumValue += dot(values, ones);\n      } else if (${reduceType === 'prod'}) {\n
      vec2 tmp = vec2(values[0], values[1]) * vec2(values[2], values[3]);\n        prodValue *= tmp[0] * tmp[1];\n      }
else {\n        minMaxValue = ${compareOp}(values, minMaxValue);\n      }\n    `;\n\n    let vecType = `vec4`;\n\n
if (reduceType === 'all') {\n      initializationValue = '1.0';\n      updateSnippet = `\n        bool reducedAllValue =
all(values);\n        float floatedReducedAllValue = float(reducedAllValue);\n        allValue = float(allValue >= 1.0
&& floatedReducedAllValue >= 1.0);\n      `;\n      vecType = `bvec4`;\n    } else if (reduceType === 'any') {\n
initializationValue = '0.0';\n      updateSnippet = `\n        bool reducedAnyValue = any(values);\n        float
floatedReducedAnyValue = float(reducedAnyValue);\n        anyValue = float(anyValue >= 1.0 ||
floatedReducedAnyValue >= 1.0);\n      `;\n      vecType = `bvec4`;\n    }\n\n    let checkOutOfBounds = '';\n    if
(inSize % windowSize > 0) {\n      checkOutOfBounds = `\n        if (inIdx < 0
 || inIdx >= ${inSize}) {\n          return initializationValue;\n        }\n      `;\n    }\n    this.userCode = `\n      const
float initializationValue = ${initializationValue};\n      const vec4 ones = vec4(1.0, 1.0, 1.0, 1.0);\n\n      float
getValue(int batch, int inIdx) {\n        ${checkOutOfBounds}\n        return getX(batch, inIdx);\n      }\n\n      void
main() {\n        ivec2 coords = getOutputCoords();\n        int batch = coords[0];\n        int outIdx = coords[1];\n
int inOffset = outIdx * ${windowSize};\n\n        vec4 minMaxValue = vec4(${initializationValue});\n        float
prodValue = 1.0;\n        float sumValue = 0.0;\n        float allValue = 1.0;\n        float anyValue = 0.0;\n\n        for
(int i = 0; i < ${windowSizeNearestVec4}; i += 4) {\n          int inIdx = inOffset + i;\n          ${vecType} values =
${vecType}(\n            getValue(batch, inIdx),\n            getValue(batch, inIdx + 1),\n            getValue(batch, inIdx +
2),\n            getValue(batch,
 inIdx + 3)\n          );\n\n          ${updateSnippet}\n        }\n\n        int inIdx = inOffset +
${windowSizeNearestVec4};\n        if (${windowSizeVec4Remainder === 1}) {\n          ${vecType} values =
${vecType}(\n            getValue(batch, inIdx),\n            initializationValue,\n            initializationValue,\n
initializationValue\n          );\n\n          ${updateSnippet}\n        } else if (${windowSizeVec4Remainder === 2}) {\n
      ${vecType} values = ${vecType}(\n            getValue(batch, inIdx),\n            getValue(batch, inIdx + 1),\n
initializationValue,\n            initializationValue\n          );\n\n          ${updateSnippet}\n        } else if
```

(${windowSizeVec4Remainder === 3}) {\n ${vecType} values = ${vecType}(\n getValue(batch, inIdx),\n getValue(batch, inIdx + 1),\n getValue(batch, inIdx + 2),\n initializationValue\n);\n\n ${updateSnippet}\n }\n setOutput(${returnValue});\n }\n `;\n }\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {backend_util, DataType, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL} from '../backend_webgl';\nimport {MeanProgram} from '../mean_gpu';\nimport {ReduceProgram} from '../reduce_gpu';\n\ntype ReduceTypes = 'all'|'any'|'max'|'min'|'sum'|'prod'|'mean';\n\n// Returns an array of configuration objects that describe each stage of the\n// reduction.\nfunction getReductionStages(inShape: number[]):\n Array<{inSize: number, windowSize: number, outSize: number}> {\n const stages = [];\n\n while (stages.length === 0 || stages[stages.length - 1].outSize !== 1) {\n const outSize: number =\n stages.length ? stages[stages.length - 1].outSize : inShape[1];\n const windowSize = backend_util.computeOptimalWindowSize(outSize);\n stages.push({\n inSize: outSize,\n windowSize,\n outSize: Math.ceil(outSize / windowSize)\n });\n }\n\n return stages;\n}\n\nexport function reduce(\n x: TensorInfo, dtype: DataType, reductionType: ReduceTypes,\n backend: MathBackendWebGL): TensorInfo {\n const reductionStages = getReductionStages(x.shape);\n\n let result = x;\n for (let i = 0; i < reductionStages.length; i++) {\n const {inSize, windowSize, outSize} = reductionStages[i];\n\n let program: ReduceProgram|MeanProgram;\n let previousResult: TensorInfo;\n if (reductionType === 'mean') {\n program = i === 0 ?\n new MeanProgram(\n {windowSize, inSize, batchSize: x.shape[0], outSize}, inSize) :\n new MeanProgram({windowSize, inSize, batchSize: x.shape[0], outSize});\n } else {\n program = new ReduceProgram(\n {windowSize, inSize, batchSize: x.shape[0], outSize}, reductionType);\n }\n\n previousResult = result;\n result = backend.runWebGLProgram(program, [result], dtype);\n\n if (previousResult.dataId !== x.dataId) {\n backend.disposeIntermediateTensorInfo(previousResult);\n }\n }\n\n return result;\n}\n","/**\n * @license\n * Copyright 2017 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {GPGPUProgram} from './gpgpu_math';\nimport {getCoordsDataType} from './shader_compiler';\n\nexport class TransposeProgram implements GPGPUProgram {\n variableNames = ['A'];\n outputShape: number[];\n userCode: string;\n rank: number;\n\n constructor(aShape: number[], newDim: number[]) {\n const outputShape: number[] = new Array(aShape.length);\n for (let i = 0; i < outputShape.length; i++) {\n outputShape[i] = aShape[newDim[i]];\n }\n this.outputShape = outputShape;\n this.rank = outputShape.length;\n const dtype = getCoordsDataType(this.rank);\n const switched = getSwitchedCoords(newDim);\n\n this.userCode = `\n void main() {\n ${dtype} resRC = getOutputCoords();\n setOutput(getA(${switched}));\n }\n `;\n }\n}\n\nfunction getSwitchedCoords(newDim: number[]): string {\n const rank = newDim.length;\n if (rank > 6) {\n throw Error(`Transpose for rank ${rank} is not yet supported`);\n }\n const originalOrder =\n ['resRC.x', 'resRC.y',

'resRC.z', 'resRC.w', 'resRC.u', 'resRC.v'];\n const switchedCoords = new Array(rank);\n for (let i = 0; i < newDim.length; i++) {\n   switchedCoords[newDim[i]] = originalOrder[i];\n }\n return switchedCoords.join();\n}\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n *
http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {GPGPUProgram} from './gpgpu_math';\nimport {getVecChannels} from './packing_util';\nimport {getCoordsDataType} from './shader_compiler';\n\nexport class TransposePackedProgram implements GPGPUProgram {\n variableNames = ['A'];\n outputShape: number[];\n userCode: string;\n rank: number;\n packedInputs = true;\n packedOutput = true;\n\n constructor(aShape: number[], newDim: number[]) {\n   const outputShape: number[] = new Array(aShape.length);\n   for (let i = 0; i < outputShape.length; i++) {\n   outputShape[i]
= aShape[newDim[i]];\n   }\n   this.outputShape = outputShape;\n   this.rank = outputShape.length;\n   if (this.rank > 6) {\n   throw Error(\n   `Packed transpose for rank ${this.rank} is not yet supported.`);\n   }\n   const dtype = getCoordsDataType(this.rank);\n\n   const outputOrder = getVecChannels('rc', this.rank);\n   const switchedOrder = new Array(this.rank);\n   for (let i = 0; i < newDim.length; i++) {\n   switchedOrder[newDim[i]] = outputOrder[i];\n   }\n   const innerDims = `vec2(${switchedOrder.slice(-2).join()})`;\n   const nextColumn =\n   `++${outputOrder[this.rank - 1]} < ${outputShape[this.rank - 1]}`;\n   const getc = `getChannel(getA(${switchedOrder.join()}), ${innerDims})`;\n\n   this.userCode = `\n   void main() {\n ${dtype} rc = getOutputCoords();\n   vec4 result = vec4(0.);\n   result[0] = ${getc};\n   if(${nextColumn}) {\n   result[1] = ${getc};\n   }\n   --${outputOrder[this.rank - 1]};\n   if(++${outputOrder[this.rank - 2]} < ${outputShape[this.rank - 2]}) {\n   result[2] = ${getc};\n   if(${nextColumn}) {\n   result[3] = ${getc};\n   }\n   }\n   setOutput(result);\n   }\n   `;\n }\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n *
http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {backend_util, sumOutType, TensorInfo,
util} from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL} from '../backend_webgl';\nimport {reduce} from '../kernel_utils/reduce';\nimport {reshape} from './Reshape';\n\nimport {transposeImpl} from './Transpose_impl';\n\nexport function sumImpl(\n   x: TensorInfo, axis: number|number[], keepDims: boolean,\n backend: MathBackendWebGL): TensorInfo {\n const reductionIndices = axis;\n\n const xRank = x.shape.length;\n\n const origAxes = util.parseAxisParam(reductionIndices, x.shape);\n let axes = origAxes;\n const permutedAxes = backend_util.getAxesPermutation(axes, xRank);\n const sumInputIsTransposed = permutedAxes != null;\n\n let sumInput = x;\n if (sumInputIsTransposed) {\n   sumInput = transposeImpl(x, permutedAxes, backend);\n\n   axes = backend_util.getInnerMostAxes(axes.length, xRank);\n }\n\n backend_util.assertAxesAreInnerMostDims('sum', axes, xRank);\n const [sumOutShape, reduceShape] =\n backend_util.computeOutAndReduceShapes(sumInput.shape, axes);\n\n
  let outShape = sumOutShape;\n if (keepDims) {\n   // rather than reshape at the end, set the target shape here.\n outShape = backend_util.expandShapeToKeepDim(sumOutShape, origAxes);\n }\n\n const inSize = util.sizeFromShape(reduceShape);\n const xSize = util.sizeFromShape(x.shape);\n const batchSize = xSize /

inSize;\n const reshapedInput = reshape(\n   {inputs: {x: sumInput}, attrs: {shape: [batchSize, inSize]}, backend});\n\n const outType = sumOutType(x.dtype);\n\n const reduced = reduce(reshapedInput, outType, 'sum', backend);\n const out =\n   reshape({inputs: {x: reduced}, attrs: {shape: outShape}, backend});\n\n backend.disposeIntermediateTensorInfo(reshapedInput);\n backend.disposeIntermediateTensorInfo(reduced);\n if (sumInputIsTransposed) {\n   backend.disposeIntermediateTensorInfo(sumInput);\n }\n\n return out;\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the
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==========\n
*/\n\nimport {KernelConfig, KernelFunc, Sum, SumAttrs, SumInputs} from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL} from '../backend_webgl';\n\nimport {sumImpl} from './Sum_impl';\n\nexport function sum(\n   args: {inputs: SumInputs, attrs: SumAttrs, backend: MathBackendWebGL}) {\n const {inputs, backend, attrs} = args;\n\n const {x} = inputs;\n const {axis, keepDims} = attrs;\n\n return sumImpl(x,
 axis, keepDims, backend);\n}\n\nexport const sumConfig: KernelConfig = {\n kernelName: Sum,\n backendName: 'webgl',\n kernelFunc: sum as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n
*/\n\nimport {backend_util, TensorInfo, upcastType, util} from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL}
 from '../backend_webgl';\nimport {mapActivationToShaderProgram} from '../kernel_utils/kernel_funcs_utils';\nimport {MatMulPackedProgram} from '../mulmat_packed_gpu';\n\nimport {multiply} from './Multiply';\nimport {reshape} from './Reshape';\nimport {sum} from './Sum';\nimport {transpose} from './Transpose';\n\n// Empirically determined minimal shared dimension in matmul before we forward\n// to a.mul(b).sum() in order to take advantage of GPU parallelism. See\n// https://github.com/tensorflow/tfjs-core/pull/1379 for benchmarks.\nexport const MATMUL_SHARED_DIM_THRESHOLD = 1000;\n\ntype BatchMatMulConfig = {\n a: TensorInfo,\n b: TensorInfo,\n transposeA: boolean,\n transposeB: boolean,\n backend: MathBackendWebGL,\n bias?: TensorInfo,\n preluActivationWeights?: TensorInfo,\n leakyreluAlpha?: number,\n activation?: backend_util.Activation\n};\n\nexport function batchMatMulImpl({\n a,\n b,\n transposeA,\n transposeB,\n backend,\n bias = null,\n preluActivationWeights
 = null,\n leakyreluAlpha = 0,\n activation = null\n}: BatchMatMulConfig): TensorInfo {\n const aRank = a.shape.length;\n const bRank = b.shape.length;\n\n const innerShapeA = transposeA ? a.shape[aRank - 2] : a.shape[aRank - 1];\n const innerShapeB = transposeB ? b.shape[bRank - 1] : b.shape[bRank - 2];\n\n const outerShapeA = transposeA ? a.shape[aRank - 1] : a.shape[aRank - 2];\n const outerShapeB = transposeB ? b.shape[bRank - 2] : b.shape[bRank - 1];\n\n const outerDimsA = a.shape.slice(0, -2);\n const outerDimsB = b.shape.slice(0, -2);\n\n const batchDimA = util.sizeFromShape(outerDimsA);\n const batchDimB = util.sizeFromShape(outerDimsB);\n\n const batchDimsCompatible =\n   batchDimA === batchDimB || batchDimA === 1 || batchDimB === 1;\n\n util.assert(\n   aRank >= 2 && bRank >= 2 && batchDimsCompatible,\n   () => `Error in matMul: the input batch dimensions must either be the ` +\n   `same or at least one input batch dimension must be 1. Got

```
input ` +\n `batch dimensions of (${outerDimsA}) and (${outerDimsB}).`);\n\n const outShapeOuterDims =\n batchDimA > batchDimB ? a.shape.slice(0, -2) : b.shape.slice(0, -2);\n const outShape = outShapeOuterDims.concat([outerShapeA, outerShapeB]);\n\n util.assert(\n innerShapeA === innerShapeB,\n () => `Error in matMul: inner shapes (${innerShapeA}) and (` +\n `${innerShapeB}) of Tensors with shapes ${a.shape} and ` +\n `${b.shape} and transposeA=${transposeA}` +\n ` and transposeB=${transposeB} must match.`);\n\n const a3dShape: [number, number, number] = transposeA ?\n [batchDimA, innerShapeA, outerShapeA] :\n [batchDimA, outerShapeA, innerShapeA];\n const b3dShape: [number, number, number] = transposeB ?\n [batchDimB, outerShapeB, innerShapeB] :\n [batchDimB, innerShapeB, outerShapeB];\n\n // The rest of the implementation is designed to operate on rank-3 tensors\n const a3d = reshape({inputs: {x: a}, backend,
 attrs: {shape: a3dShape}});\n const b3d = reshape({inputs: {x: b}, backend, attrs: {shape: b3dShape}});\n\n const intermediates: TensorInfo[] = [a3d, b3d];\n\n const batchDim = Math.max(batchDimA, batchDimB);\n const sharedDim = transposeA ? a3d.shape[1] : a3d.shape[2];\n\n const hasBias = bias != null;\n const hasPreluActivationWeights = preluActivationWeights != null;\n const hasLeakyreluAlpha = activation === 'leakyrelu';\n const fusedActivation = activation != null ?\n mapActivationToShaderProgram(activation, true) :\n null;\n const containsFusedOps = hasBias || hasPreluActivationWeights ||\n hasLeakyreluAlpha || fusedActivation != null;\n let out: TensorInfo;\n\n // Since the matrices are vectors, it is faster to call mul().sum()\n // because sum() is O(sqrt(N)) due to divide-and-conquer.\n if ((outerShapeA === 1 || outerShapeB === 1) &&\n sharedDim > MATMUL_SHARED_DIM_THRESHOLD && containsFusedOps === false) {\n let aVec = a3d;\n let bVec
 = b3d;\n if (transposeA) {\n aVec = transpose({inputs: {x: a3d}, backend, attrs: {perm: [0, 2, 1]}});\n intermediates.push(aVec);\n }\n if (transposeB) {\n bVec = transpose({inputs: {x: b3d}, backend, attrs: {perm: [0, 2, 1]}});\n intermediates.push(bVec);\n }\n\n const shouldReshapeA = outerShapeB !== 1;\n const shouldReshapeB = outerShapeB === 1;\n\n let aVec3d = aVec;\n if (shouldReshapeA) {\n aVec3d = reshape({\n inputs: {x: aVec},\n backend,\n attrs: {shape: [batchDim, sharedDim, 1]}\n });\n\n intermediates.push(aVec3d);\n }\n\n const axis = outerShapeB === 1 ? 2 : 1;\n\n let bVec3d = bVec;\n if (shouldReshapeB) {\n bVec3d = reshape({\n inputs: {x: bVec},\n backend,\n attrs: {shape: [batchDim, 1, sharedDim]}\n });\n\n intermediates.push(bVec3d);\n }\n\n const product = multiply({inputs: {a: aVec3d, b: bVec3d}, backend});\n out = sum({inputs: {x:
 product}, backend, attrs: {axis, keepDims: true}});\n intermediates.push(product);\n } else {\n const dtype = upcastType(a.dtype, b.dtype);\n\n const program = new MatMulPackedProgram(\n a3dShape, b3dShape, [batchDim, outerShapeA, outerShapeB], transposeA,\n transposeB, hasBias, fusedActivation, hasPreluActivationWeights,\n hasLeakyreluAlpha);\n\n const inputs: TensorInfo[] = [a3d, b3d];\n if (bias != null) {\n inputs.push(bias);\n }\n if (hasPreluActivationWeights) {\n inputs.push(preluActivationWeights);\n }\n if (hasLeakyreluAlpha) {\n const $leakyreluAlpha = backend.makeTensorInfo(\n [], 'float32',\n util.createScalarValue(leakyreluAlpha as {} as 'float32', 'float32'));\n inputs.push($leakyreluAlpha);\n intermediates.push($leakyreluAlpha);\n }\n\n out = backend.runWebGLProgram(program, inputs, dtype);\n }\n\n const outReshaped =\n reshape({inputs: {x: out}, backend, attrs: {shape:
 outShape}});\n intermediates.push(out);\n for (const i of intermediates) {\n backend.disposeIntermediateTensorInfo(i);\n }\n return outReshaped;\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the License);\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n *
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 ==========================================================================\n
```

*/\n\nimport {_FusedMatMul, _FusedMatMulAttrs, _FusedMatMulInputs, KernelConfig, KernelFunc} from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL} from '../backend_webgl';\nimport {batchMatMulImpl} from './BatchMatMul_impl';\n\nexport function _fusedMatMul(args: {\n inputs: _FusedMatMulInputs,\n attrs: _FusedMatMulAttrs,\n backend: MathBackendWebGL\n}) {\n const {inputs, backend, attrs} = args;\n const {a, b, bias, preluActivationWeights} = inputs;\n const {transposeA, transposeB, activation, leakyreluAlpha} = attrs;\n\n return batchMatMulImpl({\n   a,\n   b,\n   transposeA,\n   transposeB,\n   backend,\n   bias,\n   preluActivationWeights,\n   leakyreluAlpha,\n   activation\n });\n}\n\nexport const _fusedMatMulConfig: KernelConfig = {\n kernelName: _FusedMatMul,\n backendName: 'webgl',\n kernelFunc: _fusedMatMul as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n * ==\n */\n\nimport {Acos, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {unaryKernelFunc} from '../kernel_utils/kernel_funcs_utils';\nimport {CHECK_NAN_SNIPPET} from '../unaryop_gpu';\n\nconst ACOS = CHECK_NAN_SNIPPET + `\n  if (abs(x) > 1.) {\n    return NAN;\n  }\n  return acos(x);\n`;\n\nexport const acos = unaryKernelFunc({opSnippet: ACOS});\n\nexport const acosConfig: KernelConfig = {\n kernelName: Acos,\n backendName: 'webgl',\n kernelFunc: acos,\n};\n","\n/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n * ==\n */\n\nimport {Acosh, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {unaryKernelFunc} from '../kernel_utils/kernel_funcs_utils';\nimport {CHECK_NAN_SNIPPET} from '../unaryop_gpu';\n\nconst ACOSH = CHECK_NAN_SNIPPET + `\n  if (x < 1.0) return NAN;\nreturn log(x + sqrt(x * x - 1.0));`;\n\nexport const acosh = unaryKernelFunc({opSnippet: ACOSH});\n\nexport const acoshConfig: KernelConfig = {\n kernelName: Acosh,\n backendName: 'webgl',\n kernelFunc: acosh,\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n * ==\n */\n\nimport {GPGPUProgram} from './gpgpu_math';\n\nexport class AddNProgram implements GPGPUProgram {\n variableNames: string[];\n outputShape: number[] = [];\n userCode: string;\n\n constructor(outputShape: number[], shapes: number[][]) {\n   this.outputShape = outputShape;\n   this.variableNames = shapes.map((_, i) => `T${i}`);\n\n   const snippets: string[] = [];\n   // Get target elements from every input tensor.\n   this.variableNames.forEach(variable => {\n   snippets.push(`float v${variable} = get${variable}AtOutCoords();`);\n   });\n\n   // Calculate the sum of all

elements.\n const operation = this.variableNames\n .map(variable => {\n return `v${variable}`;\n })\n .join(' + ');\n\n this.userCode = `\n void main() {\n ${snippets.join('\\n ')}\n\n float result = ${operation};\n setOutput(result);\n }\n `;\n }\n}\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n
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==========\n */\n\nimport {GPGPUProgram} from './gpgpu_math';\n\nexport class AddNPackedProgram implements GPGPUProgram {\n variableNames: string[];\n outputShape: number[] = [];\n userCode: string;\n packedInputs = true;\n packedOutput = true;\n\n constructor(outputShape: number[], shapes: number[][]) {\n this.outputShape = outputShape;\n this.variableNames = shapes.map((_, i) => `T${i}`);\n\n const snippets: string[] = [];\n // Get target elements from every input tensor.\n this.variableNames.forEach(variable => {\n snippets.push(`vec4 v${variable} = get${variable}AtOutCoords();`);\n });\n\n // Calculate the sum of all elements.\n const operation = this.variableNames\n .map(variable => {\n return `v${variable}`;\n })\n .join(' + ');\n\n this.userCode = `\n void main() {\n ${snippets.join('\\n ')}\n\n vec4 result = ${operation};\n setOutput(result);\n }\n `;\n }\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing,
software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {AddN, AddNInputs, env, KernelConfig, KernelFunc, TensorInfo, upcastType} from '@tensorflow/tfjs-core';\n\nimport {AddNProgram} from '../addn_gpu';\nimport {AddNPackedProgram} from '../addn_packed_gpu';\nimport {MathBackendWebGL} from '../backend_webgl';\nimport {identity} from './Identity';\n\nexport function addN(args: {inputs: AddNInputs, backend: MathBackendWebGL}):\n TensorInfo {\n const {inputs, backend} = args;\n\n const tensors = inputs;\n if (tensors.length === 1) {\n return identity({inputs: {x: tensors[0]}, backend});\n }\n\n // Limit the number of uploaded textures for optimization.\n if (tensors.length > env().get('WEBGL_MAX_TEXTURES_IN_SHADER'))
{\n const midIndex = Math.floor(tensors.length / 2);\n const leftSide = addN({inputs: tensors.slice(0, midIndex), backend});\n const rightSide = addN({inputs: tensors.slice(midIndex), backend});\n return addN({inputs: [leftSide, rightSide], backend});\n }\n\n const dtype =\n tensors.map(t => t.dtype).reduce((d1, d2) => upcastType(d1, d2));\n const shapes = tensors.map(t => t.shape);\n // We can make sure shapes are identical in op level.\n const usePackedOp = env().getBool('WEBGL_PACK');\n const program = usePackedOp ?\n new AddNPackedProgram(tensors[0].shape, shapes) :\n new AddNProgram(tensors[0].shape, shapes);\n return backend.runWebGLProgram(program, tensors, dtype);\n}\n\nexport const addNConfig: KernelConfig = {\n kernelName: AddN,\n backendName: 'webgl',\n kernelFunc: addN as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License,
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License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {All, AllAttrs, AllInputs, backend_util, KernelConfig, KernelFunc, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL} from '../backend_webgl';\nimport {reduce} from '../kernel_utils/reduce';\n\nimport {reshape} from './Reshape';\nimport {transpose} from './Transpose';\n\nexport function all(\n args: {inputs: AllInputs, backend: MathBackendWebGL, attrs: AllAttrs}):\n TensorInfo {\n const {inputs, backend, attrs} = args;\n const {x} = inputs;\n const {axis, keepDims} = attrs;\n\n const xRank = x.shape.length;\n\n const origAxes = util.parseAxisParam(axis, x.shape);\n let axes = origAxes;\n const permutedAxes = backend_util.getAxesPermutation(axes, xRank);\n let permutedX = x;\n if (permutedAxes != null) {\n permutedX = transpose({inputs: {x}, backend, attrs: {perm: permutedAxes}});\n axes = backend_util.getInnerMostAxes(axes.length, xRank);\n }\n\n backend_util.assertAxesAreInnerMostDims('all', axes, xRank);\n const [outShape, reduceShape] =\n backend_util.computeOutAndReduceShapes(permutedX.shape, axes);\n const inSize = util.sizeFromShape(reduceShape);\n\n const a2D =\n reshape({inputs: {x: permutedX}, backend, attrs: {shape: [-1, inSize]}});\n const reduced = reduce(a2D, a2D.dtype, 'all', backend);\n\n let res;\n if (keepDims) {\n const newShape = backend_util.expandShapeToKeepDim(outShape, origAxes);\n res = reshape({inputs: {x: reduced}, backend, attrs: {shape: newShape}});\n } else {\n res = reshape({inputs: {x: reduced}, backend, attrs: {shape: outShape}});\n }\n\n backend.disposeIntermediateTensorInfo(a2D);\n backend.disposeIntermediateTensorInfo(reduced);\n\n if (permutedAxes != null) {\n backend.disposeIntermediateTensorInfo(permutedX);\n }\n\n return res;\n}\n\nexport const allConfig: KernelConfig = {\n kernelName: All,\n backendName: 'webgl',\n kernelFunc: all as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {Any, AnyAttrs, AnyInputs, backend_util, KernelConfig, KernelFunc, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL} from '../backend_webgl';\nimport {reduce} from '../kernel_utils/reduce';\nimport {reshape} from './Reshape';\nimport {transpose} from './Transpose';\n\nexport function any(\n args: {inputs: AnyInputs, backend: MathBackendWebGL, attrs: AnyAttrs}):\n TensorInfo {\n const {inputs, backend, attrs} = args;\n const {x} = inputs;\n const {axis, keepDims} = attrs;\n\n const xRank = x.shape.length;\n\n const origAxes = util.parseAxisParam(axis, x.shape);\n let axes = origAxes;\n const permutedAxes = backend_util.getAxesPermutation(axes, xRank);\n let permutedX = x;\n if (permutedAxes != null) {\n permutedX = transpose({inputs: {x}, backend, attrs: {perm: permutedAxes}});\n axes = backend_util.getInnerMostAxes(axes.length, xRank);\n }\n\n backend_util.assertAxesAreInnerMostDims('any', axes, xRank);\n const [outShape, reduceShape] =\n backend_util.computeOutAndReduceShapes(permutedX.shape, axes);\n const inSize = util.sizeFromShape(reduceShape);\n\n const a2D =\n reshape({inputs: {x: permutedX}, backend, attrs: {shape: [-1, inSize]}});\n const reduced = reduce(a2D, a2D.dtype, 'any', backend);\n\n let res;\n if (keepDims) {\n const newShape = backend_util.expandShapeToKeepDim(outShape, origAxes);\n res = reshape({inputs: {x: reduced}, backend, attrs: {shape: newShape}});\n } else {\n res = reshape({inputs: {x: reduced}, backend, attrs: {shape: outShape}});\n }\n\n backend.disposeIntermediateTensorInfo(a2D);\n backend.disposeIntermediateTensorInfo(reduced);\n\n if (permutedAxes != null) {\n backend.disposeIntermediateTensorInfo(permutedX);\n

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}\n\n  return res;\n}\n\nexport const anyConfig: KernelConfig = {\n  kernelName: Any,\n  backendName: 'webgl',\n  kernelFunc: any as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2017 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========================================================================\n
*/\n\nimport {backend_util} from '@tensorflow/tfjs-core';\nimport {GPGPUProgram} from
'./gpgpu_math';\n\nexport
 class ArgMinMaxProgram implements GPGPUProgram {\n  variableNames = ['A'];\n  outputShape: number[];\n
userCode: string;\n\n  constructor(\n      reduceInfo: backend_util.ReduceInfo, op: 'max'|'min',\n      firstPass:
boolean) {\n    const {windowSize, batchSize, outSize} = reduceInfo;\n    if (!firstPass) {\n
this.variableNames.push('bestIndicesA');\n    }\n    this.outputShape = [batchSize, outSize];\n    const compOp = (op
=== 'max') ? '>' : '<';\n    const indexSnippet = firstPass ?\n        'inOffset + i;' :\n        'round(getBestIndicesA(batch,
inOffset + i));';\n\n    this.userCode = `\n      void main() {\n        ivec2 coords = getOutputCoords();\n        int batch
= coords[0];\n        int outIdx = coords[1];\n        int inOffset = outIdx * ${windowSize};\n\n        int bestIndex =
inOffset;\n        float bestValue = getA(batch, bestIndex);\n\n        for (int i = 0; i < ${windowSize}; i++) {\n
int inIdx = ${indexSnippet};\n
 float candidate = getA(batch, inIdx);\n          if (candidate ${compOp} bestValue) {\n            bestValue =
candidate;\n            bestIndex = inIdx;\n          }\n        }\n        setOutput(float(bestIndex));\n      }\n    `;\n
}\n}\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache
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==========================================================================\n
*/\n\nimport {util} from '@tensorflow/tfjs-core';\n\nimport
 {GPGPUProgram} from './gpgpu_math';\nimport {getChannels} from './packing_util';\nimport
{getCoordsDataType} from './shader_compiler';\n\nexport class ArgMinMaxPackedProgram implements
GPGPUProgram {\n  variableNames = ['A'];\n  outputShape: number[];\n  userCode: string;\n  packedInputs =
true;\n  packedOutput = true;\n\n  constructor(\n      shape: number[], windowSize: number, op: 'max'|'min',\n
firstPass: boolean) {\n    util.assert(\n        shape.length > 2,\n        () => `Packed arg${\n
op.charAt(0).toUpperCase() +\n            op.slice(1)} supports only inputs with rank above 2.`);\n    const inSize =
shape[shape.length - 1];\n    const outSize = Math.ceil(inSize / windowSize);\n    this.outputShape = shape.slice(0, -
1);\n    if (outSize > 1) {\n      this.outputShape.push(outSize);\n    }\n    if (!firstPass) {\n
this.variableNames.push('bestIndicesA');\n    }\n    const outShape = this.outputShape;\n    const rank =
outShape.length;\n
    const dtype = getCoordsDataType(rank);\n    const coords = getChannels('coords', rank);\n\n    let
sourceLocSetup;\n    let sourceRank;\n    if (outSize === 1) {\n      sourceRank = rank + 1;\n      const
sourceLocDType = getCoordsDataType(sourceRank);\n      sourceLocSetup = `\n        ${sourceLocDType}
sourceLocR = ${sourceLocDType}(${coords.join()}, 0);\n        ++${coords[rank - 1]};\n        ${sourceLocDType}
sourceLocG = ${sourceLocDType}(${coords.join()}, 0);\n        ++${coords[rank - 2]};\n        ${sourceLocDType}
sourceLocA = ${sourceLocDType}(${coords.join()}, 0);\n        --${coords[rank - 1]};\n        ${sourceLocDType}
sourceLocB = ${sourceLocDType}(${coords.join()}, 0);\n        --${coords[rank - 2]};`;\n    } else {\n
sourceRank = rank;\n      sourceLocSetup = `\n        ${dtype} sourceLocR = coords;\n        ++${coords[rank - 1]};\n
```

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    ${dtype} sourceLocG = coords;\n        ++${coords[rank - 2]};\n        ${dtype} sourceLocA = coords;\n        --${coords[rank
 - 1]};\n        ${dtype} sourceLocB = coords;\n        --${coords[rank - 2]};`;\n    }\n    const channels = ['x', 'y', 'z',
'w', 'u', 'v'].slice(0, sourceRank);\n    const inChannel = '.' + channels[sourceRank - 1];  // e.g. \".b\" for rank 3.\n
const intChannels = channels.map(x => 'int ' + x);\n    const srcRCoords =\n        getChannels('sourceLocR',
sourceRank - 1).concat('inIdx.r');\n    const srcGCoords =\n        getChannels('sourceLocG', sourceRank -
1).concat('inIdx.g');\n    const srcBCoords =\n        getChannels('sourceLocB', sourceRank - 1).concat('inIdx.b');\n
const srcACoords =\n        getChannels('sourceLocA', sourceRank - 1).concat('inIdx.a');\n\n    const compOp = (op
=== 'max') ? 'greaterThan' : 'lessThan';\n    const fetchCandidateIdx = firstPass ? '' : `\n          inIdx =
round(vec4(getBestIndicesAChannel(${srcRCoords.join()}),\n
getBestIndicesAChannel(${srcGCoords.join()}),\n
getBestIndicesAChannel(${srcBCoords.join()}),\n
                    getBestIndicesAChannel(${srcACoords.join()})));`;\n\n    const fetchValue = `vec4(\n
getAChannel(${srcRCoords.join()}),\n            hasNextCol ? getAChannel(${srcGCoords.join()}) : 0.,\n
hasNextRow ? getAChannel(${srcBCoords.join()}) : 0.,\n            hasNextRow && hasNextCol ?
getAChannel(${srcACoords.join()}) : 0.)`;\n\n    const getBestIndicesAChannelSnippet = firstPass ? '' : `\n      float
getBestIndicesAChannel(${intChannels.join()}) {\n        return getChannel(getBestIndicesA(${channels.join()}),\n
                    vec2(${channels.slice(-2).join()}));\n      }`;\n\n    this.userCode = `\n      float
getAChannel(${intChannels.join()}) {\n        return getChannel(getA(${channels.join()}),\n
vec2(${channels.slice(-2).join()}));\n      }\n      ${getBestIndicesAChannelSnippet}\n      void main() {\n
${dtype} coords = getOutputCoords();\n
      bool hasNextCol = ${coords[rank - 1]} < ${outShape[rank - 1] - 1};\n        bool hasNextRow = ${coords[rank -
2]} < ${outShape[rank - 2] - 1};\n        ${sourceLocSetup}\n        ivec4 srcIdx = ivec4(sourceLocR${inChannel},
sourceLocG${inChannel},\n          sourceLocB${inChannel}, sourceLocA${inChannel}) * ${windowSize};\n
ivec4 inIdx = srcIdx;\n        vec4 bestIndex = vec4(inIdx);\n        vec4 bestValue = ${fetchValue};\n\n        for (int i
= 0; i < ${windowSize}; i++) {\n          inIdx = srcIdx;\n          ${fetchCandidateIdx}\n          vec4 candidate =
${fetchValue};\n          bvec4 nan = isnan(candidate);\n          bvec4 replace = bvec4(\n
vec4(${compOp}(candidate, bestValue)) * (vec4(1.0) - vec4(nan)));\n\n          bestValue = vec4(replace.x  ?
candidate.x : bestValue.x,\n                           replace.y  ? candidate.y : bestValue.y,\n                           replace.z  ?
candidate.z : bestValue.z,\n                           replace.w  ? candidate.w
 : bestValue.w);\n          bestIndex = mix(bestIndex, vec4(inIdx), vec4(replace));\n          srcIdx++;\n        }\n
setOutput(bestIndex);\n      }\n    `;\n  }\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights
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OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language
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==========================================================================\n
*/\n\nimport {backend_util, env, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {ArgMinMaxProgram}
 from '../argminmax_gpu';\nimport {ArgMinMaxPackedProgram} from '../argminmax_packed_gpu';\nimport
{MathBackendWebGL} from '../backend_webgl';\nimport {reshape} from '../kernels/Reshape';\n\nfunction
argReduce(\n    backend: MathBackendWebGL, x: TensorInfo, reduceType: 'max'|'min',\n    bestIndicesA:
TensorInfo = null): TensorInfo {\n  let batchSize = x.shape[0];\n  let inSize = x.shape[1];\n  if (bestIndicesA != null)
{\n    batchSize = bestIndicesA.shape[0];\n    inSize = bestIndicesA.shape[1];\n  }\n  const windowSize =
backend_util.computeOptimalWindowSize(inSize);\n  const reduceInfo =\n      {windowSize, inSize, batchSize,
outSize: Math.ceil(inSize / windowSize)};\n  const program =\n      new ArgMinMaxProgram(reduceInfo,
reduceType, bestIndicesA == null);\n  const inputs = [x];\n  if (bestIndicesA != null) {\n
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inputs.push(bestIndicesA);\n }\n const output = backend.runWebGLProgram(program, inputs, 'int32');\n // No need to run another GPGPU program.\n if (output.shape[1] === 1) {\n   return output;\n }\n const result = argReduce(backend, x, reduceType, output);\n backend.disposeIntermediateTensorInfo(output);\n return result;\n}\n\nfunction argReducePacked(\n   backend: MathBackendWebGL, x: TensorInfo, reduceType: 'max'|'min',\n   bestIndicesA: TensorInfo = null): TensorInfo {\n const inShape = bestIndicesA != null ? bestIndicesA.shape : x.shape;\n const inSize = inShape[inShape.length - 1];\n const windowSize = backend_util.computeOptimalWindowSize(inSize);\n const program = new ArgMinMaxPackedProgram(\n   inShape, windowSize, reduceType, bestIndicesA == null);\n const inputs = bestIndicesA == null ? [x] : [x, bestIndicesA];\n const output = backend.runWebGLProgram(program, inputs, 'int32');\n if (output.shape.length === x.shape.length) {\n   const result = argReducePacked(backend, x, reduceType, output);\n   backend.disposeIntermediateTensorInfo(output);\n   return result;\n }\n return output;\n}\n\nexport function argMinMaxReduce(\n   backend: MathBackendWebGL, x: TensorInfo, axis: number,\n   reduceType: 'min'|'max'): TensorInfo {\n const axes = [axis];\n backend_util.assertAxesAreInnerMostDims(\n   'arg' + reduceType.charAt(0).toUpperCase() + reduceType.slice(1), axes,\n   x.shape.length);\n if (!env().getBool('WEBGL_PACK_REDUCE') || x.shape.length <= 2) {\n   const intermediateTensorInfos = [];\n const [outShape, reduceShape] =\n   backend_util.computeOutAndReduceShapes(x.shape, axes);\n   const inSize = util.sizeFromShape(reduceShape);\n   const a2D = reshape({inputs: {x}, backend, attrs: {shape: [-1, inSize]}});\n intermediateTensorInfos.push(a2D);\n\n   const reduced = argReduce(backend, a2D, reduceType);\n intermediateTensorInfos.push(reduced);\n   const reshaped =\n   reshape({inputs: {x: reduced}, backend, attrs: {shape: outShape}});\n\n   intermediateTensorInfos.forEach(\n   t => backend.disposeIntermediateTensorInfo(t));\n   return reshaped;\n }\n return argReducePacked(backend, x, reduceType);\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {ArgMax, ArgMaxAttrs, ArgMaxInputs, backend_util, KernelConfig, KernelFunc, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL} from '../backend_webgl';\nimport {argMinMaxReduce} from '../kernel_utils/arg_min_max';\n\nimport {transpose} from './Transpose';\n\nexport function argMax(\n   args:\n {inputs: ArgMaxInputs, backend: MathBackendWebGL, attrs: ArgMaxAttrs}):\n   TensorInfo {\n const {inputs, backend, attrs} = args;\n const {x} = inputs;\n const {axis} = attrs;\n\n let axes = util.parseAxisParam(axis, x.shape);\n const permutedAxes = backend_util.getAxesPermutation(axes, x.shape.length);\n let $x = x;\n const intermediateTensorInfos = [];\n if (permutedAxes != null) {\n $x = transpose({inputs: {x}, backend, attrs: {perm: permutedAxes}});\n   intermediateTensorInfos.push($x);\n   axes = backend_util.getInnerMostAxes(axes.length, $x.shape.length);\n }\n\n backend_util.assertAxesAreInnerMostDims('argMax', [axes[0]], $x.shape.length);\n const out = argMinMaxReduce(backend, $x, axes[0], 'max');\n\n intermediateTensorInfos.forEach(\n   t => backend.disposeIntermediateTensorInfo(t));\n return out;\n}\n\nexport const argMaxConfig: KernelConfig = {\n kernelName: ArgMax,\n backendName: 'webgl',\n kernelFunc: argMax as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for

the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {ArgMin, ArgMinAttrs, ArgMinInputs, backend_util, KernelConfig, KernelFunc, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL} from '../backend_webgl';\nimport {argMinMaxReduce} from '../kernel_utils/arg_min_max';\nimport {transpose} from './Transpose';\n\nexport function argMin(\n args:\n {inputs: ArgMinInputs, backend: MathBackendWebGL, attrs: ArgMinAttrs}):\n TensorInfo {\n const {inputs, backend, attrs} = args;\n const {x} = inputs;\n const {axis} = attrs;\n\n let axes = util.parseAxisParam(axis, x.shape);\n const permutedAxes = backend_util.getAxesPermutation(axes, x.shape.length);\n let $x = x;\n const intermediateTensorInfos = [];\n if (permutedAxes != null) {\n $x = transpose({inputs: {x}, backend, attrs: {perm: permutedAxes}});\n intermediateTensorInfos.push($x);\n axes = backend_util.getInnerMostAxes(axes.length, $x.shape.length);\n }\n\n backend_util.assertAxesAreInnerMostDims('argMin', [axes[0]], $x.shape.length);\n\n const out = argMinMaxReduce(backend, $x, axes[0], 'min');\n\n intermediateTensorInfos.forEach(\n t => backend.disposeIntermediateTensorInfo(t));\n return out;\n}\n\nexport const argMinConfig: KernelConfig = {\n kernelName: ArgMin,\n backendName: 'webgl',\n kernelFunc: argMin as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {Asin, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {unaryKernelFunc} from '../kernel_utils/kernel_funcs_utils';\nimport {CHECK_NAN_SNIPPET} from '../unaryop_gpu';\n\nconst ASIN = CHECK_NAN_SNIPPET + `\n if (abs(x) > 1.) {\n return NAN;\n }\n return asin(x);\n`;\n\nexport const asin = unaryKernelFunc({opSnippet: ASIN});\n\nexport const asinConfig: KernelConfig = {\n kernelName: Asin,\n backendName: 'webgl',\n kernelFunc: asin,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {Asinh, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {unaryKernelFunc} from '../kernel_utils/kernel_funcs_utils';\nimport {CHECK_NAN_SNIPPET} from '../unaryop_gpu';\n\nconst ASINH = CHECK_NAN_SNIPPET + `return log(x + sqrt(x * x + 1.0));`;\n\nexport const asinh = unaryKernelFunc({opSnippet: ASINH});\n\nexport const asinhConfig: KernelConfig = {\n kernelName: Asinh,\n backendName: 'webgl',\n kernelFunc: asinh,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS

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==========\n*/\n\nimport {Atan, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {unaryKernelFunc} from '../kernel_utils/kernel_funcs_utils';\nimport {CHECK_NAN_SNIPPET} from '../unaryop_gpu';\n\nconst ATAN = CHECK_NAN_SNIPPET + `\n  return atan(x);\n`;\n\nexport const atan = unaryKernelFunc({opSnippet: ATAN});\n\nexport const atanConfig: KernelConfig = {\n  kernelName: Atan,\n  backendName: 'webgl',\n  kernelFunc: atan,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable
 law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n*/\n\nimport {Atan2} from '@tensorflow/tfjs-core';\nimport {KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {binaryKernelFunc, CHECK_NAN_SNIPPET_BINARY, CHECK_NAN_SNIPPET_BINARY_PACKED} from '../kernel_utils/kernel_funcs_utils';\n\nconst ATAN2 = CHECK_NAN_SNIPPET_BINARY + `\n  return atan(a, b);\n`;\n\nconst ATAN2_PACKED = `\n  vec4 result = atan(a, b);\n  vec4 isNaN = min(vec4(isnan(a)) + vec4(isnan(b)), vec4(1.0));\n  ` +\n  CHECK_NAN_SNIPPET_BINARY_PACKED + `\n  return result;\n`;\n\nexport const atan2 =\n  binaryKernelFunc({opSnippet: ATAN2, packedOpSnippet: ATAN2_PACKED});\n\nexport const atan2Config: KernelConfig = {\n  kernelName: Atan2,\n  backendName: 'webgl',\n  kernelFunc: atan2,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n*/\n\nimport {Atanh, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {unaryKernelFunc} from '../kernel_utils/kernel_funcs_utils';\nimport {CHECK_NAN_SNIPPET} from '../unaryop_gpu';\n\nconst ATANH = CHECK_NAN_SNIPPET + `\n  if ((x < -1.0) || (x > 1.0)) return NAN;\nreturn (log(1.0 + x) - log(1.0 - x)) / 2.0;`;\n\nexport const atanh = unaryKernelFunc({opSnippet: ATANH});\n\nexport const atanhConfig: KernelConfig = {\n  kernelName: Atanh,\n  backendName: 'webgl',\n  kernelFunc: atanh,\n};\n","/**\n * @license\n * Copyright 2017 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {backend_util} from '@tensorflow/tfjs-core';\nimport {GPGPUProgram} from './gpgpu_math';\n\nexport class Pool2DProgram implements GPGPUProgram {\n  variableNames = ['x'];\n  outputShape: number[];\n  userCode: string;\n\n  constructor(\n      convInfo: backend_util.Conv2DInfo, poolType: 'max'|'avg',\n      computePositions: boolean, flattenPositions = false,\n      includeBatchInIndex = false) {\n    if (poolType === 'avg' && computePositions) {\n      throw new Error('Cannot compute positions for average pool.');\n    }\n\n    const filterWidth = convInfo.filterWidth;\n    const strideHeight = convInfo.strideHeight;\n    const strideWidth = convInfo.strideWidth;\n    const dilationHeight = convInfo.dilationHeight;\n    const dilationWidth = convInfo.dilationWidth;\n    const effectiveFilterHeight = convInfo.effectiveFilterHeight;\n    const
```

```
effectiveFilterWidth = convInfo.effectiveFilterWidth;\n\n  const padTop = convInfo.padInfo.top;\n
  const padLeft = convInfo.padInfo.left;\n  this.outputShape = convInfo.outShape;\n\n  const isAvgPool =
poolType === 'avg';\n  const batchFlattenPositionStr = `((batch  * ${convInfo.inHeight} + xR) * ${\n
convInfo.inWidth} + xC) * ${convInfo.inChannels} + d`;\n  const flattenPositionStr =\n      `(xR *
${convInfo.inWidth} + xC) * ${convInfo.inChannels} + d`;\n\n  let initializationValue = '0.0';\n  if (!isAvgPool)
{\n    // WebGL on Firefox Linux can't compile 1/0 so we do 1/eps.\n    initializationValue = '-1.0 / 1e-20';\n
}\n\n  if (computePositions) {\n    const compareOp = '>=';\n\n    this.userCode = `\n      const ivec2 strides =
ivec2(${strideHeight}, ${strideWidth});\n      const ivec2 pads = ivec2(${padTop}, ${padLeft});\n\n      void
main() {\n        ivec4 coords = getOutputCoords();\n        int batch = coords[0];\n        int d = coords[3];\n\n
ivec2 xRCCorner = coords.yz * strides - pads;\n        int xRCorner
 = xRCCorner.x;\n        int xCCorner = xRCCorner.y;\n\n        // max/min x(?, ?, d) to get y(yR, yC, d).\n        // ?
= to be determined\n        float minMaxValue = 0.0;\n        float minMaxValueFound = 0.0;\n        int
minMaxPosition = 0;\n        float avgValue = 0.0;\n\n        for (int wR = 0; wR < ${effectiveFilterHeight};\n
  wR += ${dilationHeight}) {\n          int xR = xRCorner + wR;\n\n          if (xR < 0 || xR >=
${convInfo.inHeight}) {\n            continue;\n          }\n\n          for (int wC = 0; wC < ${effectiveFilterWidth};\n
          wC += ${dilationWidth}) {\n            int xC = xCCorner + wC;\n\n            if (xC < 0 || xC >=
${convInfo.inWidth}) {\n              continue;\n            }\n\n            float value = getX(batch, xR, xC, d);\n\n
  // If a min / max value has already been found, use it. If not,\n            // use the current value.\n            float
currMinMaxValue = mix(\n
                value, minMaxValue, minMaxValueFound);\n            if (value ${compareOp} currMinMaxValue) {\n
        minMaxValue = value;\n              minMaxValueFound = 1.0;\n              minMaxPosition = ${\n
flattenPositions ? (includeBatchInIndex ? batchFlattenPositionStr :\n
flattenPositionStr) :\n                  `wR * ${effectiveFilterWidth} + wC`};\n            }\n          }\n        }\n
  setOutput(float(minMaxPosition));\n      }\n    `;\n    return;\n  }\n\n  const compareOp = 'max';\n\n  let
returnValue = `${poolType}(${poolType}(${poolType}(` +\n      'minMaxValue[0], minMaxValue[1]),
minMaxValue[2]), minMaxValue[3])';\n  if (poolType === 'avg') {\n    returnValue = `avgValue / count`;\n
}\n\n  const filterWidthNearestVec4 = Math.floor(filterWidth / 4) * 4;\n  const filterWidthVec4Remainder =
filterWidth % 4;\n\n  const updateSnippet = `\n
  if (${isAvgPool}) {\n      avgValue += dot(values, ones);\n    } else {\n      minMaxValue =
${compareOp}(values, minMaxValue);\n    }\n  `;\n\n  this.userCode = `\n    const ivec2 strides =
ivec2(${strideHeight}, ${strideWidth});\n    const ivec2 pads = ivec2(${padTop}, ${padLeft});\n    const float
initializationValue = ${initializationValue};\n    const vec4 ones = vec4(1.0, 1.0, 1.0, 1.0);\n\n    float count =
0.0;\n\n    float getValue(int batch, int xR, int xC, int d) {\n      if (xC < 0 || xC >= ${convInfo.inWidth}) {\n
return initializationValue;\n      }\n      count += 1.0;\n      return getX(batch, xR, xC, d);\n    }\n\n    void
main() {\n      ivec4 coords = getOutputCoords();\n      int batch = coords[0];\n      int d = coords[3];\n\n
ivec2 xRCCorner = coords.yz * strides - pads;\n      int xRCorner = xRCCorner.x;\n      int xCCorner =
xRCCorner.y;\n\n      // max/min x(?, ?, d) to get y(yR, yC, d).\n
  // ? = to be determined\n      vec4 minMaxValue = vec4(${initializationValue});\n      float avgValue = 0.0;\n
 count = 0.0;\n\n      for (int wR = 0; wR < ${effectiveFilterHeight};\n          wR += ${dilationHeight}) {\n
int xR = xRCorner + wR;\n\n        if (xR < 0 || xR >= ${convInfo.inHeight}) {\n          continue;\n        }\n\n
for (int wC = 0; wC < ${filterWidthNearestVec4}; wC += 4) {\n          int xC = xCCorner + wC *
${dilationWidth};\n\n          vec4 values = vec4(\n            getValue(batch, xR, xC, d),\n            getValue(batch,
xR, xC + ${dilationWidth}, d),\n            getValue(batch, xR, xC + 2 * ${dilationWidth}, d),\n
getValue(batch, xR, xC + 3 * ${dilationWidth}, d)\n          );\n\n          ${updateSnippet}\n        }\n\n        int xC
= xCCorner + ${filterWidthNearestVec4};\n        if (${filterWidthVec4Remainder === 1}) {\n          vec4 values
= vec4(\n            getValue(batch,
 xR, xC, d),\n            initializationValue,\n            initializationValue,\n            initializationValue\n          );\n\n
        ${updateSnippet}\n        } else if (${filterWidthVec4Remainder === 2}) {\n          vec4 values = vec4(\n
```

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    getValue(batch, xR, xC, d),\n          getValue(batch, xR, xC + ${dilationWidth}, d),\n
initializationValue,\n          initializationValue\n        );\n\n        ${updateSnippet}\n      } else if
(${filterWidthVec4Remainder === 3}) {\n        vec4 values = vec4(\n          getValue(batch, xR, xC, d),\n
  getValue(batch, xR, xC + ${dilationWidth}, d),\n          getValue(batch, xR, xC + 2 * ${dilationWidth}, d),\n
      initializationValue\n        );\n\n        ${updateSnippet}\n      }\n    }\n
setOutput(${returnValue});\n    }\n  `;\n}\n\nexport class Pool3DProgram implements GPGPUProgram {\n
variableNames = ['x'];\n
 outputShape: number[];\n  userCode: string;\n\n  constructor(\n    convInfo: backend_util.Conv3DInfo, poolType:
'max'|'avg',\n    computePositions: boolean, flattenPositions = false,\n    includeBatchInIndex = false) {\n  if
(poolType === 'avg' && computePositions) {\n    throw new Error('Cannot compute positions for average
pool.');\n  }\n\n  const filterWidth = convInfo.filterWidth;\n  const strideDepth = convInfo.strideDepth;\n  const
strideHeight = convInfo.strideHeight;\n  const strideWidth = convInfo.strideWidth;\n  const dilationDepth =
convInfo.dilationDepth;\n  const dilationHeight = convInfo.dilationHeight;\n  const dilationWidth =
convInfo.dilationWidth;\n  const effectiveFilterDepth = convInfo.effectiveFilterDepth;\n  const
effectiveFilterHeight = convInfo.effectiveFilterHeight;\n  const effectiveFilterWidth =
convInfo.effectiveFilterWidth;\n\n  const padFront = convInfo.padInfo.front;\n  const padTop =
convInfo.padInfo.top;\n  const padLeft
 = convInfo.padInfo.left;\n  this.outputShape = convInfo.outShape;\n\n  const isAvgPool = poolType ===
'avg';\n\n  let initializationValue = '0.0';\n  if (!isAvgPool) {\n    // WebGL on Firefox Linux can't compile 1/0 so
we do 1/eps.\n    initializationValue = '-1.0 / 1e-20';\n  }\n\n  if (computePositions) {\n    const compareOp =
'>=';\n\n    this.userCode = `\n      const ivec3 strides =\n          ivec3(${strideDepth}, ${strideHeight},
${strideWidth});\n      const ivec3 pads = ivec3(${padFront}, ${padTop}, ${padLeft});\n\n      void main() {\n
  ivec5 coords = getOutputCoords();\n        int batch = coords.x;\n        int ch = coords.u;\n\n        ivec3 xCorner
= ivec3(coords.y, coords.z, coords.w) * strides - pads;\n        int xDCorner = xCorner.x;\n        int xRCorner =
xCorner.y;\n        int xCCorner = xCorner.z;\n\n        // max/min x(?, ?, ?, ch) to get y(yD, yR, yC, ch).\n        // ?
= to be determined\n        float
 minMaxValue = 0.0;\n        float minMaxValueFound = 0.0;\n        int minMaxPosition = 0;\n\n        for (int wD
= 0; wD < ${effectiveFilterDepth};\n            wD += ${dilationDepth}) {\n          int xD = xDCorner + wD;\n\n
    if (xD < 0 || xD >= ${convInfo.inDepth}) {\n            continue;\n          }\n\n          for (int wR = 0; wR <
${effectiveFilterHeight};\n              wR += ${dilationHeight}) {\n            int xR = xRCorner + wR;\n\n            if
(xR < 0 || xR >= ${convInfo.inHeight}) {\n              continue;\n            }\n\n            for (int wC = 0; wC <
${effectiveFilterWidth};\n                wC += ${dilationWidth}) {\n              int xC = xCCorner + wC;\n\n
if (xC < 0 || xC >= ${convInfo.inWidth}) {\n                continue;\n              }\n\n              float value =
getX(batch, xD, xR, xC, ch);\n\n              // If a min / max value has already been found, use it. If not,\n
      // use the current value.\n              float currMinMaxValue = mix(\n                  value, minMaxValue,
minMaxValueFound);\n              if (value ${compareOp} currMinMaxValue) {\n                minMaxValue =
value;\n                minMaxValueFound = 1.0;\n                minMaxPosition = ${\n        flattenPositions ?\n
(includeBatchInIndex ?\n                `(((batch * ${convInfo.inDepth} + xD) * ${\n
convInfo.inHeight} + xR) * ${convInfo.inWidth} + xC) * ${\n                  convInfo.inChannels} + ch` :\n
    `((xD * ${convInfo.inHeight} + xR) * ${\n                  convInfo.inWidth} + xC) * ${convInfo.inChannels} +
ch`) :\n            `wD * ${effectiveFilterHeight} * ${effectiveFilterWidth} +\n                wR *
${effectiveFilterWidth} + wC`};\n              }\n            }\n          }\n        }\n
setOutput(float(minMaxPosition));\n      }\n    `;\n
  return;\n  }\n\n  const compareOp = 'max';\n\n  let returnValue = `${poolType}(${poolType}(${poolType}(`
+\n        'minMaxValue[0], minMaxValue[1]), minMaxValue[2]), minMaxValue[3])';\n  if (poolType === 'avg')
{\n    returnValue = `avgValue / count`;\n  }\n\n  const filterWidthNearestVec4 = Math.floor(filterWidth / 4) *
4;\n  const filterWidthVec4Remainder = filterWidth % 4;\n\n  const updateSnippet = `\n    if (${isAvgPool}) {\n
    avgValue += dot(values, ones);\n    } else {\n      minMaxValue = ${compareOp}(values, minMaxValue);\n
```

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}\n    `;\n\n    this.userCode = `\n      const ivec3 strides =\n          ivec3(${strideDepth}, ${strideHeight},
${strideWidth});\n      const ivec3 pads = ivec3(${padFront}, ${padTop}, ${padLeft});\n      const float
initializationValue = ${initializationValue};\n      const vec4 ones = vec4(1.0, 1.0, 1.0, 1.0);\n\n      float count =
0.0;\n\n      float getValue(int batch, int xD, int xR, int xC, int ch) {\n        if (xC
< 0 || xC >= ${convInfo.inWidth}) {\n          return initializationValue;\n        }\n        count += 1.0;\n        return
getX(batch, xD, xR, xC, ch);\n      }\n\n      void main() {\n        ivec5 coords = getOutputCoords();\n        int batch =
coords.x;\n        int ch = coords.u;\n\n        ivec3 xCorner = ivec3(coords.y, coords.z, coords.w) * strides - pads;\n
int xDCorner = xCorner.x;\n        int xRCorner = xCorner.y;\n        int xCCorner = xCorner.z;\n\n        // max/min
x(?, ?, ?, d) to get y(yD, yR, yC, ch).\n        // ? = to be determined\n        vec4 minMaxValue =
vec4(${initializationValue});\n        float avgValue = 0.0;\n        count = 0.0;\n\n        for (int wD = 0; wD <
${effectiveFilterDepth};\n            wD += ${dilationDepth}) {\n          int xD = xDCorner + wD;\n\n          if (xD < 0
|| xD >= ${convInfo.inDepth}) {\n            continue;\n          }\n\n          for (int wR = 0; wR <
${effectiveFilterHeight};\n              wR += ${dilationHeight})
{\n            int xR = xRCorner + wR;\n\n            if (xR < 0 || xR >= ${convInfo.inHeight}) {\n              continue;\n
}\n\n            for (int wC = 0; wC < ${filterWidthNearestVec4}; wC += 4) {\n              int xC = xCCorner + wC *
${dilationWidth};\n\n              vec4 values = vec4(\n                getValue(batch, xD, xR, xC, ch),\n
getValue(batch, xD, xR, xC + ${dilationWidth}, ch),\n                getValue(batch, xD, xR, xC + 2 *
${dilationWidth}, ch),\n                getValue(batch, xD, xR, xC + 3 * ${dilationWidth}, ch)\n              );\n\n
${updateSnippet}\n            }\n\n            int xC = xCCorner + ${filterWidthNearestVec4};\n            if
(${filterWidthVec4Remainder === 1}) {\n              vec4 values = vec4(\n                getValue(batch, xD, xR, xC,
ch),\n                initializationValue,\n                initializationValue,\n                initializationValue\n              );\n\n
${updateSnippet}\n
          } else if (${filterWidthVec4Remainder === 2}) {\n              vec4 values = vec4(\n                getValue(batch,
xD, xR, xC, ch),\n                getValue(batch, xD, xR, xC + ${dilationWidth}, ch),\n                initializationValue,\n
initializationValue\n              );\n\n              ${updateSnippet}\n            } else if (${filterWidthVec4Remainder
=== 3}) {\n              vec4 values = vec4(\n                getValue(batch, xD, xR, xC, ch),\n                getValue(batch,
xD, xR, xC + ${dilationWidth}, ch),\n                getValue(batch, xD, xR, xC + 2 * ${dilationWidth}, ch),\n
initializationValue\n              );\n\n              ${updateSnippet}\n            }\n          }\n
setOutput(${returnValue});\n        }\n      }\n    `;\n  }\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All
Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this
file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n *
http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing,
software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES
OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language
governing permissions and\n * limitations under the License.\n *
==========================================================================\n
*/\nimport {AvgPool, AvgPoolAttrs, AvgPoolInputs, backend_util, KernelConfig, KernelFunc, TensorInfo, util}
from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL} from '../backend_webgl';\nimport
{Pool2DProgram} from '../pool_gpu';\nimport {assertNotComplex} from '../webgl_util';\nimport {identity} from
'./Identity';\n\nexport function avgPool(args: {\n  inputs: AvgPoolInputs,\n  backend: MathBackendWebGL,\n  attrs:
AvgPoolAttrs\n}): TensorInfo
 {\n  const {inputs, backend, attrs} = args;\n  const {x} = inputs;\n  assertNotComplex(x, 'avgPool');\n  const
{filterSize, strides, pad, dimRoundingMode} = attrs;\n  const dilations = 1;\n\n  util.assert(\n
backend_util.eitherStridesOrDilationsAreOne(strides, dilations),\n      () => 'Error in avgPool: Either strides or
dilations must be 1. ' +\n          `Got strides ${strides} and dilations '${dilations}'`);\n\n  const convInfo =
backend_util.computePool2DInfo(\n      x.shape as [number, number, number, number], filterSize, strides,\n
dilations, pad, dimRoundingMode);\n  if (convInfo.filterWidth === 1 && convInfo.filterHeight === 1 &&\n
util.arraysEqual(convInfo.inShape, convInfo.outShape)) {\n    return identity({inputs: {x}, backend});\n  }\n  const
```

avgPoolProgram = new Pool2DProgram(convInfo, 'avg', false);\n return backend.runWebGLProgram(avgPoolProgram, [x], 'float32');\n}\n\nexport const avgPoolConfig: KernelConfig = {\n kernelName: AvgPool,\n backendName: 'webgl',\n kernelFunc: avgPool as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==*/\nimport {AvgPool3D, AvgPool3DAttrs, AvgPool3DInputs, backend_util, KernelConfig, KernelFunc, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL} from '../backend_webgl';\nimport {Pool3DProgram} from '../pool_gpu';\n\nexport function avgPool3D(args: {\n inputs: AvgPool3DInputs,\n backend: MathBackendWebGL,\n attrs: AvgPool3DAttrs\n}): TensorInfo {\n const {inputs, backend, attrs} = args;\n const {x} = inputs;\n const {filterSize, strides, pad, dimRoundingMode, dataFormat} = attrs;\n const dilations: [number, number, number] = [1, 1, 1];\n\n const convInfo = backend_util.computePool3DInfo(\n   x.shape as [number, number, number, number], filterSize, strides,\n   dilations, pad, dimRoundingMode, dataFormat);\n const avgPoolProgram = new Pool3DProgram(convInfo, 'avg', false);\n return backend.runWebGLProgram(avgPoolProgram, [x], 'float32');\n}\n\nexport const avgPool3DConfig: KernelConfig = {\n kernelName: AvgPool3D,\n backendName: 'webgl',\n kernelFunc: avgPool3D as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2017 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==*/\n\nimport {backend_util} from '@tensorflow/tfjs-core';\nimport {GPGPUProgram} from './gpgpu_math';\n\nexport class AvgPool2DBackpropProgram implements GPGPUProgram {\n variableNames = ['dy'];\n outputShape: number[];\n userCode: string;\n\n constructor(convInfo: backend_util.Conv2DInfo) {\n   this.outputShape = convInfo.inShape;\n   const filterHeight = convInfo.filterHeight;\n   const filterWidth = convInfo.filterWidth;\n   const strideHeight = convInfo.strideHeight;\n   const strideWidth = convInfo.strideWidth;\n   const dilationHeight = convInfo.dilationHeight;\n   const dilationWidth = convInfo.dilationWidth;\n   const effectiveFilterHeight = convInfo.effectiveFilterHeight;\n   const effectiveFilterWidth = convInfo.effectiveFilterWidth;\n\n   const padTop = effectiveFilterHeight - 1 - convInfo.padInfo.top;\n   const padLeft = effectiveFilterWidth - 1 - convInfo.padInfo.left;\n\n   const avgMultiplier = 1 / (filterHeight * filterWidth);\n\n   this.userCode = `\n   const ivec2 pads = ivec2(${padTop}, ${padLeft});\n   const float avgMultiplier = float(${avgMultiplier});\n\n   void main() {\n   ivec4 coords = getOutputCoords();\n   int b = coords[0];\n   int d = coords[3];\n\n   ivec2 dyRCCorner = coords.yz - pads;\n   int dyRCorner = dyRCCorner.x;\n   int dyCCorner = dyRCCorner.y;\n\n   // Convolve dy(?, ?, d) with pos mask(:, :, d) to get dx(xR, xC, d).\n   // ? = to be determined. : = across all values in that axis.\n   float dotProd = 0.0;\n   for (int wR = 0; wR < ${effectiveFilterHeight};\n   wR += ${dilationHeight}) {\n   float dyR = float(dyRCorner + wR) / ${strideHeight}.0;\n\n   if (dyR < 0.0 || dyR >= ${convInfo.outHeight}.0 || fract(dyR) > 0.0) {\n   continue;\n   }\n   int idyR = int(dyR);\n\n   for (int wC = 0; wC < ${effectiveFilterWidth};\n

wC+= ${dilationWidth}) {\n float dyC = float(dyCCorner + wC) / ${strideWidth}.0;\n\n if (dyC < 0.0 || dyC >= ${convInfo.outWidth}.0 ||\n fract(dyC) > 0.0) {\n continue;\n }\n int idyC = int(dyC);\n\n float dyValue = getDy(b, idyR, idyC, d);\n\n dotProd += dyValue * avgMultiplier;\n }\n }\n setOutput(dotProd);\n }\n `;\n }\n}\n\nexport class AvgPool3DBackpropProgram implements GPGPUProgram {\n variableNames = ['dy'];\n outputShape: number[];\n userCode: string;\n\n constructor(convInfo: backend_util.Conv3DInfo) {\n this.outputShape = convInfo.inShape;\n const filterDepth = convInfo.filterDepth;\n const filterHeight = convInfo.filterHeight;\n const filterWidth = convInfo.filterWidth;\n const strideDepth = convInfo.strideDepth;\n const strideHeight = convInfo.strideHeight;\n const strideWidth = convInfo.strideWidth;\n const dilationDepth = convInfo.dilationDepth;\n const dilationHeight = convInfo.dilationHeight;\n const dilationWidth = convInfo.dilationWidth;\n const effectiveFilterDepth = convInfo.effectiveFilterDepth;\n const effectiveFilterHeight = convInfo.effectiveFilterHeight;\n const effectiveFilterWidth = convInfo.effectiveFilterWidth;\n\n const padFront = effectiveFilterDepth - 1 - convInfo.padInfo.front;\n const padTop = effectiveFilterHeight - 1 - convInfo.padInfo.top;\n const padLeft = effectiveFilterWidth - 1 - convInfo.padInfo.left;\n\n const avgMultiplier = 1 / (filterDepth * filterHeight * filterWidth);\n\n this.userCode = `\n const ivec3 pads = ivec3(${padFront}, ${padTop}, ${padLeft});\n const float avgMultiplier = float(${avgMultiplier});\n\n void main() {\n ivec5 coords = getOutputCoords();\n int batch = coords.x;\n int ch = coords.u;\n\n ivec3 dyCorner = ivec3(coords.y, coords.z, coords.w) - pads;\n int dyDCorner = dyCorner.x;\n int dyRCorner = dyCorner.y;\n int dyCCorner = dyCorner.z;\n\n // Convolve dy(?, ?, ?, d) with pos mask(:, :, :, ch) to get\n // dx(xD, xR, xC, ch).\n // ? = to be determined. : = across all values in that axis.\n float dotProd = 0.0;\n\n for (int wD = 0; wD < ${effectiveFilterDepth};\n wD += ${dilationDepth}) {\n float dyD = float(dyDCorner + wD) / ${strideDepth}.0;\n\n if (dyD < 0.0 || dyD >= ${convInfo.outDepth}.0 || fract(dyD) > 0.0) {\n continue;\n }\n int idyD = int(dyD);\n\n for (int wR = 0; wR < ${effectiveFilterHeight};\n wR += ${dilationHeight}) {\n float dyR = float(dyRCorner + wR) / ${strideHeight}.0;\n\n if (dyR < 0.0 || dyR >= ${convInfo.outHeight}.0 ||\n fract(dyR) > 0.0) {\n continue;\n }\n int idyR = int(dyR);\n\n for (int wC = 0; wC < ${effectiveFilterWidth};\n wC += ${dilationWidth}) {\n float dyC = float(dyCCorner + wC) / ${strideWidth}.0;\n\n if (dyC < 0.0 || dyC >= ${convInfo.outWidth}.0 ||\n fract(dyC) > 0.0) {\n continue;\n }\n int idyC = int(dyC);\n\n float dyValue = getDy(batch, idyD, idyR, idyC, ch);\n\n dotProd += dyValue * avgMultiplier;\n }\n }\n }\n setOutput(dotProd);\n }\n `;\n }\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==\n */\nimport {AvgPool3DGrad, AvgPool3DGradAttrs, AvgPool3DGradInputs, backend_util, KernelConfig, KernelFunc, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {AvgPool3DBackpropProgram} from '../avg_pool_backprop_gpu';\nimport {MathBackendWebGL} from '../backend_webgl';\n\nexport function avgPool3DGrad(args: {\n inputs: AvgPool3DGradInputs,\n backend: MathBackendWebGL,\n attrs: AvgPool3DGradAttrs\n}): TensorInfo {\n const {inputs, backend, attrs} = args;\n const {dy, input} = inputs;\n const x = input;\n const {filterSize, strides, pad, dimRoundingMode} = attrs;\n const dilations: [number, number, number] = [1, 1, 1];\n\n const convInfo = backend_util.computePool3DInfo(\n x.shape as [number, number, number, number, number], filterSize, strides,\n dilations, pad, dimRoundingMode);\n const avgPoolBackpropProgram = new AvgPool3DBackpropProgram(convInfo);\n return

backend.runWebGLProgram(avgPoolBackpropProgram, [dy], x.dtype);\n}\n\nexport const avgPoolGrad3DConfig: KernelConfig = {\n kernelName: AvgPool3DGrad,\n backendName: 'webgl',\n kernelFunc: avgPool3DGrad as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n
 * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
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*/\nimport {AvgPoolGrad, AvgPoolGradAttrs, AvgPoolGradInputs, backend_util, KernelConfig, KernelFunc, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {AvgPool2DBackpropProgram} from '../avg_pool_backprop_gpu';\nimport {MathBackendWebGL} from '../backend_webgl';\nimport {assertNotComplex} from '../webgl_util';\n\nexport function avgPoolGrad(args: {\n inputs: AvgPoolGradInputs,\n backend: MathBackendWebGL,\n attrs:
 AvgPoolGradAttrs\n}): TensorInfo {\n const {inputs, backend, attrs} = args;\n const {dy, input} = inputs;\n const x = input;\n assertNotComplex([dy, input], 'avgPoolGrad');\n const {filterSize, strides, pad} = attrs;\n\n const convInfo = backend_util.computePool2DInfo(\n   x.shape as [number, number, number, number], filterSize, strides,\n   1 /* dilations */, pad);\n const avgPoolBackpropProgram = new AvgPool2DBackpropProgram(convInfo);\n return backend.runWebGLProgram(avgPoolBackpropProgram, [dy], x.dtype);\n}\n\nexport const avgPoolGradConfig: KernelConfig = {\n kernelName: AvgPoolGrad,\n backendName: 'webgl',\n kernelFunc: avgPoolGrad as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n
 *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
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*/\n\nimport {BatchMatMul, BatchMatMulAttrs, BatchMatMulInputs, KernelConfig, KernelFunc} from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL} from '../backend_webgl';\nimport {batchMatMulImpl} from './BatchMatMul_impl';\n\nexport function batchMatMul(args: {\n inputs: BatchMatMulInputs,\n attrs: BatchMatMulAttrs,\n backend: MathBackendWebGL\n}) {\n const {inputs, backend, attrs} = args;\n const {a, b} = inputs;\n const {transposeA, transposeB} = attrs;\n\n return batchMatMulImpl({a, b, transposeA, transposeB, backend});\n}\n\nexport const batchMatMulConfig: KernelConfig
 = {\n kernelName: BatchMatMul,\n backendName: 'webgl',\n kernelFunc: batchMatMul as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2017 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
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*/\n\nimport {backend_util} from '@tensorflow/tfjs-core';\nimport {GPGPUProgram} from './gpgpu_math';\n\nexport class BatchNormProgram implements GPGPUProgram {\n

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  variableNames: string[];\n  outputShape: number[] = [];\n  userCode: string;\n\n  constructor(\n      xShape:
number[], meanShape: number[], varianceShape: number[],\n      offsetShape: number[]|null, scaleShape:
number[]|null,\n      varianceEpsilon: number) {\n    this.variableNames = ['x', 'mean', 'variance'];\n
backend_util.assertAndGetBroadcastShape(xShape, meanShape);\n
backend_util.assertAndGetBroadcastShape(xShape, varianceShape);\n\n    let offsetSnippet = '0.0';\n    if
(offsetShape != null) {\n      backend_util.assertAndGetBroadcastShape(xShape, offsetShape);\n
this.variableNames.push('offset');\n      offsetSnippet = 'getOffsetAtOutCoords()';\n    }\n\n    let scaleSnippet =
'1.0';\n    if (scaleShape != null) {\n      backend_util.assertAndGetBroadcastShape(xShape, scaleShape);\n
this.variableNames.push('scale');\n      scaleSnippet = 'getScaleAtOutCoords()';\n    }\n\n    this.outputShape =
xShape;\n    this.userCode = `\n      void main() {\n        float
 x = getXAtOutCoords();\n        float mean = getMeanAtOutCoords();\n        float variance =
getVarianceAtOutCoords();\n        float offset = ${offsetSnippet};\n        float scale = ${scaleSnippet};\n        float
inv = scale * inversesqrt(variance + float(${varianceEpsilon}));\n        setOutput(dot(vec3(x, -mean, offset),
vec3(inv, inv, 1)));\n      }\n    `;\n  }\n}\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights
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http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing,
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OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language
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==========================================================================\n
*/\n\nimport {backend_util} from '@tensorflow/tfjs-core';\nimport {GPGPUProgram} from
'./gpgpu_math';\n\nexport class BatchNormPackedProgram implements GPGPUProgram {\n  variableNames:
string[];\n  outputShape: number[];\n  userCode: string;\n  packedInputs = true;\n  packedOutput = true;\n\n
constructor(\n      xShape: number[], meanShape: number[], varianceShape: number[],\n      offsetShape:
number[]|null, scaleShape: number[]|null,\n      varianceEpsilon: number) {\n    this.variableNames = ['x', 'mean',
'variance'];\n    backend_util.assertAndGetBroadcastShape(xShape, meanShape);\n
backend_util.assertAndGetBroadcastShape(xShape, varianceShape);\n\n    let offsetSnippet = 'vec4(0.0)';\n    if
(offsetShape != null) {\n      backend_util.assertAndGetBroadcastShape(xShape, offsetShape);\n
this.variableNames.push('offset');\n      offsetSnippet = 'getOffsetAtOutCoords()';\n    }\n\n
    let scaleSnippet = 'vec4(1.0)';\n    if (scaleShape != null) {\n
backend_util.assertAndGetBroadcastShape(xShape, scaleShape);\n      this.variableNames.push('scale');\n
scaleSnippet = 'getScaleAtOutCoords()';\n    }\n\n    this.outputShape = xShape;\n    this.userCode = `\n      void
main() {\n        vec4 offset = ${offsetSnippet};\n        vec4 scale = ${scaleSnippet};\n\n        vec4 x =
getXAtOutCoords();\n        vec4 mean = getMeanAtOutCoords();\n        vec4 variance =
getVarianceAtOutCoords();\n\n        vec4 inv = scale * inversesqrt(variance + vec4(${varianceEpsilon}));\n\n
setOutput((x - mean) * inv + offset);\n      }\n    `;\n  }\n}\n","\n/**\n * @license\n * Copyright 2020 Google LLC.
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\"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n
* See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========================================================================\n
*/\n\nimport {env, FusedBatchNorm, FusedBatchNormAttrs, FusedBatchNormInputs, KernelConfig, KernelFunc,
TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL} from '../backend_webgl';\nimport
{BatchNormProgram} from '../batchnorm_gpu';\nimport {BatchNormPackedProgram} from
```

'../batchnorm_packed_gpu';\n\nexport const batchNorm: (params: {\n inputs: FusedBatchNormInputs,\n backend: MathBackendWebGL,\n attrs: FusedBatchNormAttrs\n}) => TensorInfo = ({inputs, backend, attrs}) => {\n const {x, mean, variance, offset, scale} = inputs;\n\n util.assert(\n   mean.shape.length === variance.shape.length,\n   () => 'Batch normalization gradient requires mean and variance to have ' +\n 'equal ranks.');\n util.assert(\n   offset == null || mean.shape.length === offset.shape.length,\n   () => 'Batch normalization gradient requires mean and offset to have ' +\n   'equal ranks.');\n util.assert(\n   scale == null || mean.shape.length === scale.shape.length,\n   () => 'Batch normalization gradient requires mean and scale to have ' +\n   'equal ranks.');\n\n let {varianceEpsilon} = attrs;\n if (varianceEpsilon == null) {\n   varianceEpsilon = 0.001;\n }\n\n const finalInputs = [x, mean, variance];\n\n let offsetShape = null;\n if (offset != null) {\n   offsetShape = offset.shape;\n   finalInputs.push(offset);\n }\n\n let scaleShape = null;\n if (scale != null) {\n   scaleShape = scale.shape;\n   finalInputs.push(scale);\n }\n\n const program = env().getBool('WEBGL_PACK_NORMALIZATION') ?\n   new BatchNormPackedProgram(\n   x.shape, mean.shape, variance.shape, offsetShape, scaleShape,\n   varianceEpsilon) :\n   new BatchNormProgram(\n   x.shape, mean.shape, variance.shape, offsetShape, scaleShape,\n varianceEpsilon);\n const output =\n   backend.runWebGLProgram(program, finalInputs, finalInputs[0].dtype);\n\n return output;\n};\n\nexport const batchNormConfig: KernelConfig = {\n kernelName: FusedBatchNorm,\n backendName: 'webgl',\n kernelFunc: batchNorm as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2017 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES
 OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n */\n\nimport {GPGPUContext} from './gpgpu_context';\nimport {GPGPUProgram} from './gpgpu_math';\nimport {getCoordsDataType} from './shader_compiler';\n\nexport class SliceProgram implements GPGPUProgram {\n variableNames = ['source'];\n outputShape: number[];\n userCode: string;\n rank: number;\n\n // Caching uniform location for speed.\n startLoc: WebGLUniformLocation;\n\n constructor(destSize: number[]) {\n   this.outputShape = destSize;\n   this.rank = destSize.length;\n\n   const dtype = getCoordsDataType(this.rank);\n   const uniformPart = `uniform int start[${this.rank}];`;\n   const sourceCoords = getCoords(this.rank);\n\n   let body: string;\n   const coordSum = destSize.map((_, i) => {\n   return `sourceLoc.${coords[i]} = start[${i}] + coords.${coords[i]};`;\n   });\n   body = `\n      ${dtype} sourceLoc;\n      ${dtype} coords = getOutputCoords();\n      ${coordSum.join('\\n')}\n    `;\n   this.userCode = `\n      ${uniformPart}\n      void main() {\n        ${body}\n        setOutput(getSource(${sourceCoords}));\n      }\n    `;\n }\n\n getCustomSetupFunc(start: number[]) {\n   if (start.length !== this.rank) {\n   throw Error(\n   `The rank (${this.rank}) of the program must match the ` +\n   `length of start (${start.length})`);\n   }\n   return (gpgpu: GPGPUContext, webGLProgram: WebGLProgram) => {\n   if (this.startLoc == null) {\n   this.startLoc = gpgpu.getUniformLocationNoThrow(webGLProgram, 'start');\n   if (this.startLoc == null) {\n   // This means the compiler has optimized and realized it doesn't need\n   // the uniform.\n   return;\n   }\n   }\n   gpgpu.gl.uniform1iv(this.startLoc, start);\n   };\n }\n}\n\nconst
 coords = ['x', 'y', 'z', 'w', 'u', 'v'];\n\nfunction getCoords(rank: number): string {\n if (rank === 1) {\n   return 'sourceLoc';\n } else if (rank <= 6) {\n   return coords.slice(0, rank).map(x => 'sourceLoc.' + x).join(',');\n } else {\n   throw Error(`Slicing for rank ${rank} is not yet supported`);\n }\n}\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES

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OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========================================================================\n
 */\n\nimport {GPGPUContext} from './gpgpu_context';\nimport {GPGPUProgram} from './gpgpu_math';\nimport {getChannels} from './packing_util';\nimport {getCoordsDataType} from './shader_compiler';\n\nexport class SlicePackedProgram implements GPGPUProgram {\n  variableNames = ['source'];\n  packedInputs = true;\n  packedOutput = true;\n  outputShape: number[];\n  userCode: string;\n  rank: number;\n\n  // Caching uniform location for speed.\n  startLoc: WebGLUniformLocation;\n\n  constructor(destSize: number[]) {\n    this.outputShape = destSize;\n    this.rank = destSize.length;\n\n    const dtype = getCoordsDataType(this.rank);\n    const coords = getChannels('coords', this.rank);\n    const sourceLoc = getChannels('sourceLoc', this.rank);\n\n    const innerDims =\n        this.rank === 1 ? 'sourceLoc' : `vec2(${sourceLoc.slice(-2).join()})`;\n    const getChannel =\n        `getChannel(getSource(${sourceLoc.join()}), ${innerDims})`;\n    const upperRow = `\n      result.x = ${getChannel};\n      if (++${coords[this.rank - 1]} < ${destSize[this.rank - 1]}) {\n        ++${sourceLoc[this.rank - 1]};\n        result.y = ${getChannel};\n        --${sourceLoc[this.rank - 1]};\n      }\n    `;\n    const lowerRow = this.rank === 1 ? '' : `\n      --${coords[this.rank - 1]};\n      if (++${coords[this.rank - 2]} < ${destSize[this.rank - 2]}) {\n        ++${sourceLoc[this.rank - 2]};\n        result.z = ${getChannel};\n        if (++${coords[this.rank - 1]} < ${destSize[this.rank - 1]}) {\n          ++${sourceLoc[this.rank - 1]};\n          result.w = ${getChannel};\n        }\n      }\n    `;\n\n    const sourceLocSetup = this.rank <= 4 ?\n        `sourceLoc = coords +\n        ${dtype}(${destSize.map((_, i) => `start[${i}]`).join()});` :\n        destSize.map((_, i) => `${sourceLoc[i]} = ${coords[i]} + start[${i}];`)\n            .join('\\n');\n    this.userCode = `\n      uniform int start[${this.rank}];\n      void main() {\n        ${dtype} coords = getOutputCoords();\n        ${dtype} sourceLoc;\n        ${sourceLocSetup}\n        vec4 result = vec4(0.);\n        ${upperRow}\n        ${lowerRow}\n        setOutput(result);\n      }\n    `;\n  }\n\n  getCustomSetupFunc(start: number[]) {\n    if (start.length !== this.rank) {\n      throw Error(\n          `The rank (${this.rank}) of the program must match the ` +\n          `length of start (${start.length})`);\n    }\n    return (gpgpu: GPGPUContext, webGLProgram: WebGLProgram) => {\n      if (this.startLoc == null) {\n        this.startLoc = gpgpu.getUniformLocationNoThrow(webGLProgram, 'start');\n        if (this.startLoc == null) {\n          // This means the compiler has optimized and realized it doesn't need\n          // the uniform.\n          return;\n        }\n      }\n      gpgpu.gl.uniform1iv(this.startLoc, start);\n    };\n  }\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache
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==========================================================================\n
*/\n\nimport {backend_util, BatchToSpaceND, BatchToSpaceNDAttrs, BatchToSpaceNDInputs, KernelConfig, KernelFunc, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL} from '../backend_webgl';\n\nimport {reshape} from './Reshape';\nimport {slice} from './Slice';\nimport {transpose} from './Transpose';\n\nexport const batchToSpaceND = (args: {\n  inputs:
 BatchToSpaceNDInputs,\n  backend: MathBackendWebGL,\n  attrs: BatchToSpaceNDAttrs\n}): TensorInfo => {\n  const {inputs, backend, attrs} = args;\n  const {x} = inputs;\n  const {blockShape, crops} = attrs;\n\n  util.assert(\n      x.shape.length <= 4,\n      () => 'batchToSpaceND for rank > 4 with a WebGL backend not ' +\n          'implemented yet');\n  const prod = blockShape.reduce((a, b) => a * b);\n\n  const reshaped = backend_util.getReshaped(x.shape, blockShape, prod);\n  const permuted = backend_util.getPermuted(reshaped.length, blockShape.length);\n  const reshapedPermuted =\n      backend_util.getReshapedPermuted(x.shape, blockShape, prod);\n  const sliceBeginCoords =\n      backend_util.getSliceBeginCoords(crops, blockShape.length);\n  const sliceSize =\n      backend_util.getSliceSize(reshapedPermuted, crops, blockShape.length);\n\n  const toDispose = [];\n\n  const reshapedIntermediate =\n      reshape({inputs: {x}, backend, attrs: {shape: reshaped}});\n  const
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transposedIntermediate
= transpose(\n {inputs: {x: reshapedIntermediate}, backend, attrs: {perm: permuted}});\n const reshapedIntermediate2 = reshape({\n inputs: {x: transposedIntermediate},\n backend,\n attrs: {shape: reshapedPermuted}\n });\n const sliced = slice({\n inputs: {x: reshapedIntermediate2},\n backend,\n attrs: {begin: sliceBeginCoords, size: sliceSize}\n });\n\n toDispose.push(reshapedIntermediate);\n toDispose.push(transposedIntermediate);\n toDispose.push(reshapedIntermediate2);\n\n toDispose.forEach(t => backend.disposeIntermediateTensorInfo(t));\n\n return sliced;\n};\n\nexport const batchToSpaceNDConfig: KernelConfig = {\n kernelName: BatchToSpaceND,\n backendName: 'webgl',\n kernelFunc: batchToSpaceND as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may
obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {Bincount, BincountAttrs, BincountInputs, KernelConfig, KernelFunc, TensorInfo, TypedArray} from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL} from '../backend_webgl';\nimport {bincountImplCPU} from '../kernel_utils/shared';\n\nexport function bincount(args: {\n inputs: BincountInputs,\n backend: MathBackendWebGL,\n attrs: BincountAttrs\n}): TensorInfo {\n const {inputs, backend, attrs} = args;\n const {x, weights} = inputs;\n const {size} = attrs;\n\n const xVals =
backend.readSync(x.dataId) as TypedArray;\n const weightsVals = backend.readSync(weights.dataId) as TypedArray;\n\n const outVals =\n bincountImplCPU(xVals, weightsVals, weights.dtype, weights.shape, size);\n\n return backend.makeTensorInfo([size], weights.dtype, outVals);\n}\n\nexport const bincountConfig: KernelConfig = {\n kernelName: Bincount,\n backendName: 'webgl',\n kernelFunc: bincount as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific
language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL} from '../backend_webgl';\nimport {UnaryOpProgram} from '../unaryop_gpu';\n\nconst TO_INT = `return float(int(x));`;\n\nexport function int(input: TensorInfo, backend: MathBackendWebGL): TensorInfo {\n const program = new UnaryOpProgram(input.shape, TO_INT);\n const output = backend.runWebGLProgram(program, [input], 'int32');\n return {dataId: output.dataId, shape: output.shape, dtype: output.dtype};\n}\n","/**\n * @license\n * Copyright 2017 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or
agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {GPGPUContext} from './gpgpu_context';\nimport {GPGPUProgram} from './gpgpu_math';\n\nexport class ClipProgram implements GPGPUProgram {\n variableNames = ['A'];\n userCode: string;\n outputShape:

number[];\n\n // Caching uniform locations for speed.\n minLoc: WebGLUniformLocation;\n maxLoc: WebGLUniformLocation;\n\n constructor(aShape: number[]) {\n   this.outputShape = aShape;\n   this.userCode = `\n      uniform float minVal;\n      uniform float maxVal;\n\n      void main() {\n        float value = getAAtOutCoords();\n        if (isnan(value)) {\n          setOutput(value);\n          return;\n        }\n\n        setOutput(clamp(value, minVal, maxVal));\n      }\n    `;\n }\n\n getCustomSetupFunc(min: number, max: number) {\n   return (gpgpu: GPGPUContext, webGLProgram: WebGLProgram) => {\n   if (this.minLoc == null) {\n   this.minLoc = gpgpu.getUniformLocationNoThrow(webGLProgram, 'minVal');\n   this.maxLoc = gpgpu.getUniformLocationNoThrow(webGLProgram, 'maxVal');\n   }\n   gpgpu.gl.uniform1f(this.minLoc, min);\n   gpgpu.gl.uniform1f(this.maxLoc, max);\n   };\n }\n}\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS
 OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {GPGPUContext} from './gpgpu_context';\nimport {GPGPUProgram} from './gpgpu_math';\n\nexport class ClipPackedProgram implements GPGPUProgram {\n variableNames = ['A'];\n packedInputs = true;\n packedOutput = true;\n userCode: string;\n outputShape: number[];\n\n // Caching uniform locations for speed.\n minLoc: WebGLUniformLocation;\n maxLoc: WebGLUniformLocation;\n\n constructor(aShape: number[]) {\n   this.outputShape = aShape;\n   this.userCode = `\n      uniform float minVal;\n      uniform float maxVal;\n\n      void main() {\n        vec4 value = getAAtOutCoords();\n\n        if (any(isnan(value))) {\n          setOutput(value);\n          return;\n        }\n\n        setOutput(clamp(value, vec4(minVal), vec4(maxVal)));\n      }\n    `;\n }\n\n getCustomSetupFunc(min: number, max: number) {\n   return (gpgpu: GPGPUContext, webGLProgram: WebGLProgram) => {\n   if (this.minLoc == null) {\n   this.minLoc = gpgpu.getUniformLocationNoThrow(webGLProgram, 'minVal');\n   this.maxLoc = gpgpu.getUniformLocationNoThrow(webGLProgram, 'maxVal');\n   }\n   gpgpu.gl.uniform1f(this.minLoc, min);\n   gpgpu.gl.uniform1f(this.maxLoc, max);\n   };\n }\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for
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==========\n */\n\nimport {ClipByValue, ClipByValueAttrs, ClipByValueInputs, env, KernelConfig, KernelFunc, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL} from '../backend_webgl';\nimport {ClipProgram} from '../clip_gpu';\nimport {ClipPackedProgram} from '../clip_packed_gpu';\n\nexport function clipByValue(args: {\n inputs: ClipByValueInputs,\n backend: MathBackendWebGL,\n attrs: ClipByValueAttrs\n}): TensorInfo {\n const {inputs, backend, attrs} = args;\n const {x} = inputs;\n const {clipValueMin, clipValueMax} = attrs;\n\n let program;\n if (env().getBool('WEBGL_PACK_CLIP')) {\n   program = new ClipPackedProgram(x.shape);\n } else {\n   program = new ClipProgram(x.shape);\n }\n const customSetup = program.getCustomSetupFunc(clipValueMin, clipValueMax);\n return backend.runWebGLProgram(program,
 [x], x.dtype, customSetup);\n}\n\nexport const clipByValueConfig: KernelConfig = {\n kernelName: ClipByValue,\n backendName: 'webgl',\n kernelFunc: clipByValue as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the

License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {GPGPUProgram} from './gpgpu_math';\n\nexport class ComplexAbsProgram implements GPGPUProgram {\n variableNames = ['real', 'imag'];\n userCode: string;\n outputShape: number[];\n\n constructor(shape: number[]) {\n this.outputShape = shape;\n this.userCode = `\n void main() {\n float re = abs(getRealAtOutCoords());\n float im = abs(getImagAtOutCoords());\n float mx = max(re, im);\n\n // sadly the length function in glsl is not underflow-safe\n // (at least not on Intel GPUs). So the safe solution is\n // to ensure underflow-safety in all cases.\n setOutput(\n mx == 0.0 ? 0.0 : mx * length(vec2(1, min(re, im)/mx))\n);\n }\n `;\n }\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {ComplexAbs, ComplexAbsInputs, KernelConfig, KernelFunc, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL} from '../backend_webgl';\nimport {ComplexAbsProgram} from '../complex_abs_gpu';\n\n// Returns a TensorInfo with the complex shape and the dataId of the\n// underlying part. We need to do this because a reshaped complex tensor is\n// not reflected in its parts.\nfunction makeComplexComponentTensorInfo(\n complexTensor: TensorInfo, complexPart: TensorInfo): TensorInfo {\n return {\n dataId: complexPart.dataId,\n dtype: complexPart.dtype,\n shape: complexTensor.shape\n };\n}\n\nexport function complexAbs(\n args: {inputs: ComplexAbsInputs, backend: MathBackendWebGL}): TensorInfo {\n const {inputs, backend} = args;\n const {x} = inputs;\n\n const xData = backend.texData.get(x.dataId);\n\n const program = new ComplexAbsProgram(x.shape);\n const programInputs = [\n makeComplexComponentTensorInfo(x, xData.complexTensorInfos.real),\n makeComplexComponentTensorInfo(x, xData.complexTensorInfos.imag),\n];\n\n return backend.runWebGLProgram(\n program, programInputs, programInputs[0].dtype);\n}\n\nexport const complexAbsConfig: KernelConfig = {\n kernelName: ComplexAbs,\n backendName: 'webgl',\n kernelFunc: complexAbs as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2017 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {backend_util} from '@tensorflow/tfjs-core';\nimport {GPGPUProgram} from './gpgpu_math';\n\nexport class ConcatProgram implements GPGPUProgram {\n variableNames: string[];\n outputShape: number[] = [];\n userCode: string;\n\n // Concats 2d tensors along axis=1. See comments in MathBackendWebGL.concat().\n constructor(shapes: Array<[number, number]>) {\n this.outputShape = backend_util.computeOutShape(shapes, 1 /* axis */);\n this.variableNames = shapes.map((_, i) => `T${i}`);\n\n const offsets: number[] = new Array(shapes.length - 1);\n

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 offsets[0] = shapes[0][1];\n    for (let i = 1; i < offsets.length; i++) {\n      offsets[i] = offsets[i - 1] + shapes[i][1];\n    }\n\n    const snippets = [`if (yC < ${offsets[0]}) setOutput(getT0(yR, yC));`];\n    for (let i = 1; i < offsets.length; i++) {\n      const shift = offsets[i - 1];\n      snippets.push(\n          `else if (yC < ${offsets[i]}) ` +\n          `setOutput(getT${i}(yR, yC-${shift}));`);\n    }\n    const lastIndex = offsets.length;\n    const lastShift = offsets[offsets.length - 1];\n    snippets.push(`else setOutput(getT${lastIndex}(yR, yC-${lastShift}));`);\n\n    this.userCode = `\n      void main() {\n        ivec2 coords = getOutputCoords();\n        int yR = coords.x;\n        int yC = coords.y;\n\n        ${snippets.join('\n        ')}\n      }\n    `;\n  }\n}\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance
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==========================================================================\n
*/\n\nimport {backend_util} from '@tensorflow/tfjs-core';\n\nimport {GPGPUProgram} from './gpgpu_math';\nimport {getChannels} from './packing_util';\nimport {getCoordsDataType} from './shader_compiler';\n\nexport class ConcatPackedProgram implements GPGPUProgram {\n  variableNames: string[];\n  packedInputs = true;\n  packedOutput = true;\n  outputShape: number[] = [];\n  userCode: string;\n\n  constructor(shapes: number[][], axis: number) {\n    this.outputShape = backend_util.computeOutShape(shapes, axis);\n    const shape = this.outputShape;\n    const rank = shape.length;\n    const dtype = getCoordsDataType(rank);\n    const coords = getChannels('coords', rank);\n    const channels = ['x', 'y', 'z', 'w', 'u', 'v'].slice(0, rank);\n    this.variableNames = shapes.map((_, i) => `T${i}`);\n\n    const offsets: number[] = new Array(shapes.length - 1);\n    offsets[0] = shapes[0][axis];\n    for (let i = 1; i < offsets.length; i++) {\n      offsets[i] = offsets[i - 1] + shapes[i][axis];\n    }\n\n    const channel = channels[axis];\n    const lastChannels = channels.slice(-2);\n    const allChannels = channels.join();\n\n    let getValueSnippet = `if (${channel} < ${offsets[0]}) {\n        return getChannel(\n            getT0(${allChannels}), vec2(${lastChannels.join()}));\n      }`;\n    for (let i = 1; i < offsets.length; i++) {\n      const shift = offsets[i - 1];\n      // Note: the >= comparison below may seem unnecessary given the check\n
      // above but is needed to workaround branch execution issues on some\n      // devices. It makes all the conditions exclusive without relying on\n      // execution order.\n      getValueSnippet += `\n        if (${channel} < ${offsets[i]}  && ${channel} >= ${offsets[i - 1]}) {\n          return getChannel(\n            getT${i}(${shiftedChannels(channels, channel, shift)}),\n            vec2(${shiftedChannels(lastChannels, channel, shift)}));\n        }`;\n    }\n    const lastIndex = offsets.length;\n    const shift = offsets[offsets.length - 1];\n    getValueSnippet += `\n        return getChannel(\n          getT${lastIndex}(${shiftedChannels(channels, channel, shift)}),\n          vec2(${shiftedChannels(lastChannels, channel, shift)}));`;\n\n    this.userCode = `\n      float getValue(${channels.map(x => 'int ' + x)}) {\n        ${getValueSnippet}\n      }\n\n      void main() {\n        ${dtype} coords = getOutputCoords();\n        vec4 result = vec4(getValue(${coords}), 0.,
 0., 0.);\n\n        ${coords[rank - 1]} = ${coords[rank - 1]} + 1;\n        if (${coords[rank - 1]} < ${shape[rank - 1]}) {\n          result.g = getValue(${coords});\n        }\n\n        ${coords[rank - 2]} = ${coords[rank - 2]} + 1;\n        if (${coords[rank - 2]} < ${shape[rank - 2]}) {\n          result.a = getValue(${coords});\n        }\n\n        ${coords[rank - 1]} = ${coords[rank - 1]} - 1;\n        if (${coords[rank - 2]} < ${shape[rank - 2]} &&\n            ${coords[rank - 1]} < ${shape[rank - 1]}) {\n          result.b = getValue(${coords});\n        }\n        setOutput(result);\n      }\n    `;\n  }\n}\n\n/**\n * Return an expression for coordinates into a vector where a given channel\n * will be offset by [shift].\n *\n * @param channels the channels to consider\n * @param channel the channel we want shifted\n * @param shift  the amount to subtract from the channel.\n *\n * @returns a string of the form 'x, y-[shift], z' where any one channel can\n * have the shift
```

applied.\n */\nfunction shiftedChannels(channels: string[], channel: string, shift: number) {\n const channelIdx = channels.indexOf(channel);\n const res = channels.map((c, idx) => {\n   if (idx === channelIdx) {\n   return `${c} - ${shift}`;\n   } else {\n   return c;\n   }\n });\n return res.join();\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ===\n */\n\nimport {Imag, ImagInputs, KernelConfig, KernelFunc, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL} from '../backend_webgl';\nimport {identity} from './Identity';\n\nexport function imag(args: {inputs: ImagInputs, backend: MathBackendWebGL}):\n   TensorInfo {\n const {inputs, backend} = args;\n const {input} = inputs;\n const inputData = backend.texData.get(input.dataId);\n\n return identity({inputs: {x: inputData.complexTensorInfos.imag}, backend});\n}\n\nexport const imagConfig: KernelConfig = {\n kernelName: Imag,\n backendName: 'webgl',\n kernelFunc: imag as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required\n by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ===\n */\n\nimport {backend_util, Concat, ConcatAttrs, ConcatInputs, KernelConfig, KernelFunc, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL} from '../backend_webgl';\nimport {concatImpl} from './Concat_impl';\nimport {identity} from './Identity';\n\nexport function concat(\n   args:\n   {inputs: ConcatInputs, attrs: ConcatAttrs, backend: MathBackendWebGL}):\n   TensorInfo {\n const {inputs, backend, attrs} = args;\n const {axis} = attrs;\n\n const $axis = util.parseAxisParam(axis, inputs[0].shape)[0];\n const outShape =\n   backend_util.computeOutShape(inputs.map(t\n => t.shape), $axis);\n\n if (util.sizeFromShape(outShape) === 0) {\n   return backend.makeTensorInfo(outShape, inputs[0].dtype, []);\n }\n\n // Keep only non-empty tensors (ignore tensors with 0 in their shape).\n const $inputs = inputs.filter(t => util.sizeFromShape(t.shape) > 0);\n if ($inputs.length === 1) {\n   return identity({inputs: {x: $inputs[0]}, backend});\n }\n\n const shapes = $inputs.map(t => t.shape);\n backend_util.assertParamsConsistent(shapes, $axis);\n\n return concatImpl($inputs, $axis, backend);\n}\n\nexport const concatConfig: KernelConfig = {\n kernelName: Concat,\n backendName: 'webgl',\n kernelFunc: concat as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2017 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless\n required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ===\n */\n\nimport {backend_util} from '@tensorflow/tfjs-core';\nimport {GPGPUProgram} from './gpgpu_math';\n\nexport class Conv2DProgram implements GPGPUProgram {\n variableNames = ['x', 'W'];\n outputShape: number[];\n userCode: string;\n\n constructor(\n   convInfo: backend_util.Conv2DInfo, addBias = false,\n   activation: string = null, hasPreluActivationWeights = false,\n   hasLeakyreluAlpha = false) {\n   this.outputShape = convInfo.outShape;\n   const padTop = convInfo.padInfo.top;\n   const padLeft =

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convInfo.padInfo.left;\n    const strideHeight = convInfo.strideHeight;\n
    const strideWidth = convInfo.strideWidth;\n    const dilationHeight = convInfo.dilationHeight;\n    const
dilationWidth = convInfo.dilationWidth;\n    const filterHeight = convInfo.filterHeight;\n    const filterWidth =
convInfo.filterWidth;\n\n    const inputDepthNearestVec4 = Math.floor(convInfo.inChannels / 4) * 4;\n    const
inputDepthVec4Remainder = convInfo.inChannels % 4;\n    const isChannelsLast = convInfo.dataFormat ===
'channelsLast';\n\n    const rowDim = isChannelsLast ? 1 : 2;\n    const colDim = isChannelsLast ? 2 : 3;\n    const
channelDim = isChannelsLast ? 3 : 1;\n\n    let activationSnippet = '', applyActivationSnippet = '';\n    if (activation)
{\n      if (hasPreluActivationWeights) {\n        activationSnippet = `float activation(float a) {\n          float b =
getPreluActivationWeightsAtOutCoords();\n          ${activation}\n        }`;\n      } else if (hasLeakyreluAlpha) {\n
activationSnippet = `float activation(float a) {\n          float b = getLeakyreluAlphaAtOutCoords();\n
          ${activation}\n        }`;\n      } else {\n        activationSnippet = `\n          float activation(float x) {\n
${activation}\n        }\n        `;\n      }\n\n      applyActivationSnippet = `result = activation(result);`;\n    }\n\n
const addBiasSnippet = addBias ? 'result += getBiasAtOutCoords();' : '';\n    if (addBias) {\n
this.variableNames.push('bias');\n    }\n\n    if (hasPreluActivationWeights) {\n
this.variableNames.push('preluActivationWeights');\n    }\n\n    if (hasLeakyreluAlpha) {\n
this.variableNames.push('leakyreluAlpha');\n    }\n\n    this.userCode = `\n      ${activationSnippet}\n\n      const
ivec2 strides = ivec2(${strideHeight}, ${strideWidth});\n      const ivec2 pads = ivec2(${padTop}, ${padLeft});\n\n
  void main() {\n        ivec4 coords = getOutputCoords();\n        int batch = coords[0];\n        int d2 =
coords[${channelDim}];\n\n        ivec2 xRCCorner =\n            ivec2(coords[${rowDim}],
 coords[${colDim}]) * strides - pads;\n        int xRCorner = xRCCorner.x;\n        int xCCorner = xRCCorner.y;\n\n
  // Convolve x(?, ?, d1) with w(:, :, d1, d2) to get y(yR, yC, d2).\n        // ? = to be determined. : = across all values
in that axis.\n        float dotProd = 0.0;\n        for (int wR = 0; wR < ${filterHeight}; wR++) {\n          int xR =
xRCorner + wR * ${dilationHeight};\n\n          if (xR < 0 || xR >= ${convInfo.inHeight}) {\n            continue;\n
}\n\n          for (int wC = 0; wC < ${filterWidth}; wC++) {\n            int xC = xCCorner + wC *
${dilationWidth};\n\n            if (xC < 0 || xC >= ${convInfo.inWidth}) {\n              continue;\n            }\n\n
for (int d1 = 0; d1 < ${inputDepthNearestVec4}; d1 += 4) {\n              vec4 wValues = vec4(\n                getW(wR,
wC, d1, d2),\n                getW(wR, wC, d1 + 1, d2),\n                getW(wR, wC, d1 + 2, d2),\n                getW(wR,
wC, d1 + 3, d2)\n
          );\n\n            if (${isChannelsLast}) {\n              vec4 xValues = vec4(\n                getX(batch, xR, xC,
d1),\n                getX(batch, xR, xC, d1 + 1),\n                getX(batch, xR, xC, d1 + 2),\n                getX(batch, xR,
xC, d1 + 3)\n              );\n              dotProd += dot(xValues, wValues);\n            } else {\n              vec4 xValues
= vec4(\n                getX(batch, d1, xR, xC),\n                getX(batch, d1 + 1, xR, xC),\n                getX(batch, d1
+ 2, xR, xC),\n                getX(batch, d1 + 3, xR, xC)\n              );\n              dotProd += dot(xValues,
wValues);\n            }\n          }\n\n          if (${inputDepthVec4Remainder === 1}) {\n\n            if
(${isChannelsLast}) {\n              dotProd +=\n                getX(batch, xR, xC, ${inputDepthNearestVec4}) *\n
            getW(wR, wC, ${inputDepthNearestVec4}, d2);\n            } else {\n
  dotProd +=\n                getX(batch, ${inputDepthNearestVec4}, xR, xC) *\n                getW(wR, wC,
${inputDepthNearestVec4}, d2);\n            }\n\n          } else if (${inputDepthVec4Remainder === 2}) {\n
vec2 wValues = vec2(\n              getW(wR, wC, ${inputDepthNearestVec4}, d2),\n              getW(wR, wC,
${inputDepthNearestVec4} + 1, d2)\n            );\n\n            if (${isChannelsLast}) {\n              vec2 xValues =
vec2(\n                getX(batch, xR, xC, ${inputDepthNearestVec4}),\n                getX(batch, xR, xC,
${inputDepthNearestVec4} + 1)\n              );\n              dotProd += dot(xValues, wValues);\n            } else {\n
            vec2 xValues = vec2(\n                getX(batch, ${inputDepthNearestVec4}, xR, xC),\n                getX(batch,
${inputDepthNearestVec4} + 1, xR, xC)\n              );\n              dotProd += dot(xValues, wValues);\n
}\n\n          } else if
 (${inputDepthVec4Remainder === 3}) {\n            vec3 wValues = vec3(\n              getW(wR, wC,
${inputDepthNearestVec4}, d2),\n              getW(wR, wC, ${inputDepthNearestVec4} + 1, d2),\n
getW(wR, wC, ${inputDepthNearestVec4} + 2, d2)\n            );\n\n            if (${isChannelsLast}) {\n
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vec3 xValues = vec3(\n getX(batch, xR, xC, ${inputDepthNearestVec4}),\n getX(batch, xR, xC, ${inputDepthNearestVec4} + 1),\n getX(batch, xR, xC, ${inputDepthNearestVec4} + 2)\n );\n dotProd += dot(xValues, wValues);\n } else {\n vec3 xValues = vec3(\n getX(batch, ${inputDepthNearestVec4}, xR, xC),\n getX(batch, ${inputDepthNearestVec4} + 1, xR, xC),\n getX(batch, ${inputDepthNearestVec4} + 2, xR, xC)\n );\n dotProd += dot(xValues, wValues);\n }\n\n }\n }\n }\n\n float result = dotProd;\n ${addBiasSnippet}\n ${applyActivationSnippet}\n setOutput(result);\n }\n `;\n }\n}\n\nexport class Conv3DProgram implements GPGPUProgram {\n variableNames = ['x', 'W'];\n outputShape: number[];\n userCode: string;\n\n constructor(convInfo: backend_util.Conv3DInfo) {\n this.outputShape = convInfo.outShape;\n const padFront = convInfo.padInfo.front;\n const padTop = convInfo.padInfo.top;\n const padLeft = convInfo.padInfo.left;\n const strideDepth = convInfo.strideDepth;\n const strideHeight = convInfo.strideHeight;\n const strideWidth = convInfo.strideWidth;\n const dilationDepth = convInfo.dilationDepth;\n const dilationHeight = convInfo.dilationHeight;\n const dilationWidth = convInfo.dilationWidth;\n const filterDepth = convInfo.filterDepth;\n const filterHeight = convInfo.filterHeight;\n const filterWidth = convInfo.filterWidth;\n\n const inputDepthNearestVec4 = Math.floor(convInfo.inChannels / 4) * 4;\n const inputDepthVec4Remainder = convInfo.inChannels % 4;\n\n this.userCode = `\n const ivec3 strides = ivec3(${strideDepth}, ${strideHeight}, ${\n strideWidth});\n const ivec3 pads = ivec3(${padFront}, ${padTop}, ${padLeft});\n\n void main() {\n ivec5 coords = getOutputCoords();\n int batch = coords.x;\n int d2 = coords.u;\n\n ivec3 xFRCCorner = ivec3(coords.y, coords.z, coords.w) * strides - pads;\n int xFCorner = xFRCCorner.x;\n int xRCorner = xFRCCorner.y;\n int xCCorner = xFRCCorner.z;\n\n // Convolve x(?, ?, ?, d1) with w(:, :, :, d1, d2) to get\n // y(yF, yR, yC, d2). ? = to be determined. : = across all\n // values in that axis.\n float dotProd = 0.0;\n for (int wF = 0; wF < ${filterDepth}; wF++) {\n int xF = xFCorner + wF * ${dilationDepth};\n\n if (xF < 0 || xF >= ${convInfo.inDepth}) {\n continue;\n }\n\n for (int wR = 0; wR < ${filterHeight}; wR++) {\n int xR = xRCorner + wR * ${dilationHeight};\n\n if (xR < 0 || xR >= ${convInfo.inHeight}) {\n continue;\n }\n\n for (int wC = 0; wC < ${filterWidth}; wC++) {\n int xC = xCCorner + wC * ${dilationWidth};\n\n if (xC < 0 || xC >= ${convInfo.inWidth}) {\n continue;\n }\n\n for (int d1 = 0; d1 < ${inputDepthNearestVec4}; d1 += 4) {\n vec4 xValues = vec4(\n getX(batch, xF, xR, xC, d1),\n getX(batch, xF, xR, xC, d1 + 1),\n getX(batch, xF, xR, xC, d1 + 2),\n getX(batch, xF, xR, xC, d1 + 3)\n );\n vec4 wValues = vec4(\n getW(wF, wR, wC, d1, d2),\n getW(wF, wR, wC, d1 + 1, d2),\n getW(wF, wR, wC, d1 + 2, d2),\n getW(wF, wR, wC, d1 + 3, d2)\n );\n\n dotProd += dot(xValues, wValues);\n }\n\n if (${inputDepthVec4Remainder === 1}) {\n dotProd +=\n getX(batch, xF, xR, xC, ${inputDepthNearestVec4}) *\n getW(wF, wR, wC, ${inputDepthNearestVec4}, d2);\n } else if (${inputDepthVec4Remainder === 2}) {\n vec2 xValues = vec2(\n getX(batch, xF, xR, xC, ${inputDepthNearestVec4}),\n getX(batch, xF, xR, xC, ${inputDepthNearestVec4} + 1)\n );\n vec2 wValues = vec2(\n getW(wF, wR, wC, ${inputDepthNearestVec4}, d2),\n getW(wF, wR, wC, ${inputDepthNearestVec4} + 1, d2)\n );\n dotProd += dot(xValues, wValues);\n } else if (${inputDepthVec4Remainder === 3}) {\n vec3 xValues = vec3(\n getX(batch, xF,\n xR, xC, ${inputDepthNearestVec4}),\n getX(batch, xF, xR, xC, ${inputDepthNearestVec4} + 1),\n getX(batch, xF, xR, xC, ${inputDepthNearestVec4} + 2)\n );\n vec3 wValues = vec3(\n getW(wF, wR, wC, ${inputDepthNearestVec4}, d2),\n getW(wF, wR, wC,\n ${inputDepthNearestVec4} + 1, d2),\n getW(wF, wR, wC, ${inputDepthNearestVec4} + 2, d2)\n );\n dotProd += dot(xValues, wValues);\n }\n }\n }\n }\n setOutput(dotProd);\n }\n `;\n }\n}\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights
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==========\n */\n\nimport {backend_util} from '@tensorflow/tfjs-core';\nimport {getGlslDifferences} from './glsl_version';\nimport {GPGPUProgram} from './gpgpu_math';\n\nexport class Im2ColPackedProgram implements GPGPUProgram {\n variableNames = ['A'];\n packedInputs = true;\n packedOutput = true;\n outputShape: number[];\n userCode: string;\n\n constructor(\n outputShape: number[], inputShape: number[],\n convInfo: backend_util.Conv2DInfo) {\n this.outputShape = outputShape;\n\n const {\n filterWidth,\n inChannels,\n strideWidth,\n strideHeight,\n padInfo,\n outWidth,\n dilationWidth,\n dilationHeight,\n dataFormat\n } = convInfo;\n const {left, top} = padInfo;\n const itemsPerBlockRow = inChannels * filterWidth;\n const glsl = getGlslDifferences();\n const isChannelsLast = dataFormat === 'channelsLast';\n const rowDim = isChannelsLast ? 0 : 1;\n const colDim = isChannelsLast ? 1 : 2;\n\n let unrolled = ``;\n\n for (let row = 0; row <= 1; row++) {\n for (let col = 0; col <= 1; col++) {\n unrolled += `\n blockIndex = rc.y + ${col};\n pos = rc.x + ${row};\n\n if(blockIndex < ${outputShape[1]} && pos < ${outputShape[0]}) {\n offsetY = int(blockIndex / (${outWidth})) * ${strideHeight} - ${\n top};\n d0 = offsetY + ${dilationHeight} * (pos / ${itemsPerBlockRow});\n\n if(d0 < ${inputShape[rowDim]} && d0 >= 0) {\n\n offsetX = int(mod(float(blockIndex), ${outWidth}.) * ${\n strideWidth}. - ${left}.);\n d1 = offsetX + ${dilationWidth}\n * (int(mod(float(pos), ${\n itemsPerBlockRow}.) / ${inChannels}.));\n\n if(d1 < ${inputShape[colDim]} && d1 >= 0) {\n\n ch = int(mod(float(pos), ${inChannels}.));\n\n if (${isChannelsLast}) {\n innerDims = vec2(d1, ch);\n result[${row * 2 + col}] = getChannel(\n getA(d0, int(innerDims.x),\n int(innerDims.y)), innerDims);\n } else {\n innerDims = vec2(d0, d1);\n result[${row * 2 + col}] = getChannel(\n getA(ch, int(innerDims.x),\n int(innerDims.y)), innerDims);\n }\n }\n }\n }\n `;\n }\n }\n\n this.userCode = `\n void main() {\n ivec2 rc = getOutputCoords();\n\n vec4 result = vec4(0);\n\n int blockIndex, pos, offsetY, d0, offsetX, d1, ch;\n vec2 innerDims;\n\n ${unrolled}\n\n ${glsl.output} = result;\n }\n `;\n }\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {backend_util, env, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL} from '../backend_webgl';\nimport {Im2ColPackedProgram} from '../im2col_packed_gpu';\nimport {mapActivationToShaderProgram}
from '../kernel_utils/kernel_funcs_utils';\nimport {MatMulPackedProgram} from '../mulmat_packed_gpu';\nimport * as webgl_util from '../webgl_util';\n\nimport {batchMatMulImpl, MATMUL_SHARED_DIM_THRESHOLD} from './BatchMatMul_impl';\nimport {identity} from './Identity';\nimport {reshape} from './Reshape';\n\ntype Conv2DConfig = {\n x: TensorInfo,\n filter: TensorInfo,\n convInfo: backend_util.Conv2DInfo,\n backend: MathBackendWebGL,\n bias?: TensorInfo,\n preluActivationWeights?: TensorInfo,\n leakyreluAlpha?: number,\n activation?: backend_util.Activation\n};\n\n// For 1x1 kernels that iterate through every point in the input, convolution\n// can be expressed as matrix multiplication (without need for memory\n// remapping).\nexport

```
function conv2dByMatMul({\n  x,\n  filter,\n  convInfo,\n  backend,\n  bias = null,\n  preluActivationWeights =
null,\n  leakyreluAlpha = 0,\n  activation = null\n}: Conv2DConfig) {\n  // Reshapes conv2D input to 2D tensors,
uses
 matMul and then reshape the\n  // result from 2D to 4D.\n  const xShape = x.shape;\n  const xTexData =
backend.texData.get(x.dataId);\n  const sharedMatMulDim = convInfo.inChannels;\n  const outerShapeX =
xShape[0] * xShape[1] * xShape[2];\n  const outerShapeFilter = convInfo.outChannels;\n  const isChannelsLast =
convInfo.dataFormat === 'channelsLast';\n  const transposeA = false;\n  const transposeB = false;\n\n  let out:
TensorInfo;\n  const intermediates: TensorInfo[] = [];\n\n  // TODO: Once reduction ops are packed, batchMatMul
will always be packed\n  // and we can remove this condition.\n  const batchMatMulWillBeUnpacked =\n
(outerShapeX === 1 || outerShapeFilter === 1) &&\n      sharedMatMulDim >
MATMUL_SHARED_DIM_THRESHOLD;\n  const reshapeWillBeExpensive = xShape[2] % 2 !== 0 &&
!!xTexData.isPacked;\n\n  if (batchMatMulWillBeUnpacked || !env().getBool('WEBGL_LAZILY_UNPACK') ||\n
 !env().getBool('WEBGL_PACK_BINARY_OPERATIONS') ||\n      !reshapeWillBeExpensive) {\n
    const targetShape = isChannelsLast ? xShape[0] * xShape[1] * xShape[2] :\n                                    xShape[0]
* xShape[2] * xShape[3];\n    const xReshaped = reshape({\n      inputs: {x},\n      backend,\n      attrs: {shape: [1,
targetShape, convInfo.inChannels]}\n    });\n    const filterReshaped = reshape({\n      inputs: {x: filter},\n
backend,\n      attrs: {shape: [1, convInfo.inChannels, convInfo.outChannels]}\n    });\n    const result =
batchMatMulImpl({\n      a: xReshaped,\n      b: filterReshaped,\n      transposeA,\n      transposeB,\n      backend,\n
 bias,\n      activation,\n      preluActivationWeights,\n      leakyreluAlpha\n    });\n\n    out = reshape(\n      {inputs:
{x: result}, backend, attrs: {shape: convInfo.outShape}});\n\n    intermediates.push(xReshaped);\n
intermediates.push(filterReshaped);\n    intermediates.push(result);\n  } else {\n    // Following optimization is
specific to packed |x| with odd row count\n    // (For
 example, in channelLast mode, 'row count' refers to x.shape[2]):\n    // we avoid expensive packed 2x2 reshape by
padding row count to next,\n    // even number. When x.shape[2] is odd, the result of packed batchMatMul is\n    //
the same (has the same texture layout and and values in the texture) as\n    // it is for even x.shape[2] + 1. We make
the odd-rows tensor to look like\n    // even-rows tensor before the operation and, after the batchMatMul,\n    // fix
the even-rows result to have odd number of rows.\n    const targetShape = isChannelsLast ?\n        xShape[0] *
xShape[1] * (xShape[2] + 1) :\n        xShape[0] * xShape[2] * (xShape[3] + 1);\n    const xReshaped: TensorInfo =
{\n      dataId: x.dataId,\n      shape: [1, targetShape, convInfo.inChannels],\n      dtype: x.dtype\n    };\n    //
xTexData.shape gets referenced from GPGPUBinary.inShapeInfos.\n    // Decrementing row count, after
batchMatMul->...->compileProgram leads to\n    // invalid row count within the reference
 in GPGPUBinary.inShapeInfos.\n    // Alternative fix would be to provide a copy to GPGPUBinary.inShapeInfos\n
// in compileProgram method, but that would affect compilation of all\n    // programs - instead, provide a copy here,
with even row count, before\n    // calling batchMatMul->...->compileProgram and after that, the original\n    //
xTexData.shape is restored.\n    const originalXTexDataShape = xTexData.shape;\n    xTexData.shape =
xTexData.shape.slice();\n    xTexData.shape[xTexData.shape.length - 2]++;\n    util.assert(\n
webgl_util.isReshapeFree(xTexData.shape, xReshaped.shape),\n        () => `packed reshape ${xTexData.shape} to
${\n            xReshaped.shape} isn't free`);\n    const filterReshaped = reshape({\n      inputs: {x: filter},\n
backend,\n      attrs: {shape: [1, convInfo.inChannels, convInfo.outChannels]}\n    });\n
intermediates.push(filterReshaped);\n    const pointwiseConv = batchMatMulImpl({\n      a: xReshaped,\n      b:
filterReshaped,\n
     backend,\n      transposeA,\n      transposeB,\n      bias,\n      activation,\n      preluActivationWeights,\n
leakyreluAlpha\n    });\n\n    const pointwiseConvTexData = backend.texData.get(pointwiseConv.dataId);\n
util.assert(\n        pointwiseConvTexData.isPacked,\n        () => 'batchMatMul result is expected to be packed');\n
// Restore the input shape to original.\n    xTexData.shape = originalXTexDataShape;\n    // Set the output shape -
there is no need for expensive reshape as data\n    // layout is already correct.\n    pointwiseConvTexData.shape =
convInfo.outShape;\n\n    out = identity({inputs: {x: pointwiseConv}, backend});\n    out.shape =
convInfo.outShape;\n\n    intermediates.push(pointwiseConv);\n  }\n\n  for (const i of intermediates) {\n
```

backend.disposeIntermediateTensorInfo(i);\n }\n\n return out;\n}\n\n// Implements the im2row algorithm as outlined in \"High Performance\n// Convolutional Neural Networks for Document Processing\" (Suvisoft, 2006)\nexport function conv2dWithIm2Row({\n x,\n filter,\n convInfo,\n backend,\n bias = null,\n preluActivationWeights = null,\n leakyreluAlpha = 0,\n activation = null\n}: Conv2DConfig) {\n // Rearranges conv2d input so each block to be convolved over forms the\n // column of a new matrix with shape [filterWidth * filterHeight *\n // inChannels, outHeight * outWidth]. The filter is also rearranged so each\n // output channel forms a row of a new matrix with shape [outChannels,\n // filterWidth * filterHeight * inChannels]. The convolution is then\n // computed by multiplying these matrices and reshaping the result.\n const {\n filterWidth,\n filterHeight,\n inChannels,\n outWidth,\n outHeight,\n dataFormat\n } = convInfo;\n\n const isChannelsLast = dataFormat === 'channelsLast';\n\n const sharedDim = filterWidth * filterHeight * inChannels;\n const numCols = outHeight * outWidth;\n const x2ColShape = [sharedDim, numCols];\n const transposeA
 = true;\n const transposeB = false;\n\n const intermediates: TensorInfo[] = [];\n\n const xSqueezed =\n reshape({inputs: {x}, backend, attrs: {shape: x.shape.slice(1)}});\n const w2Row = reshape({\n   inputs: {x: filter},\n   backend,\n   attrs: {shape: [1, sharedDim, util.sizeFromShape(filter.shape) / sharedDim]}\n });\n\n intermediates.push(xSqueezed);\n intermediates.push(w2Row);\n\n const im2ColProgram =\n   new Im2ColPackedProgram(x2ColShape, xSqueezed.shape, convInfo);\n const im2Col = backend.runWebGLProgram(im2ColProgram, [xSqueezed], 'float32');\n const im2ColReshaped = reshape({\n inputs: {x: im2Col},\n   backend,\n   attrs: {shape: [1, x2ColShape[0], x2ColShape[1]]}\n });\n\n intermediates.push(im2Col);\n intermediates.push(im2ColReshaped);\n\n const hasBias = bias != null;\n const hasPreluActivationWeights = preluActivationWeights != null;\n const hasLeakyreluAlpha = activation === 'leakyrelu';\n const fusedActivation =\n   activation ?
 mapActivationToShaderProgram(activation, true) : null;\n const matmulProgram = new MatMulPackedProgram(\n   im2ColReshaped.shape as [number, number, number],\n   w2Row.shape as [number, number, number],\n   [1, numCols, convInfo.outChannels], transposeA, transposeB, hasBias,\n   fusedActivation, hasPreluActivationWeights, hasLeakyreluAlpha);\n const inputs: TensorInfo[] = [im2ColReshaped, w2Row];\n if (bias) {\n   inputs.push(bias);\n }\n if (hasPreluActivationWeights) {\n   inputs.push(preluActivationWeights);\n }\n if (hasLeakyreluAlpha) {\n   const $leakyreluAlpha = backend.makeTensorInfo(\n   [], 'float32',\n   util.createScalarValue(leakyreluAlpha as {} as 'float32', 'float32'));\n   inputs.push($leakyreluAlpha);\n   intermediates.push($leakyreluAlpha);\n }\n const product = backend.runWebGLProgram(matmulProgram, inputs, 'float32');\n\n const outShape = isChannelsLast ?\n   [1, outHeight, outWidth, convInfo.outChannels] :\n   [1, convInfo.outChannels,
 outHeight, outWidth];\n const out =\n   reshape({inputs: {x: product}, backend, attrs: {shape: outShape}});\n\n intermediates.push(product);\n for (const i of intermediates) {\n   backend.disposeIntermediateTensorInfo(i);\n }\n\n return out;\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n */\n\nimport
 {backend_util, Conv2D, Conv2DAttrs, Conv2DInputs, env, KernelConfig, KernelFunc, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL} from '../backend_webgl';\nimport {Conv2DProgram} from '../conv_gpu';\nimport {conv2dByMatMul, conv2dWithIm2Row} from './Conv2D_impl';\nimport {reshape} from './Reshape';\n\nexport function conv2d(\n   args:\n   {inputs: Conv2DInputs, attrs: Conv2DAttrs, backend: MathBackendWebGL}) {\n const {inputs, backend, attrs} = args;\n const {x, filter} = inputs;\n const {strides, pad,

dataFormat, dilations, dimRoundingMode} = attrs;\n\n const $dataFormat = backend_util.convertConv2DDataFormat(dataFormat);\n const convInfo = backend_util.computeConv2DInfo(\n x.shape as [number, number, number, number],\n   filter.shape as [number, number, number, number], strides, dilations, pad,\n   dimRoundingMode, false /* depthwise */, $dataFormat);\n let out: TensorInfo;\n\n if (convInfo.filterHeight === 1 && convInfo.filterWidth ===
 1 &&\n   convInfo.dilationHeight === 1 && convInfo.dilationWidth === 1 &&\n   convInfo.strideHeight === 1 && convInfo.strideWidth === 1 &&\n   (convInfo.padInfo.type === 'SAME' || convInfo.padInfo.type === 'VALID')) {\n   out = conv2dByMatMul({x, filter, convInfo, backend});\n } else if (env().getBool('WEBGL_CONV_IM2COL') && x.shape[0] === 1) {\n   out = conv2dWithIm2Row({x, filter, convInfo, backend});\n } else {\n   const program = new Conv2DProgram(convInfo);\n   out = backend.runWebGLProgram(program, [x, filter], 'float32');\n }\n\n const outReshaped =\n   reshape({inputs: {x: out}, backend, attrs: {shape: convInfo.outShape}});\n backend.disposeIntermediateTensorInfo(out);\n\n return outReshaped;\n}\n\nexport const conv2DConfig: KernelConfig = {\n kernelName: Conv2D,\n backendName: 'webgl',\n kernelFunc: conv2d as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2017 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version
 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n */\n\nimport {backend_util} from '@tensorflow/tfjs-core';\nimport {GPGPUProgram} from './gpgpu_math';\n\nexport class Conv2DDerFilterProgram implements GPGPUProgram {\n variableNames = ['x', 'dy'];\n outputShape: number[];\n userCode: string;\n\n constructor(convInfo: backend_util.Conv2DInfo) {\n   this.outputShape = convInfo.filterShape;\n\n   const strideHeight = convInfo.strideHeight;\n   const strideWidth = convInfo.strideWidth;\n   const padTop = convInfo.padInfo.top;\n   const padLeft = convInfo.padInfo.left;\n   const isChannelsLast = convInfo.dataFormat === 'channelsLast';\n\n   this.userCode = `\n   void main() {\n   ivec4 coords = getOutputCoords();\n   int wR = coords.x;\n   int wC = coords.y;\n   int d1 = coords.z;\n   int d2 = coords.w;\n\n   // Convolve x(?, ?, d1) with dy(:, :, d2) to get dw(wR, wC, d1, d2).\n   // ? = to be determined. : = across all values in that axis.\n   float dotProd = 0.0;\n\n   for (int b = 0; b < ${convInfo.batchSize}; b++) {\n   for (int yR = 0; yR < ${convInfo.outHeight}; yR++) {\n   int xR = wR + yR * ${strideHeight} - ${padTop};\n\n   if (xR < 0 || xR >= ${convInfo.inHeight}) {\n   continue;\n   }\n\n   for (int yC = 0; yC < ${convInfo.outWidth}; yC++) {\n   int xC = wC + yC * ${strideWidth} - ${padLeft};\n\n
              if (xC < 0 || xC >= ${convInfo.inWidth}) {\n   continue;\n   }\n\n   if (${isChannelsLast}) {\n   float dyValue = getDy(b, yR, yC, d2);\n   float xValue = getX(b, xR, xC, d1);\n   dotProd += (xValue * dyValue);\n   } else {\n   float dyValue = getDy(b, d2, yR, yC);\n   float xValue = getX(b, d1, xR, xC);\n   dotProd += (xValue * dyValue);\n   }\n\n   }\n   }\n   }\n   setOutput(dotProd);\n   }\n   `;\n }\n}\n\nexport class Conv2DDerInputProgram implements GPGPUProgram {\n variableNames = ['dy', 'W'];\n outputShape: number[];\n userCode: string;\n\n constructor(convInfo: backend_util.Conv2DInfo) {\n   this.outputShape = convInfo.inShape;\n\n   const filterHeight = convInfo.filterHeight;\n   const filterWidth = convInfo.filterWidth;\n   const strideHeight = convInfo.strideHeight;\n   const strideWidth
 = convInfo.strideWidth;\n   const isChannelsLast = convInfo.dataFormat === 'channelsLast';\n\n   const padTop = filterHeight - 1 - convInfo.padInfo.top;\n   const padLeft = filterWidth - 1 - convInfo.padInfo.left;\n\n   const rowDim = isChannelsLast ? 1 : 2;\n   const colDim = isChannelsLast ? 2 : 3;\n   const channelDim = isChannelsLast ? 3 : 1;\n\n   this.userCode = `\n   const ivec2 pads = ivec2(${padTop}, ${padLeft});\n\n   void main() {\n   ivec4 coords = getOutputCoords();\n   int batch = coords[0];\n   int d1 =

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coords[${channelDim}];\n\n  ivec2 dyCorner = ivec2(coords[${rowDim}], coords[${colDim}]) - pads;\n  int dyRCorner = dyCorner.x;\n  int dyCCorner = dyCorner.y;\n\n  // Convolve dy(?, ?, d2) with w(:, :, d1, d2) to compute dx(xR, xC, d1).\n  // ? = to be determined. : = across all values in that axis.\n  float dotProd = 0.0;\n  for (int wR = 0; wR < ${filterHeight}; wR++) {\n  float dyR = float(dyRCorner + wR) / ${strideHeight}.0;\n\n  if (dyR < 0.0 || dyR >= ${convInfo.outHeight}.0 || fract(dyR) > 0.0) {\n  continue;\n  }\n  int idyR = int(dyR);\n\n  int wRPerm = ${filterHeight} - 1 - wR;\n\n  for (int wC = 0; wC < ${filterWidth}; wC++) {\n  float dyC = float(dyCCorner + wC) / ${strideWidth}.0;\n\n  if (dyC < 0.0 || dyC >= ${convInfo.outWidth}.0 ||\n  fract(dyC) > 0.0) {\n  continue;\n  }\n  int idyC = int(dyC);\n\n  int wCPerm = ${filterWidth} - 1 - wC;\n\n  for (int d2 = 0; d2 < ${convInfo.outChannels}; d2++) {\n\n  if (${isChannelsLast}) {\n  float xValue = getDy(batch, idyR, idyC, d2);\n  float wValue = getW(wRPerm, wCPerm, d1, d2);\n  dotProd += xValue * wValue;\n  } else {\n  float xValue = getDy(batch, d2, idyR, idyC);\n  float wValue = getW(wRPerm, wCPerm, d1, d2);\n  dotProd += xValue * wValue;\n  }\n\n  }\n  }\n  }\n  setOutput(dotProd);\n  }\n  `;\n  }\n}\n\nexport class Conv3DDerFilterProgram implements GPGPUProgram {\n  variableNames = ['x', 'dy'];\n  outputShape: number[];\n  userCode: string;\n\n  constructor(convInfo: backend_util.Conv3DInfo) {\n  this.outputShape = convInfo.filterShape;\n\n  const strideDepth = convInfo.strideDepth;\n  const strideHeight = convInfo.strideHeight;\n  const strideWidth = convInfo.strideWidth;\n  const padFront = convInfo.padInfo.front;\n  const padTop = convInfo.padInfo.top;\n  const padLeft = convInfo.padInfo.left;\n\n  this.userCode = `\n  void main() {\n  ivec5 coords = getOutputCoords();\n  int wF = coords.x;\n  int wR = coords.y;\n  int wC = coords.z;\n  int d1 = coords.w;\n  int d2 = coords.u;\n\n  float dotProd = 0.0;\n\n  for (int b = 0; b < ${convInfo.batchSize}; b++) {\n  for (int yF = 0; yF < ${convInfo.outDepth}; yF++) {\n  int xF = wF + yF * ${strideDepth} - ${padFront};\n\n  if (xF < 0 || xF >= ${convInfo.inDepth}) {\n  continue;\n  }\n\n  for (int yR = 0; yR < ${convInfo.outHeight}; yR++) {\n  int xR = wR + yR * ${strideHeight} - ${padTop};\n\n  if (xR < 0 || xR >= ${convInfo.inHeight}) {\n  continue;\n  }\n\n  for (int yC = 0; yC < ${convInfo.outWidth}; yC++) {\n  int xC = wC + yC * ${strideWidth} - ${padLeft};\n\n  if (xC < 0 || xC >= ${convInfo.inWidth}) {\n  continue;\n  }\n\n  float dyValue = getDy(b, yF, yR, yC, d2);\n  float xValue = getX(b, xF, xR, xC, d1);\n  dotProd += (xValue * dyValue);\n  }\n  }\n  }\n  }\n  setOutput(dotProd);\n  }\n  `;\n  }\n}\n\nexport class Conv3DDerInputProgram implements GPGPUProgram {\n  variableNames = ['dy', 'W'];\n  outputShape: number[];\n  userCode: string;\n\n  constructor(convInfo: backend_util.Conv3DInfo) {\n  this.outputShape = convInfo.inShape;\n\n  const filterDepth = convInfo.filterDepth;\n  const filterHeight = convInfo.filterHeight;\n  const filterWidth = convInfo.filterWidth;\n  const strideDepth = convInfo.strideDepth;\n  const strideHeight = convInfo.strideHeight;\n  const strideWidth = convInfo.strideWidth;\n\n  const padFront = filterDepth - 1 - convInfo.padInfo.front;\n  const padTop = filterHeight - 1 - convInfo.padInfo.top;\n  const padLeft = filterWidth - 1 - convInfo.padInfo.left;\n\n  this.userCode = `\n  const ivec3 pads = ivec3(${padFront}, ${padTop}, ${padLeft});\n\n  void main() {\n  ivec5 coords = getOutputCoords();\n  int batch = coords.x;\n  int d1 = coords.u;\n\n\n  ivec3 dyCorner = ivec3(coords.y, coords.z, coords.w) - pads;\n  int dyFCorner = dyCorner.x;\n  int dyRCorner = dyCorner.y;\n  int dyCCorner = dyCorner.z;\n\n  float dotProd = 0.0;\n  for (int wF = 0; wF < ${filterDepth}; wF++) {\n  float dyF = float(dyFCorner + wF) / ${strideDepth}.0;\n\n  if (dyF < 0.0 || dyF >= ${convInfo.outDepth}.0 || fract(dyF) > 0.0) {\n  continue;\n  }\n  int idyF = int(dyF);\n\n  int wFPerm = ${filterDepth} - 1 - wF;\n\n  for (int wR = 0; wR < ${filterHeight}; wR++) {\n  float dyR = float(dyRCorner + wR) / ${strideHeight}.0;\n\n  if (dyR < 0.0 || dyR >= ${convInfo.outHeight}.0 ||\n  fract(dyR) > 0.0) {\n  continue;\n  }\n  int idyR = int(dyR);\n\n  int wRPerm = ${filterHeight} - 1 - wR;\n\n  for (int wC = 0; wC < ${filterWidth}; wC++) {\n  float dyC = float(dyCCorner + wC) / ${strideWidth}.0;\n\n  if (dyC < 0.0 || dyC
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>= ${convInfo.outWidth}.0 ||\n fract(dyC) > 0.0) {\n continue;\n }\n int idyC = int(dyC);\n\n int wCPerm = ${filterWidth} - 1 - wC;\n\n for (int d2 = 0; d2 < ${convInfo.outChannels}; d2++) {\n float xValue = getDy(batch, idyF, idyR, idyC, d2);\n float wValue = getW(wFPerm, wRPerm, wCPerm, d1, d2);\n dotProd += xValue * wValue;\n }\n }\n }\n }\n setOutput(dotProd);\n }\n `;\n }\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed
on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n */\n\nimport {backend_util, Conv2DBackpropFilter, Conv2DBackpropFilterAttrs, Conv2DBackpropFilterInputs, KernelConfig, KernelFunc} from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL} from '../backend_webgl';\nimport {Conv2DDerFilterProgram} from '../conv_backprop_gpu';\n\nexport function conv2DBackpropFilter(args: {\n inputs: Conv2DBackpropFilterInputs,\n attrs: Conv2DBackpropFilterAttrs,\n backend: MathBackendWebGL\n}) {\n const {inputs, backend, attrs} = args;\n const {x, dy} = inputs;\n const {strides, pad, dataFormat, dimRoundingMode, filterShape} = attrs;\n\n const $dataFormat = backend_util.convertConv2DDataFormat(dataFormat);\n const convInfo = backend_util.computeConv2DInfo(\n x.shape as [number, number, number, number], filterShape, strides,\n 1 /* dilations */, pad, dimRoundingMode, false /* depthwise */,\n $dataFormat);\n\n const program = new Conv2DDerFilterProgram(convInfo);\n return backend.runWebGLProgram(program, [x, dy], 'float32');\n}\n\nexport const conv2DBackpropFilterConfig: KernelConfig = {\n kernelName: Conv2DBackpropFilter,\n backendName: 'webgl',\n kernelFunc: conv2DBackpropFilter as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n
* See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n */\n\nimport {backend_util, Conv2DBackpropInput, Conv2DBackpropInputAttrs, Conv2DBackpropInputInputs, KernelConfig, KernelFunc} from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL} from '../backend_webgl';\nimport {Conv2DDerInputProgram} from '../conv_backprop_gpu';\n\nexport function conv2DBackpropInput(args: {\n inputs: Conv2DBackpropInputInputs,\n attrs: Conv2DBackpropInputAttrs,\n backend: MathBackendWebGL\n}) {\n const {inputs, backend, attrs} = args;\n const {dy, filter} = inputs;\n const {inputShape, strides, pad, dataFormat, dimRoundingMode} = attrs;\n\n const $dataFormat = backend_util.convertConv2DDataFormat(dataFormat);\n const convInfo = backend_util.computeConv2DInfo(\n inputShape, filter.shape as [number, number, number, number], strides,\n 1 /* dilations
*/, pad, dimRoundingMode, false, $dataFormat);\n\n const program = new Conv2DDerInputProgram(convInfo);\n return backend.runWebGLProgram(program, [dy, filter], 'float32');\n}\n\nexport const conv2DBackpropInputConfig: KernelConfig = {\n kernelName: Conv2DBackpropInput,\n backendName: 'webgl',\n kernelFunc: conv2DBackpropInput as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing,

software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n
 * ==========\n
*/\n\nimport {backend_util, Conv3D, Conv3DAttrs, Conv3DInputs, KernelConfig, KernelFunc} from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL} from '../backend_webgl';\nimport {Conv3DProgram} from '../conv_gpu';\n\nexport function conv3D(\n args:\n {inputs: Conv3DInputs, attrs: Conv3DAttrs, backend: MathBackendWebGL}) {\n const {inputs, backend, attrs} = args;\n const {x, filter} = inputs;\n const {strides, pad, dilations} = attrs;\n\n const convInfo = backend_util.computeConv3DInfo(\n x.shape as [number, number, number, number, number],\n filter.shape as [number, number, number, number, number], strides,\n dilations, pad);\n\n const program = new Conv3DProgram(convInfo);\n return backend.runWebGLProgram(program, [x, filter], 'float32');\n}\n\nexport const conv3DConfig: KernelConfig = {\n kernelName: Conv3D,\n backendName: 'webgl',\n kernelFunc: conv3D as {} as KernelFunc,\n};\n","/**\n
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 * ==========\n
*/\n\nimport {backend_util, Conv3DBackpropFilterV2, Conv3DBackpropFilterV2Attrs, Conv3DBackpropFilterV2Inputs, KernelConfig, KernelFunc} from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL} from '../backend_webgl';\nimport {Conv3DDerFilterProgram} from '../conv_backprop_gpu';\n\nexport
 function conv3DBackpropFilterV2(args: {\n inputs: Conv3DBackpropFilterV2Inputs,\n attrs: Conv3DBackpropFilterV2Attrs,\n backend: MathBackendWebGL\n}) {\n const {inputs, backend, attrs} = args;\n const {x, dy} = inputs;\n const {strides, pad, filterShape} = attrs;\n\n const convInfo = backend_util.computeConv3DInfo(\n x.shape as [number, number, number, number, number], filterShape, strides,\n 1 /* dilations */, pad);\n\n const program = new Conv3DDerFilterProgram(convInfo);\n return backend.runWebGLProgram(program, [x, dy], 'float32');\n}\n\nexport const conv3DBackpropFilterV2Config: KernelConfig = {\n kernelName: Conv3DBackpropFilterV2,\n backendName: 'webgl',\n kernelFunc: conv3DBackpropFilterV2 as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You
 may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
 * ==========\n
*/\n\nimport {backend_util, Conv3DBackpropInputV2, Conv3DBackpropInputV2Attrs, Conv3DBackpropInputV2Inputs, KernelConfig, KernelFunc} from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL} from '../backend_webgl';\nimport {Conv3DDerInputProgram} from '../conv_backprop_gpu';\n\nexport function conv3DBackpropInput(args: {\n inputs: Conv3DBackpropInputV2Inputs,\n attrs: Conv3DBackpropInputV2Attrs,\n backend: MathBackendWebGL\n}) {\n const {inputs, backend, attrs} = args;\n const {dy, filter}
 = inputs;\n const {pad, strides, inputShape} = attrs;\n\n const convInfo = backend_util.computeConv3DInfo(\n inputShape, filter.shape as [number, number, number, number, number],\n strides, 1 /* dilations */, pad);\n\n const program = new Conv3DDerInputProgram(convInfo);\n return backend.runWebGLProgram(program, [dy,

filter], 'float32');\n}\n\nexport const conv3DBackpropInputConfig: KernelConfig = {\n kernelName: Conv3DBackpropInputV2,\n backendName: 'webgl',\n kernelFunc: conv3DBackpropInput as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n
 * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n
*/\n\nimport {Cos, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {CHECK_NAN_SNIPPET_UNARY, unaryKernelFunc} from '../kernel_utils/kernel_funcs_utils';\n\nconst COS = CHECK_NAN_SNIPPET_UNARY + `\n  return cos(x);\n`;\n\nexport const cos = unaryKernelFunc({opSnippet: COS});\n\nexport const cosConfig: KernelConfig = {\n kernelName: Cos,\n backendName: 'webgl',\n kernelFunc: cos,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable
 law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n
*/\n\nimport {Cosh, KernelConfig} from '@tensorflow/tfjs-core';\nimport {unaryKernelFunc} from '../kernel_utils/kernel_funcs_utils';\n\nconst COSH = `\n  float e2x = exp(-x);\n  return (e2x + 1.0 / e2x) / 2.0;\n`;\n\nexport const cosh = unaryKernelFunc({opSnippet: COSH});\n\nexport const coshConfig: KernelConfig = {\n kernelName: Cosh,\n backendName: 'webgl',\n kernelFunc: cosh,\n};\n","/**\n * @license\n * Copyright 2017 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may
 obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n
*/\n\nimport {GPGPUProgram} from './gpgpu_math';\n\nexport class CropAndResizeProgram implements GPGPUProgram {\n variableNames = ['Image', 'Boxes', 'BoxInd'];\n outputShape: number[] = [];\n userCode: string;\n\n constructor(\n   imageShape: [number, number, number, number], boxShape: [number, number],\n   cropSize: [number, number], method: 'bilinear'|'nearest',\n   extrapolationValue: number) {\n   const [batch, imageHeight, imageWidth, depth] = imageShape;\n   const [numBoxes,
 ] = boxShape;\n   const [cropHeight, cropWidth] = cropSize;\n   this.outputShape = [numBoxes, cropHeight, cropWidth, depth];\n   const methodId = method === 'bilinear' ? 1 : 0;\n\n   const [inputHeightFloat, inputWidthFloat] =\n   [`${imageHeight - 1}.0`, `${imageWidth - 1}.0`];\n\n   const [heightRatio, heightScale, inY] = cropHeight > 1 ?\n   [\n   `${(imageHeight - 1) / (cropHeight - 1)}`,\n   '(y2-y1) * height_ratio',\n   `y1*${inputHeightFloat} + float(y)*(height_scale)`,\n   ] :\n   [\n   '0.0',\n   '0.0',\n   `0.5 * (y1+y2) * ${inputHeightFloat}`,\n   ];\n   const [widthRatio, widthScale, inX] = cropWidth > 1 ?\n   [\n   `${(imageWidth - 1) / (cropWidth - 1)}`,\n   '(x2-x1) * width_ratio',\n   `x1*${inputWidthFloat} + float(x)*(width_scale)`,\n   ] :\n   [\n   '0.0',\n   '0.0',\n   `0.5 * (x1+x2) * ${inputWidthFloat}`,\n   ];\n\n   // Reference
 implementation\n   // tslint:disable-next-line:max-line-length\n   // https://github.com/tensorflow/tensorflow/blob/master/tensorflow/core/kernels/crop_and_resize_op_gpu.cu.cc\n

```
this.userCode = `\n const float height_ratio = float(${heightRatio});\n const float width_ratio = float(${widthRatio});\n void main() {\n ivec4 coords = getOutputCoords();\n int b = coords[0];\n int y = coords[1];\n int x = coords[2];\n int d = coords[3];\n\n // get box vals\n float y1 = getBoxes(b,0);\n float x1 = getBoxes(b,1);\n float y2 = getBoxes(b,2);\n float x2 = getBoxes(b,3);\n\n // get image in batch index\n int bInd = round(getBoxInd(b));\n if(bInd < 0 || bInd >= ${batch}) {\n return;\n }\n\n float height_scale = ${heightScale};\n float width_scale = ${widthScale};\n\n float in_y = ${inY};\n if( in_y < 0.0 || in_y > ${inputHeightFloat} ) {\n setOutput(float(${extrapolationValue}));\n return;\n }\n float in_x = ${inX};\n if( in_x < 0.0 || in_x > ${inputWidthFloat} ) {\n setOutput(float(${extrapolationValue}));\n return;\n }\n\n vec2 sourceFracIndexCR = vec2(in_x,in_y);\n if(${methodId} == 1) {\n // Compute the four integer indices.\n ivec2 sourceFloorCR = ivec2(sourceFracIndexCR);\n ivec2 sourceCeilCR = ivec2(ceil(sourceFracIndexCR));\n\n float topLeft = getImage(b, sourceFloorCR.y, sourceFloorCR.x, d);\n float bottomLeft = getImage(b, sourceCeilCR.y, sourceFloorCR.x, d);\n float topRight = getImage(b, sourceFloorCR.y, sourceCeilCR.x, d);\n float bottomRight = getImage(b, sourceCeilCR.y, sourceCeilCR.x, d);\n\n vec2 fracCR = sourceFracIndexCR - vec2(sourceFloorCR);\n\n float top = topLeft + (topRight - topLeft) * fracCR.x;\n float bottom = bottomLeft + (bottomRight - bottomLeft) * fracCR.x;\n float newValue = top + (bottom - top) * fracCR.y;\n setOutput(newValue);\n } else {\n // Compute the coordinators of nearest neighbor point.\n ivec2 sourceNearestCR = ivec2(floor(\n sourceFracIndexCR + vec2(0.5,0.5)));\n float newValue = getImage(b, sourceNearestCR.y, sourceNearestCR.x, d);\n setOutput(newValue);\n }\n }\n `;\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========================================================================\n */\n\nimport {CropAndResize, CropAndResizeAttrs, CropAndResizeInputs, KernelConfig, KernelFunc, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL} from '../backend_webgl';\nimport {CropAndResizeProgram} from '../crop_and_resize_gpu';\n\nexport const cropAndResize = (args: {\n inputs: CropAndResizeInputs,\n backend: MathBackendWebGL,\n attrs: CropAndResizeAttrs\n}): TensorInfo => {\n const {inputs, backend, attrs} = args;\n const {image, boxes, boxInd} = inputs;\n const {cropSize, method, extrapolationValue} = attrs;\n\n const program = new CropAndResizeProgram(\n image.shape as [number, number, number, number],\n boxes.shape as [number, number], cropSize, method, extrapolationValue);\n return backend.runWebGLProgram(program, [image, boxes, boxInd], 'float32');\n};\n\nexport const cropAndResizeConfig: KernelConfig = {\n kernelName: CropAndResize,\n backendName: 'webgl',\n kernelFunc: cropAndResize as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========================================================================\n */\nimport {GPGPUContext} from './gpgpu_context';\nimport {GPGPUProgram} from './gpgpu_math';\nimport {getCoordsDataType} from
```

'./shader_compiler';\n\nexport class CumSumProgram implements GPGPUProgram {\n variableNames = ['x'];\n outputShape: number[];\n userCode: string;\n\n // Caching uniform location for speed.\n index: WebGLUniformLocation;\n\n constructor(shape: number[], exclusive: boolean, reverse: boolean) {\n this.outputShape = shape;\n const rank = shape.length;\n const val = exclusive ? '0.0' : `getX(${getCoords(rank, 'coords')})`;\n const length = shape[shape.length - 1];\n let condition = '';\n let idxString = '';\n // When exclusive is set, the cumsum op becomes roll op that copies the\n // value from the previous index based on the direction specified by the\n // reverse flag.\n if (exclusive) {\n condition = reverse ? `end != ${length - 1}` : 'end != 0';\n idxString = reverse ? 'end + 1' : 'end - 1';\n } else {\n condition = reverse ? `end + pow2 < ${length}` : 'end >= pow2';\n idxString = (reverse ? 'end + pow2' : 'end - pow2');\n }\n\n this.userCode = `\n uniform float index;\n void main() {\n ${getCoordsDataType(rank)} coords = getOutputCoords();\n int end = ${getFinalCoord(rank, 'coords')};\n float val = ${val};\n int pow2 = int(pow(2.0, index));\n if (${condition}) {\n int idx = ${idxString};\n ${getFinalCoord(rank, 'coords')} = idx;\n val += getX(${getCoords(rank, 'coords')});\n }\n setOutput(val);\n }\n `;\n }\n\n getCustomSetupFunc(index: number) {\n return (gpgpu: GPGPUContext, webGLProgram: WebGLProgram) => {\n if (this.index == null) {\n this.index = gpgpu.getUniformLocation(webGLProgram, 'index');\n }\n gpgpu.gl.uniform1f(this.index, index);\n };\n }\n}\n\nfunction getCoords(rank: number, name: string): string {\n if (rank === 1) {\n return `${name}`;\n } else if (rank === 2) {\n return `${name}.x, ${name}.y`;\n } else if (rank === 3) {\n return `${name}.x, ${name}.y, ${name}.z`;\n } else if (rank === 4) {\n return `${name}.x, ${name}.y, ${name}.z, ${name}.w`;\n } else {\n throw Error(`Cumulative sum for rank ${rank} is not yet supported`);\n }\n}\n\nfunction getFinalCoord(rank: number, name: string): string {\n if (rank === 1) {\n return `${name}`;\n } else if (rank === 2) {\n return `${name}.y`;\n } else if (rank === 3) {\n return `${name}.z`;\n } else if (rank === 4) {\n return `${name}.w`;\n } else {\n throw Error(`Cumulative sum for rank ${rank} is not yet supported`);\n }\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==\n */\n\nimport {backend_util, Cumsum, CumsumAttrs, CumsumInputs, KernelConfig, KernelFunc, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL} from '../backend_webgl';\nimport {CumSumProgram} from '../cumsum_gpu';\n\nimport {identity} from './Identity';\nimport {transpose} from './Transpose';\n\nexport function cumsum(\n args:\n {inputs: CumsumInputs, backend: MathBackendWebGL, attrs: CumsumAttrs}):\n TensorInfo {\n const {inputs, backend, attrs} = args;\n const {x} = inputs;\n const {axis, exclusive, reverse} = attrs;\n\n const xRank = x.shape.length;\n const permutation = backend_util.getAxesPermutation([axis], xRank);\n let permutedX = x;\n if (permutation != null) {\n permutedX = transpose({inputs: {x}, backend, attrs: {perm: permutation}});\n }\n const permutedAxis = backend_util.getInnerMostAxes(1, xRank)[0];\n\n if (permutedAxis !== xRank - 1) {\n throw new Error(\n `WebGL cumsum shader expects an inner-most axis=${\n x.shape.length - 1} ` +\n `but got axis=${axis}`);\n }\n const size = permutedX.shape[permutedAxis];\n let result = identity({inputs: {x: permutedX}, backend});\n // Use cumsum parallel algorithm, ref:\n // https://developer.nvidia.com/gpugems/gpugems3/part-vi-gpu-computing/chapter-39-parallel-prefix-sum-scan-cuda\n\n for (let i = 0; i <= Math.ceil(Math.log2(size)) - 1; i++) {\n const program = new CumSumProgram(permutedX.shape, false, reverse);\n const customSetup = program.getCustomSetupFunc(i);\n const prevResult = result;\n result =\n backend.runWebGLProgram(program, [result], result.dtype, customSetup);\n backend.disposeIntermediateTensorInfo(prevResult);\n }\n // For

exclusive cumsum, shift the end result in the direction of sum\n // and add 0 to the front index.\n if (exclusive) {\n const program = new CumSumProgram(permutedX.shape, exclusive, reverse);\n   const prevResult = result;\n result = backend.runWebGLProgram(program, [result], result.dtype);\n backend.disposeIntermediateTensorInfo(prevResult);\n }\n\n if (permutation != null) {\n   const reversePermutation = backend_util.getUndoAxesPermutation(permutation);\n   const reverseTransposedResult = transpose(\n   {inputs: {x: result}, backend, attrs: {perm: reversePermutation}});\n\n backend.disposeIntermediateTensorInfo(result);\n   backend.disposeIntermediateTensorInfo(permutedX);\n\n return reverseTransposedResult;\n }\n\n return result;\n}\n\nexport const cumsumConfig: KernelConfig = {\n kernelName: Cumsum,\n backendName: 'webgl',\n kernelFunc: cumsum as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed
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==\n */\n\nimport {DenseBincount, DenseBincountAttrs, DenseBincountInputs, KernelConfig, KernelFunc, TensorInfo, TypedArray} from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL} from '../backend_webgl';\nimport {bincountImplCPU, bincountReduceImplCPU} from '../kernel_utils/shared';\n\nexport function denseBincount(args: {\n inputs: DenseBincountInputs,\n
  backend: MathBackendWebGL,\n attrs: DenseBincountAttrs\n}): TensorInfo {\n const {inputs, backend, attrs} = args;\n const {x, weights} = inputs;\n const {size, binaryOutput} = attrs;\n\n if (x.shape.length === 1) {\n   const xVals = backend.readSync(x.dataId) as TypedArray;\n   const weightsVals = backend.readSync(weights.dataId) as TypedArray;\n\n   const outVals =\n   bincountImplCPU(xVals, weightsVals, weights.dtype, weights.shape, size);\n\n   return backend.makeTensorInfo([size], weights.dtype, outVals);\n } else if (x.shape.length === 2) {\n const xBuf = backend.bufferSync(x);\n   const weightsBuf = backend.bufferSync(weights);\n\n   const outBuf = bincountReduceImplCPU(xBuf, weightsBuf, size, binaryOutput);\n\n   return backend.makeTensorInfo(outBuf.shape, weights.dtype, outBuf.values);\n }\n\n throw new Error(\n   `Error in denseBincount: input must be at most rank 2, but got rank` +\n   `${x.shape.length}.`);\n}\n\nexport const denseBincountConfig:
 KernelConfig = {\n kernelName: DenseBincount,\n backendName: 'webgl',\n kernelFunc: denseBincount as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n */\n\nimport {GPGPUProgram} from './gpgpu_math';\n\nexport class DepthToSpaceProgram implements GPGPUProgram {\n variableNames = ['x'];\n outputShape:
 number[] = [];\n userCode: string;\n blockSize: number;\n dataFormat: string;\n\n constructor(\n   outputShape: number[], blockSize: number, dataFormat: 'NHWC'|'NCHW') {\n   this.outputShape = outputShape;\n this.blockSize = blockSize;\n   this.dataFormat = dataFormat;\n   this.userCode = `\n   void main() {\n   ivec4 coords = getOutputCoords();\n   int b = coords[0];\n   int h = ${this.getHeightCoordString()};\n   int w = ${this.getWidthCoordString()};\n   int d = ${this.getDepthCoordString()};\n\n   int in_h = h / ${blockSize};\n int offset_h = imod(h, ${blockSize});\n   int in_w = w / ${blockSize};\n   int offset_w = imod(w,

${blockSize});\n int offset_d = (offset_h * ${blockSize} + offset_w) *\n ${this.getOutputDepthSize()};\n int in_d = d + offset_d;\n\n float result = ${this.getInputSamplingString()};\n setOutput(result);\n }\n `;\n }\n\n private getHeightCoordString(): string {\n if (this.dataFormat === 'NHWC') {\n return `coords[1]`;\n } else {\n return `coords[2]`;\n }\n }\n\n private getWidthCoordString(): string {\n if (this.dataFormat === 'NHWC') {\n return `coords[2]`;\n } else {\n return `coords[3]`;\n }\n }\n\n private getDepthCoordString(): string {\n if (this.dataFormat === 'NHWC') {\n return `coords[3]`;\n } else {\n return `coords[1]`;\n }\n }\n\n private getOutputDepthSize(): number {\n if (this.dataFormat === 'NHWC') {\n return this.outputShape[3];\n } else {\n return this.outputShape[1];\n }\n }\n\n private getInputSamplingString(): string {\n if (this.dataFormat === 'NHWC') {\n return `getX(b, in_h, in_w, in_d)`;\n } else {\n return `getX(b, in_d, in_h, in_w)`;\n }\n }\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {DepthToSpace, DepthToSpaceAttrs, DepthToSpaceInputs, KernelConfig, KernelFunc, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL} from '../backend_webgl';\nimport {DepthToSpaceProgram} from '../depth_to_space_gpu';\n\nexport function depthToSpace(args: {\n inputs: DepthToSpaceInputs,\n backend: MathBackendWebGL,\n attrs: DepthToSpaceAttrs\n}): TensorInfo {\n const {inputs, backend, attrs} = args;\n const {x} = inputs;\n const {blockSize, dataFormat} = attrs;\n\n util.assert(\n blockSize > 1,\n () => `blockSize should be > 1 for depthToSpace, but was: ${blockSize}`);\n\n const batchSize = x.shape[0];\n const inputHeight = (dataFormat === 'NHWC') ? x.shape[1] : x.shape[2];\n const inputWidth = (dataFormat === 'NHWC') ? x.shape[2] : x.shape[3];\n const inputDepth = (dataFormat === 'NHWC') ? x.shape[3] : x.shape[1];\n\n const outputHeight = inputHeight * blockSize;\n const outputWidth = inputWidth * blockSize;\n const outputDepth = inputDepth / (blockSize * blockSize);\n\n const outputShape = (dataFormat === 'NHWC') ?\n [batchSize, outputHeight, outputWidth, outputDepth] :\n [batchSize, outputDepth, outputHeight, outputWidth];\n\n const program = new DepthToSpaceProgram(outputShape, blockSize, dataFormat);\n return backend.runWebGLProgram(program, [x], x.dtype);\n}\n\nexport const depthToSpaceConfig: KernelConfig = {\n kernelName: DepthToSpace,\n backendName: 'webgl',\n kernelFunc: depthToSpace as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2017 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {backend_util} from '@tensorflow/tfjs-core';\nimport {GPGPUProgram} from './gpgpu_math';\n\nexport class DepthwiseConv2DProgram implements GPGPUProgram {\n variableNames = ['x', 'W'];\n outputShape: number[];\n userCode: string;\n\n constructor(\n convInfo: backend_util.Conv2DInfo, addBias = false,\n activation: string = null, hasPreluActivation = false,\n hasLeakyReluAlpha = false) {\n this.outputShape = convInfo.outShape;\n\n const xNumRows = convInfo.inHeight;\n const xNumCols = convInfo.inWidth;\n const padTop = convInfo.padInfo.top;\n const padLeft = convInfo.padInfo.left;\n const strideHeight = convInfo.strideHeight;\n

```
const strideWidth = convInfo.strideWidth;\n    const dilationHeight = convInfo.dilationHeight;\n    const dilationWidth = convInfo.dilationWidth;\n    const filterHeight = convInfo.filterHeight;\n    const filterWidth = convInfo.filterWidth;\n    const channelMul = convInfo.outChannels / convInfo.inChannels;\n\n    let activationSnippet = '', applyActivationSnippet = '';\n    if (activation) {\n      if (hasPreluActivation) {\n activationSnippet = `float activation(float a) {\n          float b = getPreluActivationWeightsAtOutCoords();\n          ${activation}\n        }`;\n      } else if (hasLeakyReluAlpha) {\n        activationSnippet = `float activation(float a) {\n          float b = getLeakyreluAlphaAtOutCoords();\n          ${activation}\n        }`;\n      } else {\n activationSnippet = `\n          float activation(float x) {\n            ${activation}\n          }\n        `;\n      }\n\n applyActivationSnippet = `result = activation(result);`;\n    }\n\n    const addBiasSnippet = addBias ? 'result += getBiasAtOutCoords();' : '';\n    if (addBias) {\n      this.variableNames.push('bias');\n    }\n\n    if (hasPreluActivation) {\n      this.variableNames.push('preluActivationWeights');\n    }\n    if (hasLeakyReluAlpha) {\n      this.variableNames.push('leakyreluAlpha');\n    }\n\n    this.userCode = `\n      ${activationSnippet}\n\n      const ivec2 strides = ivec2(${strideHeight}, ${strideWidth});\n      const ivec2 pads = ivec2(${padTop}, ${padLeft});\n\n      void main() {\n        ivec4
 coords = getOutputCoords();\n        int batch = coords.x;\n        ivec2 xRCCorner = coords.yz * strides - pads;\n        int d2 = coords.w;\n        int d1 = d2 / ${channelMul};\n        int q = d2 - d1 * ${channelMul};\n\n        int xRCorner = xRCCorner.x;\n        int xCCorner = xRCCorner.y;\n\n        // Convolve x(?, ?, d1) with w(:, :, d1, q) to get y(yR, yC, d2).\n        // ? = to be determined. : = across all values in that axis.\n        float dotProd = 0.0;\n        // TODO(dsmilkov): Flatten the two for loops and vec4 the operations.\n        for (int wR = 0; wR < ${filterHeight}; wR++) {\n          int xR = xRCorner + wR * ${dilationHeight};\n\n          if (xR < 0 || xR >= ${xNumRows}) {\n            continue;\n          }\n\n          for (int wC = 0; wC < ${filterWidth}; wC++) {\n            int xC = xCCorner + wC * ${dilationWidth};\n\n            if (xC < 0 || xC >= ${xNumCols}) {\n              continue;\n            }\n\n            float xVal = getX(batch, xR,
 xC, d1);\n            float wVal = getW(wR, wC, d1, q);\n            dotProd += xVal * wVal;\n          }\n        }\n\n        float result = dotProd;\n        ${addBiasSnippet}\n        ${applyActivationSnippet}\n        setOutput(result);\n      }\n    `;\n  }\n}\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========================================================================\n */\n\nimport
 {backend_util, util} from '@tensorflow/tfjs-core';\n\nimport {GPGPUProgram} from './gpgpu_math';\n\nexport class DepthwiseConvPacked2DProgram implements GPGPUProgram {\n  variableNames = ['x', 'W'];\n  packedInputs = true;\n  packedOutput = true;\n  outputShape: number[];\n  userCode: string;\n\n  constructor(\n      convInfo: backend_util.Conv2DInfo, addBias = false,\n      activation: string = null, hasPreluActivation = false,\n      hasLeakyReluAlpha = false) {\n    this.outputShape = convInfo.outShape;\n\n    const xNumRows = convInfo.inHeight;\n    const xNumCols = convInfo.inWidth;\n    const padTop = convInfo.padInfo.top;\n    const padLeft = convInfo.padInfo.left;\n    const strideHeight = convInfo.strideHeight;\n    const strideWidth = convInfo.strideWidth;\n    const dilationHeight = convInfo.dilationHeight;\n    const dilationWidth = convInfo.dilationWidth;\n    const filterHeight = convInfo.filterHeight;\n    const filterWidth = convInfo.filterWidth;\n    const texelsAcross
 = filterWidth;\n\n    let mainLoop = `int xR; int xC; int xCOffset;`;\n\n    for (let r = 0; r < filterHeight; r++) {\n      for (let c = 0; c < filterWidth; c++) {\n        mainLoop += `\n          vec4 xTexelR${r}C${c * 2} = vec4(0.);\n          vec4 wR${r}C${c} = vec4(0.);\n          vec4 xR${r}C${c} = vec4(0.);`;\n      }\n    }\n\n    /**\n     * This vectorized implementation works by gathering the values needed for\n     * each output channel's dot product into vec4's and
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then multiplying them\n     * all together (this happens in the final double for-loop below). Most of\n     * the main loop consists of constructing these vec4's with the minimum\n     * number of texture2D calls, which means making use of all four returned\n     * values from a texture2D call at once.\n     */\n    for (let r = 0; r < filterHeight; r++) {\n      for (let texelC = 0; texelC < texelsAcross; texelC++) {\n        const c = texelC * 2;\n\n        mainLoop += `\n
xR = xRCorner + ${r *
 dilationHeight};\n          xC = xCCorner + ${c * dilationWidth};\n        `;\n\n        if (strideWidth === 1) {\n          if (c < filterWidth) {\n            // If padding is odd, the outer texels have to be composed.\n            if (padLeft % 2 === 1) {\n              // TODO: Ensure vec4 previous does not result in redundant sample,\n              // and avoid setting xTexelRC's that exceed the boundary in the\n              // first place rather than resetting them to vec4(0)).\n\n
// To compute xCOffset:\n              // - If padding is odd, we must add 1 to ensure we ask for an\n              // even-numbered row.\n              // - We subtract 2 to access the previous texel.\n\n              mainLoop += `\n
xCOffset = xC + 1;\n              if(xR >= 0 && xR < ${xNumRows} && xCOffset >= 0 && xCOffset < ${\n
    xNumCols}) {\n                xTexelR${r}C${c} = getX(batch, xR, xCOffset, d1);\n\n                // Need to manually
 clear unused channels in case\n                // we're reading from recycled texture.\n                if(xCOffset + 1 >=
 ${xNumCols}) {\n                  xTexelR${r}C${c}.zw = vec2(0.);\n                }\n              } else {\n
xTexelR${r}C${c} = vec4(0.);\n              }\n\n              xCOffset = xC + 1 - 2;\n              if(xR >= 0 && xR <
 ${xNumRows} && xCOffset >= 0 && xCOffset < ${\n                xNumCols}) {\n                vec4 previous =
 getX(batch, xR, xCOffset, d1);\n\n                // Need to manually clear unused channels in case\n                // we're
 reading from recycled texture.\n                if(xCOffset + 1 >= ${xNumCols}) {\n                  previous.zw =
 vec2(0.);\n                }\n\n                xR${r}C${c} = vec4(previous.zw, xTexelR${r}C${c}.xy);\n              } else
 {\n                xR${r}C${c} = vec4(0, 0, xTexelR${r}C${c}.xy);\n              }\n            `;\n          } else
 {\n            // Padding is even, so xRC corresponds to a single texel.\n            mainLoop += `\n              if(xR >=
 0 && xR < ${xNumRows} && xC >= 0 && xC < ${xNumCols}) {\n                xTexelR${r}C${c} = getX(batch,
 xR, xC, d1);\n              } else {\n                xTexelR${r}C${c} = vec4(0.);\n              }\n\n
xR${r}C${c} = xTexelR${r}C${c};\n            `;\n          }\n\n          if (c + 1 < filterWidth) {\n            // If
 dilation is even, the second entry should match the first\n            // (either both are composed or both are single
 samples). But if\n            // dilation is odd, then the second entry should be the opposite\n            // of the first (if
 the first is composed, the second is a single\n            // sample, and vice versa.)\n\n            const nextTexelOffset =
 padLeft % 2 === 0 ?\n                util.nearestLargerEven(dilationWidth) :\n                dilationWidth;\n\n
      if ((dilationWidth % 2 === 0 && padLeft % 2 === 1) ||\n                (dilationWidth % 2 !== 0 && padLeft % 2
 !== 1)) {\n              mainLoop += `\n                xCOffset = xC + ${padLeft % 2} + ${nextTexelOffset};\n\n
    if(xR >= 0 && xR < ${xNumRows} &&\n                  xCOffset >= 0 && xCOffset < ${xNumCols}) {\n
      xTexelR${r}C${c + 2} = getX(batch, xR, xCOffset, d1);\n                }\n              `;\n\n              // If dilation
 > 1 then the xRC's will not be able to share any\n              // values, so each xRC will require two unique calls to
 getX.\n              if (dilationWidth > 1) {\n                mainLoop += `\n                  xCOffset -= 2;\n
 if(xR >= 0 && xR < ${xNumRows} &&\n                    xCOffset >= 0 && xCOffset < ${xNumCols}) {\n
     xTexelR${r}C${c} = getX(batch, xR, xCOffset, d1);\n                  } else {\n                    xTexelR${r}C${c}
 = vec4(0.);\n                  }\n                `;\n              }\n\n              mainLoop += `\n                xR${r}C${c + 1}
 = vec4(\n                  xTexelR${r}C${c}.zw, xTexelR${r}C${c + 2}.xy);\n                `;\n            } else {\n
 mainLoop += `\n                xCOffset = xC + ${nextTexelOffset};\n\n                if(xR >= 0 && xR <
 ${xNumRows} &&\n                  xCOffset >= 0 && xCOffset < ${xNumCols}) {\n                  xTexelR${r}C${c
 + 2} = getX(batch, xR, xCOffset, d1);\n                }\n\n                xR${r}C${c + 1} = xTexelR${r}C${c + 2};\n
          `;\n            }\n          }\n        }\n      } else {  // stride > 1\n        if (c < filterWidth) {\n          mainLoop
 += `\n            if(xR >= 0 && xR < ${xNumRows}) {\n              `;\n\n            // Depending on whether padLeft is
 even or odd, we want either the\n            // xy or zw channels from X texels for xR${r}C${c}.
 If padLeft is\n            // even, xR${r}C${c + 1} is simply the zw channels of texels we've\n            // already
 sampled. But if padLeft is odd, xR${r}C{$c + 1}.zw will\n            // need to come from the xy channels of a new
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texel, hence the `vec4\n          // final` initialized below.\n          if (padLeft % 2 === 1) {\n            mainLoop +=
`\n              xCOffset = xC + 1 - ${strideWidth};\n              if(xCOffset >= 0 && xCOffset < ${xNumCols}) {\n
          xTexelR${r}C${c} = getX(batch, xR, xCOffset, d1);\n            } else {\n              xTexelR${r}C${c} =
vec4(0.);\n            }\n\n            if(xC + 1 >= 0 && xC + 1 < ${xNumCols}) {\n              xTexelR${r}C${c +
2} = getX(batch, xR, xC + 1, d1);\n            } else {\n              xTexelR${r}C${c + 2} = vec4(0.);\n
}\n\n            xR${r}C${c} = vec4(\n              xTexelR${r}C${c}.zw, xTexelR${r}C${c + 2}.zw);\n
`;\n\n
          if (c + 1 < filterWidth) {\n            mainLoop += `\n              vec4 final = vec4(0.);\n
xCOffset = xC + 1 + ${strideWidth};\n              if(xCOffset >= 0 && xCOffset < ${xNumCols}) {\n
final = getX(batch, xR, xCOffset, d1);\n              }\n              xR${r}C${c + 1} = vec4(xTexelR${r}C${c +
2}.xy, final.xy);\n            `;\n          }\n        } else {\n          mainLoop += `\n            if(xC >= 0 && xC <
${xNumCols}) {\n              xTexelR${r}C${c} = getX(batch, xR, xC, d1);\n            } else {\n
xTexelR${r}C${c} = vec4(0.);\n            }\n\n            xCOffset = xC + ${strideWidth};\n            if(xCOffset
>= 0 && xCOffset < ${xNumCols}) {\n              xTexelR${r}C${c + 2} = getX(batch, xR, xCOffset, d1);\n
    } else {\n              xTexelR${r}C${c + 2} = vec4(0.);\n            }\n\n            xR${r}C${c}
 = vec4(\n              xTexelR${r}C${c}.xy, xTexelR${r}C${c + 2}.xy);\n            `;\n\n          if (c + 1 <
filterWidth) {\n            mainLoop += `\n              xR${r}C${c + 1} = vec4(\n
xTexelR${r}C${c}.zw, xTexelR${r}C${c + 2}.zw);\n            `;\n          }\n        }\n\n        mainLoop +=
`}`;\n      }\n    }\n\n    if (c < filterWidth) {\n      mainLoop += `\n        vec4 wTexelR${r}C${c} =
getW(${r}, ${c}, d1, q);\n        wR${r}C${c} = vec4(wTexelR${r}C${c}.xz, wTexelR${r}C${c}.xz);\n
`;\n\n      if (c + 1 < filterWidth) {\n        mainLoop += `\n          vec4 wTexelR${r}C${c + 1} = getW(${r},
${c + 1}, d1, q);\n          wR${r}C${c + 1} =\n            vec4(wTexelR${r}C${c + 1}.xz, wTexelR${r}C${c +
1}.xz);`;\n      }\n    }\n  }\n\n  for (let r = 0; r < filterHeight; r++) {\n    for (let c = 0; c < filterWidth;
c++) {\n      mainLoop +=
 `dotProd += xR${r}C${c} * wR${r}C${c};`;\n    }\n  }\n\n  let activationSnippet = '', applyActivationSnippet =
'';\n  if (activation) {\n    if (hasPreluActivation) {\n      activationSnippet = `vec4 activation(vec4 a) {\n
vec4 b = getPreluActivationWeightsAtOutCoords();\n        ${activation}\n      }`;\n    } else if
(hasLeakyReluAlpha) {\n      activationSnippet = `vec4 activation(vec4 a) {\n        vec4 b =
getLeakyreluAlphaAtOutCoords();\n        ${activation}\n      }`;\n    } else {\n      activationSnippet = `vec4
activation(vec4 x) {\n        ${activation}\n      }`;\n    }\n\n    applyActivationSnippet = `result =
activation(result);`;\n  }\n\n  const addBiasSnippet = addBias ? 'result += getBiasAtOutCoords();' : '';\n  if
(addBias) {\n    this.variableNames.push('bias');\n  }\n\n  if (hasPreluActivation) {\n
this.variableNames.push('preluActivationWeights');\n  }\n  if (hasLeakyReluAlpha) {\n
this.variableNames.push('leakyreluAlpha');\n
  }\n\n  this.userCode = `\n    ${activationSnippet}\n\n    const ivec2 strides = ivec2(${strideHeight},
${strideWidth});\n    const ivec2 pads = ivec2(${padTop}, ${padLeft});\n\n    void main() {\n\n      ivec4 coords
= getOutputCoords();\n      int batch = coords.x;\n      ivec2 xRCCorner = coords.yz * strides - pads;\n      int d2
= coords.w;\n      int d1 = d2;\n      int q = 0;\n      int xRCorner = xRCCorner.x;\n      int xCCorner =
xRCCorner.y;\n\n      vec4 dotProd = vec4(0.);\n\n      ${mainLoop}\n\n      vec4 result = dotProd;\n
${addBiasSnippet}\n      ${applyActivationSnippet}\n      setOutput(result);\n    }\n  `;\n}\n","/**\n *
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==========================================================================\n
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*/\n\nimport {backend_util, DepthwiseConv2dNative, DepthwiseConv2dNativeAttrs,
DepthwiseConv2dNativeInputs, env, KernelConfig, KernelFunc, util} from '@tensorflow/tfjs-core';\n\nimport
{MathBackendWebGL} from '../backend_webgl';\nimport {DepthwiseConv2DProgram} from
'../conv_gpu_depthwise';\nimport {DepthwiseConvPacked2DProgram} from
'../conv_packed_gpu_depthwise';\n\nexport function depthwiseConv2dNative(args: {\n  inputs:
DepthwiseConv2dNativeInputs,\n  attrs: DepthwiseConv2dNativeAttrs,\n  backend: MathBackendWebGL\n}) {\n
const {inputs, backend,
 attrs} = args;\n  const {x, filter} = inputs;\n  const {strides, pad, dilations, dimRoundingMode} = attrs;\n\n  let
$dilations = dilations;\n  if ($dilations == null) {\n    $dilations = [1, 1];\n  }\n\n  util.assert(\n
backend_util.eitherStridesOrDilationsAreOne(strides, $dilations),\n      () => 'Error in depthwiseConv2d: Either
strides or dilations must be ' +\n          `1. Got strides ${strides} and dilations '${$dilations}'`);\n\n  const convInfo =
backend_util.computeConv2DInfo(\n      x.shape as [number, number, number, number],\n      filter.shape as
[number, number, number, number], strides, $dilations,\n      pad, dimRoundingMode, true /* depthwise */);\n\n  let
program: DepthwiseConv2DProgram|DepthwiseConvPacked2DProgram;\n  if
(env().getBool('WEBGL_PACK_DEPTHWISECONV') && convInfo.strideWidth <= 2 &&\n
convInfo.outChannels / convInfo.inChannels === 1) {\n    program = new
DepthwiseConvPacked2DProgram(convInfo);\n  } else {\n    program = new
DepthwiseConv2DProgram(convInfo);\n
  }\n\n  return backend.runWebGLProgram(program, [x, filter], 'float32');\n}\n\nexport const
depthwiseConv2dNativeConfig: KernelConfig = {\n  kernelName: DepthwiseConv2dNative,\n  backendName:
'webgl',\n  kernelFunc: depthwiseConv2dNative as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2018
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==========================================================================\n
 */\n\nimport {backend_util} from '@tensorflow/tfjs-core';\nimport {GPGPUProgram} from
'./gpgpu_math';\n\nexport class DepthwiseConv2DDerFilterProgram implements GPGPUProgram {\n
variableNames = ['x', 'dy'];\n  outputShape: number[];\n  userCode: string;\n\n  constructor(convInfo:
backend_util.Conv2DInfo) {\n    this.outputShape = convInfo.filterShape;\n\n    const strideHeight =
convInfo.strideHeight;\n    const strideWidth = convInfo.strideWidth;\n    const padTop = convInfo.padInfo.top;\n
const padLeft = convInfo.padInfo.left;\n    const channelMul = convInfo.outChannels / convInfo.inChannels;\n\n
this.userCode = `\n      void main() {\n        ivec4 coords = getOutputCoords();\n        int wR = coords.x;\n        int
wC = coords.y;\n        int d1 = coords.z;\n        int dm = coords.w;\n        int d2 = d1 * ${channelMul} + dm;\n\n
float dotProd = 0.0;\n\n        // TO DO: Vec4 over the batch size\n        for (int b = 0; b < ${convInfo.batchSize};
b++) {\n
        for (int yR = 0; yR < ${convInfo.outHeight}; yR++) {\n          int xR = wR + yR * ${strideHeight} -
${padTop};\n\n          if (xR < 0 || xR >= ${convInfo.inHeight}) {\n            continue;\n          }\n\n          for (int
yC = 0; yC < ${convInfo.outWidth}; yC++) {\n            int xC = wC + yC * ${strideWidth} - ${padLeft};\n\n
  if (xC < 0 || xC >= ${convInfo.inWidth}) {\n              continue;\n            }\n\n            float dyValue = getDy(b,
yR, yC, d2);\n            float xValue = getX(b, xR, xC, d1);\n            dotProd += (xValue * dyValue);\n          }\n
    }\n        }\n        setOutput(dotProd);\n      }\n    `;\n  }\n}\n\nexport class DepthwiseConv2DDerInputProgram
implements GPGPUProgram {\n  variableNames = ['dy', 'W'];\n  outputShape: number[];\n  userCode: string;\n\n
constructor(convInfo: backend_util.Conv2DInfo) {\n    this.outputShape = convInfo.inShape;\n\n    const
filterHeight = convInfo.filterHeight;\n
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const filterWidth = convInfo.filterWidth;\n const strideHeight = convInfo.strideHeight;\n const strideWidth = convInfo.strideWidth;\n\n const padTop = filterHeight - 1 - convInfo.padInfo.top;\n const padLeft = filterWidth - 1 - convInfo.padInfo.left;\n const channelMul = convInfo.outChannels / convInfo.inChannels;\n\n this.userCode = `\n const ivec2 pads = ivec2(${padTop}, ${padLeft});\n\n void main() {\n ivec4 coords = getOutputCoords();\n int batch = coords[0];\n int d1 = coords[3];\n ivec2 dyCorner = coords.yz - pads;\n int dyRCorner = dyCorner.x;\n int dyCCorner = dyCorner.y;\n\n float dotProd = 0.0;\n\n for (int wR = 0; wR < ${filterHeight}; wR++) {\n float dyR = float(dyRCorner + wR) / ${strideHeight}.0;\n\n if (dyR < 0.0 || dyR >= ${convInfo.outHeight}.0 || fract(dyR) > 0.0) {\n continue;\n }\n int idyR = int(dyR);\n\n int wRPerm = ${filterHeight} - 1 - wR;\n\n for (int wC = 0; wC < ${filterWidth}; wC++) {\n float dyC = float(dyCCorner + wC) / ${strideWidth}.0;\n\n if (dyC < 0.0 || dyC >= ${convInfo.outWidth}.0 ||\n fract(dyC) > 0.0) {\n continue;\n }\n int idyC = int(dyC);\n\n int wCPerm = ${filterWidth} - 1 - wC;\n\n // TO DO: Vec4 over the channelMul\n for (int dm = 0; dm < ${channelMul}; dm++) {\n int d2 = d1 * ${channelMul} + dm;\n float xValue = getDy(batch, idyR, idyC, d2);\n float wValue = getW(wRPerm, wCPerm, d1, dm);\n dotProd += xValue * wValue;\n }\n }\n }\n setOutput(dotProd);\n }\n `;\n }\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n
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/\n\nimport {backend_util, DepthwiseConv2dNativeBackpropFilter, DepthwiseConv2dNativeBackpropFilterAttrs, DepthwiseConv2dNativeBackpropFilterInputs, KernelConfig, KernelFunc} from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL} from '../backend_webgl';\nimport {DepthwiseConv2DDerFilterProgram} from '../conv_backprop_gpu_depthwise';\n\nexport function depthwiseConv2dNativeBackpropFilter(args: {\n inputs: DepthwiseConv2dNativeBackpropFilterInputs,\n attrs: DepthwiseConv2dNativeBackpropFilterAttrs,\n backend: MathBackendWebGL\n}) {\n const {inputs, backend, attrs} = args;\n const {x, dy} = inputs;\n const {strides, dilations, pad, dimRoundingMode, filterShape} = attrs;\n\n const convInfo = backend_util.computeConv2DInfo(\n x.shape as [number, number, number, number], filterShape, strides,\n dilations, pad, dimRoundingMode, true / depthwise */);\n\n const program = new DepthwiseConv2DDerFilterProgram(convInfo);\n return backend.runWebGLProgram(program, [x, dy], 'float32');\n}\n\nexport const depthwiseConv2dNativeBackpropFilterConfig: KernelConfig = {\n kernelName: DepthwiseConv2dNativeBackpropFilter,\n backendName: 'webgl',\n kernelFunc: depthwiseConv2dNativeBackpropFilter as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n
*/\n\nimport {backend_util, DepthwiseConv2dNativeBackpropInput, DepthwiseConv2dNativeBackpropInputAttrs, DepthwiseConv2dNativeBackpropInputInputs, KernelConfig, KernelFunc} from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL} from '../backend_webgl';\nimport {DepthwiseConv2DDerInputProgram} from '../conv_backprop_gpu_depthwise';\n\nexport function depthwiseConv2dNativeBackpropInput(args: {\n inputs: DepthwiseConv2dNativeBackpropInputInputs,\n attrs: DepthwiseConv2dNativeBackpropInputAttrs,\n backend:

MathBackendWebGL\n})
{\n const {inputs, backend, attrs} = args;\n const {dy, filter} = inputs;\n const {strides, dilations, pad, dimRoundingMode, inputShape} = attrs;\n\n const convInfo = backend_util.computeConv2DInfo(\n   inputShape, filter.shape as [number, number, number, number], strides,\n   dilations, pad, dimRoundingMode, true /* depthwise */);\n\n const program = new DepthwiseConv2DDerInputProgram(convInfo);\n return backend.runWebGLProgram(program, [dy, filter], 'float32');\n}\n\nexport const depthwiseConv2dNativeBackpropInputConfig: KernelConfig = {\n kernelName: DepthwiseConv2dNativeBackpropInput,\n backendName: 'webgl',\n kernelFunc: depthwiseConv2dNativeBackpropInput as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n
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*/\n\nimport {GPGPUProgram} from './gpgpu_math';\n\nexport class DiagProgram implements GPGPUProgram {\n variableNames = ['X'];\n outputShape: number[];\n userCode: string;\n\n constructor(size: number) {\n   this.outputShape = [size, size];\n   this.userCode = `\n      void main() {\n        ivec2 coords = getOutputCoords();\n        float val = coords[0] == coords[1] ? getX(coords[0]) : 0.0;\n        setOutput(val);\n      }\n    `;\n }\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
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*/\n\nimport {Diag, DiagInputs, KernelConfig, KernelFunc, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL} from '../backend_webgl';\nimport {DiagProgram} from '../diag_gpu';\nimport {reshape} from './Reshape';\n\nexport function diag(args: {inputs: DiagInputs, backend: MathBackendWebGL}):\n   TensorInfo {\n const {inputs, backend} = args;\n const {x} = inputs;\n\n const outShape = [...x.shape, ...x.shape];\n const xSize = util.sizeFromShape(x.shape);\n\n const flat = reshape({inputs: {x}, backend, attrs: {shape: [xSize]}});\n\n const program = new DiagProgram(xSize);\n const res = backend.runWebGLProgram(program, [flat], flat.dtype);\n\n const out = reshape({inputs: {x: res}, backend, attrs: {shape: outShape}});\n\n backend.disposeIntermediateTensorInfo(flat);\n backend.disposeIntermediateTensorInfo(res);\n\n return out;\n}\n\nexport const diagConfig: KernelConfig = {\n kernelName: Diag,\n backendName: 'webgl',\n kernelFunc: diag as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2017 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in
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==\n
*/\n\nimport {backend_util} from '@tensorflow/tfjs-core';\nimport {GPGPUProgram} from './gpgpu_math';\n\nexport class Dilation2DProgram implements GPGPUProgram {\n variableNames = ['x', 'W'];\n

outputShape: number[];\n userCode: string;\n\n constructor(convInfo: backend_util.Conv2DInfo) {\n this.outputShape = convInfo.outShape;\n\n   const {\n   inHeight,\n   inWidth,\n   padInfo,\n   strideHeight,\n   strideWidth,\n   filterHeight,\n   filterWidth,\n   dilationHeight,\n   dilationWidth\n   } = convInfo;\n\n const {top: padTop, left: padLeft} = padInfo;\n\n   this.userCode = `\n   const ivec2
 strides = ivec2(${strideHeight}, ${strideWidth});\n   const ivec2 pads = ivec2(${padTop}, ${padLeft});\n const float neg_infinity = -3.4e38;\n\n   void main() {\n   ivec4 coords = getOutputCoords();\n   int batch = coords.x;\n   int d1 = coords.w;\n   ivec2 outTopLeftCorner =\n   coords.yz * strides - pads;\n   int hBeg = outTopLeftCorner.x;\n   int wBeg = outTopLeftCorner.y;\n\n   float curVal = neg_infinity;\n   for (int h = 0; h < ${filterHeight}; h++) {\n   int hIn = hBeg + h * ${dilationHeight};\n\n   if (hIn >= 0 && hIn < ${inHeight}) {\n   for (int w = 0; w < ${filterWidth}; w++) {\n   int wIn = wBeg + w * ${dilationWidth};\n\n   if (wIn >= 0 && wIn < ${inWidth}) {\n   float xVal = getX(batch, hIn, wIn, d1);\n   float wVal = getW(h, w, d1);\n\n   float val = xVal + wVal;\n   if (val > curVal) {\n
curVal =
 val;\n   }\n   }\n   }\n   }\n   }\n\n   float result = curVal;\n   setOutput(result);\n   }\n   `;\n }\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
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*/\n\nimport {backend_util, Dilation2D, Dilation2DAttrs, Dilation2DInputs, KernelConfig, KernelFunc, TensorInfo}
 from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL} from '../backend_webgl';\nimport {Dilation2DProgram} from '../dilation_gpu';\nimport {reshape} from './Reshape';\n\nexport function dilation2D(args: {\n inputs: Dilation2DInputs,\n attrs: Dilation2DAttrs,\n backend: MathBackendWebGL\n}) {\n const {inputs, backend, attrs} = args;\n const {x, filter} = inputs;\n const {strides, pad, dilations} = attrs;\n\n const convInfo = backend_util.computeDilation2DInfo(\n   x.shape as [number, number, number, number],\n filter.shape as [number, number, number], strides, pad,\n   'NHWC' /* dataFormat */, dilations);\n let out: TensorInfo;\n\n const program = new Dilation2DProgram(convInfo);\n out = backend.runWebGLProgram(program, [x, filter], 'float32');\n\n const outReshaped =\n   reshape({inputs: {x: out}, backend, attrs: {shape: convInfo.outShape}});\n backend.disposeIntermediateTensorInfo(out);\n\n return outReshaped;\n}\n\nexport const dilation2DConfig: KernelConfig
 = {\n kernelName: Dilation2D,\n backendName: 'webgl',\n kernelFunc: dilation2D as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n
*/\n\nimport {Elu, KernelConfig, KernelFunc} from '@tensorflow/tfjs-core';\nimport {unaryKernelFunc} from '../kernel_utils/kernel_funcs_utils';\n\nconst ELU = `return
 (x >= 0.0) ? x : (exp(x) - 1.0);`;\n\nconst ELU_PACKED = `\n vec4 result;\n\n result.r = (x.r >= 0.0) ? x.r : (exp(x.r) - 1.0);\n result.g = (x.g >= 0.0) ? x.g : (exp(x.g) - 1.0);\n result.b = (x.b >= 0.0) ? x.b : (exp(x.b) - 1.0);\n result.a = (x.a >= 0.0) ? x.a : (exp(x.a) - 1.0);\n\n return result;\n`;\n\nconst elu = unaryKernelFunc({opSnippet:

ELU, packedOpSnippet: ELU_PACKED});\n\nexport const eluConfig: KernelConfig = {\n kernelName: Elu,\n backendName: 'webgl',\n kernelFunc: elu as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ===\n */\n\nimport {EluGrad, EluGradInputs, env, KernelConfig, KernelFunc, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL} from '../backend_webgl';\nimport {BinaryOpProgram} from '../binaryop_gpu';\nimport {BinaryOpPackedProgram} from '../binaryop_packed_gpu';\n\nconst ELU_DER = `return (b >= 1.0) ? a : a * (b + 1.0);`;\nconst ELU_DER_PACKED = `\n  vec4 bGTEZero = vec4(greaterThanEqual(b, vec4(0.)));\n  return (bGTEZero * a) + ((vec4(1.0) - bGTEZero) * (a * (b + vec4(1.0))));\n`;\n\nexport const eluGrad =\n   (args: {inputs: EluGradInputs, backend: MathBackendWebGL}): TensorInfo => {\n   const {inputs, backend} = args;\n   const {dy, y} = inputs;\n\n   const program = env().getBool('WEBGL_PACK_BINARY_OPERATIONS')\n   ?\n   new BinaryOpPackedProgram(ELU_DER_PACKED, dy.shape, y.shape) :\n   new BinaryOpProgram(ELU_DER, dy.shape, y.shape);\n   return backend.runWebGLProgram(program, [dy, y], dy.dtype);\n   };\n\nexport const eluGradConfig: KernelConfig = {\n kernelName: EluGrad,\n backendName: 'webgl',\n kernelFunc: eluGrad as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n * ===\n */\n\nimport {Equal, KernelConfig, KernelFunc} from '@tensorflow/tfjs-core';\nimport {binaryKernelFunc} from '../kernel_utils/kernel_funcs_utils';\n\nconst PACKED_EQUAL = `\n  return vec4(equal(a, b));\n`;\n\nconst EQUAL = `return float(a == b);`;\n\nexport const equal = binaryKernelFunc(\n   {opSnippet: EQUAL, packedOpSnippet: PACKED_EQUAL, dtype: 'bool'});\n\nexport const equalConfig: KernelConfig = {\n kernelName: Equal,\n backendName: 'webgl',\n kernelFunc: equal as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is
 distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ===\n */\n\nimport {backend_util, Erf, KernelConfig} from '@tensorflow/tfjs-core';\n\nimport {unaryKernelFunc} from '../kernel_utils/kernel_funcs_utils';\n\nconst ERF = `\n // Error function is calculated approximately with elementary function.\n // See \"Handbook of Mathematical Functions with Formulas,\n // Graphs, and Mathematical Tables\", Abramowitz and Stegun.\n float p = ${backend_util.ERF_P};\n float a1 = ${backend_util.ERF_A1};\n float a2 = ${backend_util.ERF_A2};\n float a3 = ${backend_util.ERF_A3};\n float a4 = ${backend_util.ERF_A4};\n float a5 = ${backend_util.ERF_A5};\n\n float sign = sign(x);\n x = abs(x);\n float t = 1.0 / (1.0 + p * x);\n return sign * (1.0 - (((((a5*t

+ a4)*t) + a3)*t + a2)*t + a1)*t*exp(-x*x));\n`;\n\nexport const erf = unaryKernelFunc({opSnippet: ERF});\n\nexport const erfConfig: KernelConfig = {\n kernelName: Erf,\n backendName: 'webgl',\n kernelFunc: erf,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the License);\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an AS IS BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {ExpandDims, ExpandDimsAttrs, ExpandDimsInputs,\n KernelConfig, KernelFunc, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL} from '../backend_webgl';\nimport {reshape} from './Reshape';\n\nexport function expandDims(args: {\n inputs: ExpandDimsInputs,\n attrs: ExpandDimsAttrs,\n backend: MathBackendWebGL\n}): TensorInfo {\n const {inputs, attrs, backend} = args;\n const {dim} = attrs;\n const {input} = inputs;\n\n const inputRank = input.shape.length;\n const newShape = input.shape.slice();\n let $dim = dim;\n if (dim < 0) {\n // Negative value is counted from the tail of rank.\n util.assert(\n -(inputRank + 1) <= dim,\n () => `Axis must be in the interval [${- (inputRank + 1)}, ${\n inputRank}]`);\n $dim = inputRank + dim + 1;\n }\n newShape.splice($dim, 0, 1);\n\n return reshape({inputs: {x: input}, backend, attrs: {shape: newShape}});\n}\n\nexport const expandDimsConfig: KernelConfig = {\n kernelName: ExpandDims,\n backendName: 'webgl',\n kernelFunc: expandDims\n as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {GPGPUProgram} from './gpgpu_math';\n\nexport class FFTProgram implements GPGPUProgram {\n variableNames = ['real', 'imag'];\n outputShape: number[];\n userCode: string;\n\n constructor(\n component: 'real'|'imag', inputShape:\n [number, number],\n inverse: boolean) {\n const innerDim = inputShape[1];\n this.outputShape = inputShape;\n\n const exponentMultiplierSnippet =\n inverse ? `2.0 * ${Math.PI}` : `-2.0 * ${Math.PI}`;\n const resultDenominator = inverse ? `${innerDim}.0` : '1.0';\n\n let opString: string;\n if (component === 'real') {\n opString = 'return real * expR - imag * expI;';\n } else if (component === 'imag') {\n opString = 'return real * expI + imag * expR;';\n } else {\n throw new Error(\n `FFT component must be either \"real\" or \"imag\", got ${component}.`);\n }\n\n this.userCode = `\n const float exponentMultiplier = ${exponentMultiplierSnippet};\n\n float unaryOpComplex(float real, float expR, float imag, float expI) {\n ${opString}\n }\n\n float mulMatDFT(int batch, int index) {\n float indexRatio = float(index) / float(${innerDim});\n float exponentMultiplierTimesIndexRatio =\n exponentMultiplier * indexRatio;\n\n float result = 0.0;\n\n for (int i = 0; i < ${innerDim}; i++) {\n // x = (-2|2 * PI / N) * index * i;\n float x = exponentMultiplierTimesIndexRatio * float(i);\n float expR = cos(x);\n float expI = sin(x);\n float real = getReal(batch, i);\n float imag = getImag(batch, i);\n\n result +=\n unaryOpComplex(real, expR, imag, expI) / ${resultDenominator};\n }\n\n return result;\n }\n\n void main() {\n ivec2 coords = getOutputCoords();\n setOutput(mulMatDFT(coords[0], coords[1]));\n }\n `;\n }\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n *

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==========\n
*/\n\nimport {TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL} from
'../backend_webgl';\nimport {FFTProgram} from '../fft_gpu';\n\nimport {complex} from './Complex';\nimport
{reshape} from './Reshape';\n\nexport function fftImpl(\n x: TensorInfo, inverse: boolean, backend:
MathBackendWebGL): TensorInfo {\n const xData = backend.texData.get(x.dataId);\n\n const inputSize =
util.sizeFromShape(x.shape);\n // Collapse all outer dimensions to a single batch dimension.\n const
innerDimensionSize = x.shape[x.shape.length - 1];\n const batch = inputSize / innerDimensionSize;\n\n
const input2D = reshape(\n {inputs: {x}, backend, attrs: {shape: [batch, innerDimensionSize]}});\n\n const
xShape = input2D.shape as [number, number];\n const realProgram = new FFTProgram('real', xShape, inverse);\n
const imagProgram = new FFTProgram('imag', xShape, inverse);\n\n const inputs = [\n {\n dataId:
xData.complexTensorInfos.real.dataId,\n dtype: xData.complexTensorInfos.real.dtype,\n shape: xShape\n
},\n {\n dataId: xData.complexTensorInfos.imag.dataId,\n dtype: xData.complexTensorInfos.imag.dtype,\n
shape: xShape\n }\n];\n\n const realPart = backend.runWebGLProgram(realProgram, inputs, 'float32');\n const
imagPart = backend.runWebGLProgram(imagProgram, inputs, 'float32');\n\n const complexOutput =\n
complex({inputs: {real: realPart, imag: imagPart}, backend});\n\n
backend.disposeIntermediateTensorInfo(realPart);\n backend.disposeIntermediateTensorInfo(imagPart);\n\n const
complexOutputReshaped
=\n reshape({inputs: {x: complexOutput}, backend, attrs: {shape: x.shape}});\n\n
backend.disposeIntermediateTensorInfo(input2D);\n backend.disposeIntermediateTensorInfo(complexOutput);\n
return complexOutputReshaped;\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n *
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OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language
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==========\n
*/\n\nimport {FFT, FFTInputs, KernelConfig,
TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL} from '../backend_webgl';\n\nimport
{fftImpl} from './FFT_impl';\n\nexport function fft(args: {inputs: FFTInputs, backend: MathBackendWebGL}):\n
TensorInfo {\n const {inputs, backend} = args;\n const {input} = inputs;\n\n return fftImpl(input, false /* inverse
*/, backend);\n}\n\nexport const fftConfig: KernelConfig = {\n kernelName: FFT,\n backendName: 'webgl',\n
kernelFunc: fft\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under
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on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or
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==========\n
*/\n\nimport {GPGPUContext} from './gpgpu_context';\nimport {GPGPUProgram} from './gpgpu_math';\n\nexport
class FillProgram implements GPGPUProgram {\n variableNames: string[];\n outputShape: number[] = [];\n
userCode: string;\n\n valueLoc: WebGLUniformLocation;\n\n constructor(shape: number[], value: number) {\n
this.variableNames = ['x'];\n this.outputShape = shape;\n\n this.userCode = `\n uniform float value;\n void

main() {\n // Input can be obtained from uniform value.\n setOutput(value);\n }\n `;\n }\n\n getCustomSetupFunc(value: number) {\n return (gpgpu: GPGPUContext, webGLProgram: WebGLProgram) => {\n if (this.valueLoc == null) {\n this.valueLoc = gpgpu.getUniformLocationNoThrow(webGLProgram, 'value');\n }\n gpgpu.gl.uniform1f(this.valueLoc, value);\n };\n }\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {Fill, FillAttrs, KernelConfig, KernelFunc, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL} from '../backend_webgl';\nimport {FillProgram} from '../fill_gpu';\n\nexport function fill(args: {backend: MathBackendWebGL, attrs: FillAttrs}):\n TensorInfo {\n const {backend, attrs} = args;\n const {shape, value} = attrs;\n let {dtype} = attrs;\n\n dtype = dtype || util.inferDtype(value);\n\n if (dtype === 'string') {\n // String type should be handled in CPU memory.\n const values = util.getArrayFromDType(dtype, util.sizeFromShape(shape));\n values.fill(value as string);\n return backend.makeTensorInfo(shape, dtype, values);\n } else {\n const program = new FillProgram(shape, value as number);\n const customSetup = program.getCustomSetupFunc(value as number);\n return backend.runWebGLProgram(program, [], dtype, customSetup);\n }\n}\n\nexport const fillConfig: KernelConfig = {\n kernelName: Fill,\n backendName: 'webgl',\n kernelFunc: fill as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {GPGPUProgram} from './gpgpu_math';\n\nexport class FlipLeftRightProgram implements GPGPUProgram {\n variableNames = ['Image'];\n outputShape: number[] = [];\n userCode: string;\n\n constructor(imageShape: [number, number, number, number]) {\n const imageWidth = imageShape[2];\n this.outputShape = imageShape;\n\n this.userCode = `\n void main() {\n ivec4 coords = getOutputCoords();\n int x = coords[2];\n\n int coordX = ${imageWidth} - x;\n float outputValue;\n if(coordX >= 0 && coordX < ${imageWidth}) {\n outputValue = getImage(coords[0], coords[1], coordX, coords[3]);\n } else {\n outputValue = getImage(coords[0], coords[1], coords[2], coords[3]);\n }\n setOutput(outputValue);\n }\n `;\n }\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {KernelConfig, Tensor4D} from '@tensorflow/tfjs-core';\nimport {FlipLeftRight, FlipLeftRightInputs}

from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL} from '../backend_webgl';\nimport {FlipLeftRightProgram} from '../flip_left_right_gpu';\n\nexport const flipLeftRightConfig: KernelConfig = {\n kernelName: FlipLeftRight,\n backendName: 'webgl',\n kernelFunc: ({inputs, backend}) => {\n const {image} = inputs as FlipLeftRightInputs;\n const webglBackend = backend as MathBackendWebGL;\n\n const program = new FlipLeftRightProgram((image as Tensor4D).shape);\n const output = webglBackend.runWebGLProgram(program, [image], image.dtype);\n return output;\n }\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==========\n */\n\nimport {FloorDiv, KernelConfig, KernelFunc} from '@tensorflow/tfjs-core';\n\nimport {binaryKernelFunc} from '../kernel_utils/kernel_funcs_utils';\n\n// We use native integer division to deal with floating point imprecision. Since\n// we implement floor division and glsl implements truncated division, we\n// correct for this by subtracting 1 from result when the result is negative and\n// there is a remainder.\nconst INT_DIV = `\n float s = sign(a) * sign(b);\n int ia = round(a);\n int ib = round(b);\n if (ib != 0) {\n // Windows (D3D) wants guaranteed non-zero int division at compile-time.\n return float(idiv(ia, ib, s));\n } else {\n return NAN;\n }\n`;\n\nconst INT_DIV_PACKED = `\n ivec4 ia = round(a);\n ivec4 ib = round(b);\n bvec4 cond = notEqual(ib, ivec4(0));\n ivec4 result = ivec4(0);\n vec4 s = sign(a) * sign(b);\n\n // Windows (D3D) wants guaranteed non-zero int division at compile-time.\n if (cond[0]) {\n result[0] = idiv(ia[0], ib[0], s[0]);\n }\n if (cond[1]) {\n result[1] = idiv(ia[1], ib[1], s[1]);\n }\n if (cond[2]) {\n result[2] = idiv(ia[2], ib[2], s[2]);\n }\n if (cond[3]) {\n result[3] = idiv(ia[3], ib[3], s[3]);\n }\n return vec4(result);\n`;\n\nexport const floorDiv = binaryKernelFunc(\n {opSnippet: INT_DIV, packedOpSnippet: INT_DIV_PACKED, dtype: 'int32'});\n\nexport const floorDivConfig: KernelConfig = {\n kernelName: FloorDiv,\n backendName: 'webgl',\n kernelFunc: floorDiv as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==========\n */\n\nimport {getGlslDifferences} from '../../glsl_version';\nimport {GPGPUProgram} from '../../gpgpu_math';\n\nexport class FromPixelsProgram implements GPGPUProgram {\n variableNames = ['A'];\n userCode: string;\n outputShape: number[];\n\n constructor(outputShape: number[]) {\n const glsl = getGlslDifferences();\n const [height, width,] = outputShape;\n this.outputShape = outputShape;\n this.userCode = `\n void main() {\n ivec3 coords = getOutputCoords();\n int texR = coords[0];\n int texC = coords[1];\n int depth = coords[2];\n vec2 uv = (vec2(texC, texR) + halfCR) / vec2(${width}.0, ${height}.0);\n\n vec4 values = ${glsl.texture2D}(A, uv);\n float value;\n if (depth == 0) {\n value = values.r;\n } else if (depth == 1) {\n value = values.g;\n } else if (depth == 2) {\n value = values.b;\n } else if (depth == 3) {\n value = values.a;\n }\n\n setOutput(floor(value * 255.0 + 0.5));\n }\n `;\n }\n}\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in

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OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language
governing permissions and\n * limitations under the License.\n *
==========================================================================\n
*/\n\nimport {getGlslDifferences} from '../../glsl_version';\nimport {GPGPUProgram} from
'../../gpgpu_math';\n\nexport class FromPixelsPackedProgram implements GPGPUProgram {\n  variableNames =
['A'];\n  userCode: string;\n  outputShape: number[];\n  packedInputs = false;\n  packedOutput = true;\n\n
constructor(outputShape: number[]) {\n    const glsl = getGlslDifferences();\n    const [height, width, ] =
outputShape;\n    this.outputShape = outputShape;\n
    this.userCode = `\n      void main() {\n        ivec3 coords = getOutputCoords();\n        int texR = coords[0];\n
int texC = coords[1];\n        int depth = coords[2];\n\n        vec4 result = vec4(0.);\n\n        for(int row=0; row<=1;
row++) {\n          for(int col=0; col<=1; col++) {\n            texC = coords[1] + row;\n            depth = coords[2] +
col;\n\n            vec2 uv = (vec2(texC, texR) + halfCR) /\n                       vec2(${width}.0, ${height}.0);\n
vec4 values = ${glsl.texture2D}(A, uv);\n            float value;\n            if (depth == 0) {\n              value = values.r;\n
          } else if (depth == 1) {\n              value = values.g;\n            } else if (depth == 2) {\n              value =
values.b;\n            } else if (depth == 3) {\n              value = values.a;\n            }\n\n            result[row * 2 + col] =
floor(value * 255.0 + 0.5);\n          }\n        }\n\n        ${glsl.output} = result;\n      }\n
    `;\n  }\n}\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the
Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the
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on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or
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License.\n *
==========================================================================\n
*/\n\nimport {env, KernelConfig, KernelFunc, TensorInfo} from '@tensorflow/tfjs-core';\nimport {FromPixels,
FromPixelsAttrs, FromPixelsInputs} from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL} from
'../backend_webgl';\nimport {TextureUsage} from '../tex_util';\n\nimport
 {FromPixelsProgram} from './FromPixels_utils/from_pixels_gpu';\nimport {FromPixelsPackedProgram} from
'./FromPixels_utils/from_pixels_packed_gpu';\n\nexport const fromPixelsConfig: KernelConfig = {\n  kernelName:
FromPixels,\n  backendName: 'webgl',\n  kernelFunc: fromPixels as {} as KernelFunc,\n};\n\nlet
fromPixels2DContext: CanvasRenderingContext2D;\n\nfunction fromPixels(args: {\n  inputs: FromPixelsInputs,\n
backend: MathBackendWebGL,\n  attrs: FromPixelsAttrs\n}): TensorInfo {\n  const {inputs, backend, attrs} =
args;\n  let {pixels} = inputs;\n  const {numChannels} = attrs;\n\n  const isVideo = typeof (HTMLVideoElement)
!== 'undefined' &&\n      pixels instanceof HTMLVideoElement;\n  const isImage = typeof (HTMLImageElement)
!== 'undefined' &&\n      pixels instanceof HTMLImageElement;\n  const isImageBitmap = typeof(ImageBitmap)
!== 'undefined' &&\n      pixels instanceof ImageBitmap;\n  const [width, height] = isVideo ?\n      [\n        (pixels as
HTMLVideoElement).videoWidth,\n
        (pixels as HTMLVideoElement).videoHeight\n      ] :\n      [pixels.width, pixels.height];\n\n  const texShape:
[number, number] = [height, width];\n  const outShape = [height, width, numChannels];\n\n  if (isImage || isVideo ||
isImageBitmap) {\n    if (fromPixels2DContext == null) {\n      fromPixels2DContext =
document.createElement('canvas').getContext('2d');\n    }\n\n    fromPixels2DContext.canvas.width = width;\n
fromPixels2DContext.canvas.height = height;\n    fromPixels2DContext.drawImage(\n        pixels as
HTMLVideoElement | HTMLImageElement | ImageBitmap,\n        0, 0, width, height);\n    pixels =
fromPixels2DContext.canvas;\n  }\n\n  const tempPixelHandle = backend.makeTensorInfo(texShape, 'int32');\n  //
This is a byte texture with pixels.\n  backend.texData.get(tempPixelHandle.dataId).usage =
```

TextureUsage.PIXELS;\n backend.gpgpu.uploadPixelDataToTexture(\n backend.getTexture(tempPixelHandle.dataId), pixels as ImageData);\n const program = env().getBool('WEBGL_PACK') ?\n   new FromPixelsPackedProgram(outShape) :\n   new FromPixelsProgram(outShape);\n const res = backend.runWebGLProgram(program, [tempPixelHandle], 'int32');\n backend.disposeData(tempPixelHandle.dataId);\n return res;\n}\n\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==\n */\n\nimport {backend_util, env, FusedConv2D, FusedConv2DAttrs, FusedConv2DInputs, KernelConfig, KernelFunc, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL} from '../backend_webgl';\nimport {Conv2DProgram} from '../conv_gpu';\nimport {mapActivationToShaderProgram} from '../kernel_utils/kernel_funcs_utils';\n\nimport {conv2dByMatMul, conv2dWithIm2Row} from './Conv2D_impl';\nimport {reshape} from './Reshape';\n\nexport function fusedConv2d(args: {\n inputs: FusedConv2DInputs,\n attrs: FusedConv2DAttrs,\n backend: MathBackendWebGL\n}) {\n const {inputs, backend, attrs} = args;\n const {x, filter, bias, preluActivationWeights} = inputs;\n const {\n   strides,\n   pad,\n   dataFormat,\n   dilations,\n   dimRoundingMode,\n   activation,\n   leakyreluAlpha\n } = attrs;\n\n const $dataFormat = backend_util.convertConv2DDataFormat(dataFormat);\n const convInfo = backend_util.computeConv2DInfo(\n   x.shape as [number, number, number, number],\n   filter.shape as [number, number, number, number], strides, dilations, pad,\n   dimRoundingMode, false /* depthwise */, $dataFormat);\n let out: TensorInfo;\n const intermediates: TensorInfo[] = [];\n\n if (convInfo.filterHeight === 1 && convInfo.filterWidth === 1 &&\n   convInfo.dilationHeight === 1 && convInfo.dilationWidth === 1 &&\n   convInfo.strideHeight === 1 && convInfo.strideWidth === 1 &&\n   (convInfo.padInfo.type === 'SAME' || convInfo.padInfo.type === 'VALID')) {\n   out = conv2dByMatMul({\n   x,\n   filter,\n   convInfo,\n   backend,\n   bias,\n   activation,\n   preluActivationWeights,\n   leakyreluAlpha\n   });\n } else if (env().getBool('WEBGL_CONV_IM2COL') && x.shape[0] === 1) {\n   out = conv2dWithIm2Row({\n   x,\n   filter,\n   convInfo,\n   backend,\n   bias,\n   activation,\n   preluActivationWeights,\n   leakyreluAlpha\n   });\n } else {\n   const hasBias = bias != null;\n   const hasPreluActivationWeights = preluActivationWeights != null;\n   const hasLeakyreluAlpha = activation === 'leakyrelu';\n   const fusedActivation =\n   activation ? mapActivationToShaderProgram(activation, false) : null;\n   const program = new Conv2DProgram(\n   convInfo, hasBias, fusedActivation, hasPreluActivationWeights,\n   hasLeakyreluAlpha);\n   const inputs: TensorInfo[] = [x, filter];\n   if (bias) {\n   inputs.push(bias);\n   }\n   if (preluActivationWeights) {\n   inputs.push(preluActivationWeights);\n   }\n   if (hasLeakyreluAlpha) {\n   const $leakyreluAlpha = backend.makeTensorInfo(\n   [], 'float32',\n   util.createScalarValue(leakyreluAlpha as {} as 'float32', 'float32'));\n   inputs.push($leakyreluAlpha);\n   intermediates.push($leakyreluAlpha);\n   }\n   out = backend.runWebGLProgram(program, inputs, 'float32');\n }\n\n const outReshaped =\n   reshape({inputs: {x: out}, backend, attrs: {shape: convInfo.outShape}});\n\n intermediates.push(out);\n intermediates.forEach(t => backend.disposeIntermediateTensorInfo(t));\n\n return outReshaped;\n}\n\nexport const fusedConv2DConfig: KernelConfig = {\n kernelName: FusedConv2D,\n backendName: 'webgl',\n kernelFunc: fusedConv2d as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing,

software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport
{backend_util, env, FusedDepthwiseConv2D, FusedDepthwiseConv2DAttrs, FusedDepthwiseConv2DInputs, KernelConfig, KernelFunc, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL} from '../backend_webgl';\nimport {DepthwiseConv2DProgram} from '../conv_gpu_depthwise';\nimport {DepthwiseConvPacked2DProgram} from '../conv_packed_gpu_depthwise';\nimport {mapActivationToShaderProgram} from '../kernel_utils/kernel_funcs_utils';\n\nexport function fusedDepthwiseConv2D(args: {\n inputs: FusedDepthwiseConv2DInputs,\n attrs: FusedDepthwiseConv2DAttrs,\n backend: MathBackendWebGL\n}) {\n const {inputs, backend, attrs} = args;\n const {x, filter, bias, preluActivationWeights} = inputs;\n const {strides, pad, dilations, dimRoundingMode, activation, leakyreluAlpha} =\n attrs;\n\n const intermediates: TensorInfo[] = [];\n\n let $dilations = dilations;\n if ($dilations == null) {\n $dilations = [1, 1];\n }\n\n util.assert(\n backend_util.eitherStridesOrDilationsAreOne(strides, $dilations),\n () => 'Error in depthwiseConv2d: Either strides or dilations must be ' +\n `1. Got strides ${strides} and dilations '${$dilations}'`);\n\n const convInfo = backend_util.computeConv2DInfo(\n x.shape as [number, number, number, number],\n filter.shape as [number, number, number, number], strides, $dilations,\n pad, dimRoundingMode, true /* depthwise */);\n\n const shouldPackDepthwiseConv =
env().getBool('WEBGL_PACK_DEPTHWISECONV') &&\n convInfo.strideWidth <= 2 &&\n convInfo.outChannels / convInfo.inChannels === 1;\n const fusedActivation = activation ?\n mapActivationToShaderProgram(activation, shouldPackDepthwiseConv) :\n null;\n const programInputs: TensorInfo[] = [x, filter];\n\n const hasBias = bias != null;\n const hasPreluActivationWeights = preluActivationWeights != null;\n const hasLeakyreluAlpha = activation === 'leakyrelu';\n\n if (hasBias) {\n programInputs.push(bias);\n }\n
if (hasPreluActivationWeights) {\n programInputs.push(preluActivationWeights);\n }\n if (hasLeakyreluAlpha) {\n const $leakyreluAlpha = backend.makeTensorInfo(\n [], 'float32',\n util.createScalarValue(leakyreluAlpha as {} as 'float32', 'float32'));\n programInputs.push($leakyreluAlpha);\n intermediates.push($leakyreluAlpha);\n }\n\n let program: DepthwiseConv2DProgram|DepthwiseConvPacked2DProgram;\n if (shouldPackDepthwiseConv) {\n program = new DepthwiseConvPacked2DProgram(\n convInfo, hasBias, fusedActivation, hasPreluActivationWeights,\n hasLeakyreluAlpha);\n } else {\n program = new DepthwiseConv2DProgram(\n convInfo, hasBias, fusedActivation, hasPreluActivationWeights,\n hasLeakyreluAlpha);\n }\n\n const result =
backend.runWebGLProgram(program, programInputs, 'float32');\n\n intermediates.forEach(t => backend.disposeIntermediateTensorInfo(t));\n\n return result;\n}\n\nexport const fusedDepthwiseConv2DConfig:
KernelConfig = {\n kernelName: FusedDepthwiseConv2D,\n backendName: 'webgl',\n kernelFunc: fusedDepthwiseConv2D as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n *
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==========\n */\nimport {GPGPUProgram} from './gpgpu_math';\nimport {getCoordsDataType} from './shader_compiler';\n\nexport class GatherNDProgram implements
GPGPUProgram {\n variableNames = ['x', 'indices'];\n outputShape: number[];\n userCode: string;\n constructor(\n private sliceDim: number, private strides: number[], shape: number[]) {\n this.outputShape =

shape;\n const stridesType = getCoordsDataType(strides.length);\n const dtype = getCoordsDataType(shape.length);\n const strideString = this.sliceDim > 1 ? 'strides[j]' : 'strides';\n this.userCode = `\n ${stridesType} strides = ${stridesType}(${this.strides});\n void main() {\n ${dtype} coords = getOutputCoords();\n int flattenIndex = 0;\n for (int j = 0; j < ${this.sliceDim}; j++) {\n int index = round(getIndices(coords[0], j));\n flattenIndex += index * ${strideString};\n }\n setOutput(getX(flattenIndex, coords[1]));\n }\n `;\n }\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n*/\n\nimport {backend_util, GatherNd, GatherNdInputs, KernelConfig, KernelFunc, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL} from '../backend_webgl';\nimport {GatherNDProgram} from '../gather_nd_gpu';\nimport {reshape} from './Reshape';\n\nexport function gatherNd(\n args: {inputs: GatherNdInputs, backend: MathBackendWebGL}): TensorInfo {\n const {inputs, backend} = args;\n const {params, indices} = inputs;\n\n const indicesShape = indices.shape;\n const sliceRank = indicesShape[indicesShape.length - 1];\n\n const [resultShape, numSlices, sliceSize, strides] =\n backend_util.prepareAndValidate(params, indices);\n\n const flattenIndices = reshape(\n {inputs: {x: indices}, backend, attrs: {shape: [numSlices, sliceRank]}});\n const flattenX = reshape({\n inputs: {x: params},\n backend,\n attrs: {shape: [(util.sizeFromShape(params.shape) / sliceSize), sliceSize]}\n });\n\n const program =\n new GatherNDProgram(sliceRank, strides, [numSlices, sliceSize]);\n const res = backend.runWebGLProgram(\n program, [flattenX, flattenIndices], flattenX.dtype);\n\n const reshaped =\n reshape({inputs: {x: res}, backend, attrs: {shape: resultShape}});\n\n backend.disposeIntermediateTensorInfo(flattenIndices);\n backend.disposeIntermediateTensorInfo(flattenX);\n backend.disposeIntermediateTensorInfo(res);\n\n return reshaped;\n}\n\nexport const gatherNdConfig: KernelConfig = {\n kernelName: GatherNd,\n backendName: 'webgl',\n kernelFunc: gatherNd as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2017 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n*/\n\nimport {GPGPUProgram} from './gpgpu_math';\nimport {getCoordsDataType} from './shader_compiler';\n\nexport class GatherProgram implements GPGPUProgram {\n variableNames = ['A', 'indices'];\n outputShape: number[];\n userCode: string;\n rank: number;\n\n constructor(aShape: number[], outputShape: number[]) {\n this.outputShape = outputShape;\n this.rank = outputShape.length;\n const dtype = getCoordsDataType(this.rank);\n const sourceCoords = getSourceCoords(aShape, 2);\n\n this.userCode = `\n void main() {\n ${dtype} resRC = getOutputCoords();\n setOutput(getA(${sourceCoords}));\n }\n `;\n }\n}\n\n// The input and output are always flattened into rank 4 tensors.\nfunction getSourceCoords(aShape: number[], axis: number): string {\n const currentCoords = ['resRC.x', 'resRC.y', 'resRC.z', 'resRC.w'];\n\n const sourceCoords = [];\n for (let i = 0; i < aShape.length; i++) {\n if (i === 2) {\n sourceCoords.push('int(getIndices(resRC.x, resRC.z))');\n } else {\n sourceCoords.push(`${currentCoords[i]}`);\n }\n }\n return sourceCoords.join();\n}\n","/**\n

```
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==========================================================================\n
*/\n\nimport {backend_util, GatherV2, GatherV2Attrs, GatherV2Inputs, KernelConfig, KernelFunc, TensorInfo, TypedArray, util} from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL} from '../backend_webgl';\nimport {GatherProgram} from '../gather_gpu';\nimport {gatherV2ImplCPU} from '../kernel_utils/shared';\n\nimport {reshape} from './Reshape';\n\nexport function gatherV2(args: {\n  inputs: GatherV2Inputs,\n  backend: MathBackendWebGL,\n  attrs: GatherV2Attrs\n}): TensorInfo {\n  const {inputs, backend, attrs} = args;\n  const {x, indices} = inputs;\n  const {axis, batchDims} = attrs;\n\n  const parsedAxis = util.parseAxisParam(axis, x.shape)[0];\n  const shapeInfo = backend_util.segment_util.collectGatherOpShapeInfo(\n    x, indices, parsedAxis, batchDims);\n\n  const indicesSize = util.sizeFromShape(indices.shape);\n\n  const toDispose = [];\n\n  const flattenX = reshape({\n    inputs: {x},\n    backend,\n    attrs: {\n      shape: [\n shapeInfo.batchSize, shapeInfo.outerSize, shapeInfo.dimSize,\n        shapeInfo.sliceSize\n      ]\n    }\n  });\n\n  const flattenIndex = reshape({\n    inputs: {x: indices},\n    backend,\n    attrs: {shape: [shapeInfo.batchSize, indicesSize / shapeInfo.batchSize]}\n  });\n\n  toDispose.push(flattenX);\n
  toDispose.push(flattenIndex);\n\n  const flattenOutputShape = [\n    shapeInfo.batchSize, shapeInfo.outerSize, indicesSize / shapeInfo.batchSize,\n    shapeInfo.sliceSize\n  ];\n\n  if (backend.shouldExecuteOnCPU([x, indices]) || x.dtype === 'string') {\n    const indicesBuf = backend.bufferSync(flattenIndex);\n    const xBuf = backend.bufferSync(flattenX);\n    const outBuf = gatherV2ImplCPU(xBuf, indicesBuf, flattenOutputShape);\n\n toDispose.forEach(t => backend.disposeIntermediateTensorInfo(t));\n\n    return backend.makeTensorInfo(\n shapeInfo.outputShape, outBuf.dtype, outBuf.values as TypedArray);\n  }\n\n  const program = new GatherProgram(flattenX.shape, flattenOutputShape);\n  const res = backend.runWebGLProgram(\n      program, [flattenX, flattenIndex], flattenX.dtype);\n  toDispose.push(res);\n\n  const reshaped = reshape(\n      {inputs: {x: res}, backend, attrs: {shape: shapeInfo.outputShape}});\n  toDispose.forEach(t => backend.disposeIntermediateTensorInfo(t));\n
  return reshaped;\n}\n\nexport const gatherV2Config: KernelConfig = {\n  kernelName: GatherV2,\n backendName: 'webgl',\n  kernelFunc: gatherV2 as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========================================================================\n
*/\n\nimport {GreaterEqual, KernelConfig, KernelFunc} from '@tensorflow/tfjs-core';\nimport {binaryKernelFunc} from '../kernel_utils/kernel_funcs_utils';\n\nconst GREATER_EQUAL = `return float(a >= b);`;\nconst GREATER_EQUAL_PACKED = `\n  return vec4(greaterThanEqual(a, b));\n`;\n\nexport const greaterEqual = binaryKernelFunc({\n  opSnippet: GREATER_EQUAL,\n  packedOpSnippet: GREATER_EQUAL_PACKED,\n dtype: 'bool'\n});\n\nexport const greaterEqualConfig: KernelConfig = {\n  kernelName: GreaterEqual,\n backendName: 'webgl',\n  kernelFunc: greaterEqual as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES
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OR CONDITIONS OF ANY KIND, either express
or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
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/\n\nimport {IFFT, IFFTInputs, KernelConfig, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL} from '../backend_webgl';\n\nimport {fftImpl} from './FFT_impl';\n\nexport function ifft(args: {inputs: IFFTInputs, backend: MathBackendWebGL}):\n TensorInfo {\n const {inputs, backend} = args;\n const {input} = inputs;\n\n return fftImpl(input, true / inverse */, backend);\n}\n\nexport const ifftConfig: KernelConfig = {\n kernelName: IFFT,\n backendName: 'webgl',\n kernelFunc: ifft\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n
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==========\n
*/\n\nimport {IsFinite, KernelConfig} from '@tensorflow/tfjs-core';\nimport {unaryKernelFunc} from '../kernel_utils/kernel_funcs_utils';\n\nconst IS_FINITE = `return float(!isnan(x) && !isinf(x));`;\n\nexport const isFinite = unaryKernelFunc({opSnippet: IS_FINITE, dtype: 'bool'});\n\nexport const isFiniteConfig: KernelConfig = {\n kernelName: IsFinite,\n backendName: 'webgl',\n kernelFunc: isFinite,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n
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==========\n
*/\n\nimport {IsInf, KernelConfig} from '@tensorflow/tfjs-core';\nimport {unaryKernelFunc} from '../kernel_utils/kernel_funcs_utils';\n\nconst IS_INF = `return float(isinf(x));`;\n\nexport const isInf = unaryKernelFunc({opSnippet: IS_INF, dtype: 'bool'});\n\nexport const isInfConfig: KernelConfig = {\n kernelName: IsInf,\n backendName: 'webgl',\n kernelFunc: isInf,\n};\n","/**\n * @license\n * Copyright 2020 Google
LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n
*/\n\nimport {IsNan, KernelConfig} from '@tensorflow/tfjs-core';\nimport {unaryKernelFunc} from '../kernel_utils/kernel_funcs_utils';\n\nconst IS_NAN = `return float(isnan(x));`;\n\nexport const isNaN = unaryKernelFunc({opSnippet: IS_NAN, dtype: 'bool'});\n\nexport const isNaNConfig: KernelConfig = {\n kernelName: IsNan,\n
  backendName: 'webgl',\n kernelFunc: isNaN,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n *

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==========\n */\n\nimport {KernelConfig, KernelFunc, LessEqual} from '@tensorflow/tfjs-core';\n\nimport {binaryKernelFunc} from '../kernel_utils/kernel_funcs_utils';\n\nexport const LESS_EQUAL = `return float(a <= b);`;\nexport const LESS_EQUAL_PACKED
= `\n  return vec4(lessThanEqual(a, b));\n`;\n\nexport const lessEqual = binaryKernelFunc(\n   {opSnippet: LESS_EQUAL, packedOpSnippet: LESS_EQUAL_PACKED, dtype: 'bool'});\n\nexport const lessEqualConfig: KernelConfig = {\n kernelName: LessEqual,\n backendName: 'webgl',\n kernelFunc: lessEqual as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {KernelConfig, KernelFunc, LinSpace, LinSpaceAttrs, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL} from '../backend_webgl';\nimport {linSpaceImplCPU} from '../kernel_utils/shared';\n\nexport function linSpace(\n   args: {backend: MathBackendWebGL, attrs: LinSpaceAttrs}): TensorInfo {\n const {backend, attrs} = args;\n const {start, stop, num} = attrs;\n\n // TODO: Use CPU implementation due to the precision problem in Safari.\n const outVals = linSpaceImplCPU(start, stop, num);\n return backend.makeTensorInfo([outVals.length], 'float32', outVals);\n}\n\nexport const linSpaceConfig: KernelConfig = {\n kernelName: LinSpace,\n backendName: 'webgl',\n kernelFunc: linSpace as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance
with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {KernelConfig, Log1p} from '@tensorflow/tfjs-core';\nimport {unaryKernelFunc} from '../kernel_utils/kernel_funcs_utils';\n\nconst LOG1P = `return log(1.0 + x);`;\n\nexport const log1p = unaryKernelFunc({opSnippet: LOG1P});\n\nexport const log1pConfig: KernelConfig = {\n kernelName: Log1p,\n backendName: 'webgl',\n kernelFunc: log1p,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version
2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {KernelConfig, KernelFunc, LogicalAnd} from '@tensorflow/tfjs-core';\n\nimport {binaryKernelFunc} from '../kernel_utils/kernel_funcs_utils';\n\nconst LOGICAL_AND = `return float(a >= 1.0 && b >= 1.0);`;\nconst LOGICAL_AND_PACKED = `\n return vec4(\n   vec4(greaterThanEqual(a, vec4(1.0))) *\n

vec4(greaterThanEqual(b, vec4(1.0))));\n`;\n\nexport const logicalAnd = binaryKernelFunc({\n opSnippet: LOGICAL_AND,\n packedOpSnippet: LOGICAL_AND_PACKED,\n dtype: 'bool'\n});\n\nexport const logicalAndConfig: KernelConfig = {\n kernelName: LogicalAnd,\n backendName: 'webgl',\n kernelFunc: logicalAnd as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {KernelConfig,\n LogicalNot} from '@tensorflow/tfjs-core';\nimport {unaryKernelFunc} from '../kernel_utils/kernel_funcs_utils';\n\nconst LOGICAL_NOT = `return float(!(x >= 1.0));`;\n\nexport const logicalNot = unaryKernelFunc({opSnippet: LOGICAL_NOT});\n\nexport const logicalNotConfig: KernelConfig = {\n kernelName: LogicalNot,\n backendName: 'webgl',\n kernelFunc: logicalNot,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under\n the License.\n *\n ==\n */\n\nimport {KernelConfig, KernelFunc, LogicalOr} from '@tensorflow/tfjs-core';\n\nimport {binaryKernelFunc} from '../kernel_utils/kernel_funcs_utils';\n\nconst LOGICAL_OR = `return float(a >= 1.0 || b >= 1.0);`;\nconst LOGICAL_OR_PACKED = `\n return min(\n vec4(greaterThanEqual(a, vec4(1.0))) +\n vec4(greaterThanEqual(b, vec4(1.0))),\n vec4(1.0));\n`;\n\nexport const logicalOr = binaryKernelFunc(\n {opSnippet: LOGICAL_OR, packedOpSnippet: LOGICAL_OR_PACKED, dtype: 'bool'});\n\nexport const logicalOrConfig: KernelConfig = {\n kernelName: LogicalOr,\n backendName: 'webgl',\n kernelFunc: logicalOr as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2017 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {GPGPUProgram} from './gpgpu_math';\n\nexport class LRNProgram implements GPGPUProgram {\n variableNames = ['x'];\n outputShape: number[] = [];\n userCode: string;\n\n constructor(\n xShape: number[], radius: number, bias: number, alpha: number,\n beta: number) {\n const rad = radius;\n const maxD = xShape[3] - 1;\n this.outputShape = xShape;\n\n // optimize pow(bias + alpha * sum, -beta)\n // src: https://github.com/tensorflow/tensorflow/..\n // blob/26033a1644a9c4a5fbe3170ab2e864b6a4ccd4ca/..\n // tensorflow/core/kernels/mkl_lrn_op.cc#L320\n let powOperator;\n const basis = `float(${bias}) + float(${alpha}) * sum`;\n if (beta === 0.5) {\n powOperator = `inversesqrt(${basis})`;\n } else if (beta === 1.0) {\n powOperator = `1.0/(${basis})`;\n } else {\n powOperator = `exp(log(${basis}) * float(-${beta}));`;\n }\n\n this.userCode = `\n void main() {\n ivec4 coords = getOutputCoords();\n int b = coords[0];\n int r = coords[1];\n int c = coords[2];\n int d = coords[3];\n float x = getX(b, r, c, d);\n

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    float sum = 0.0;\n      for (int j = -${rad}; j <= ${rad}; j++) {\n        int idx = d + j;\n        if (idx >= 0 && idx <=  ${maxD}) {\n          float z = getX(b, r, c, idx);\n          sum += z * z;\n        }\n      }\n      float val = x * ${powOperator};\n      setOutput(val);\n    }\n    `;\n  }\n}\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights
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==========================================================================\n
*/\n\nimport {GPGPUProgram} from './gpgpu_math';\n\nexport class LRNPackedProgram implements GPGPUProgram {\n  variableNames = ['x'];\n  outputShape: number[] = [];\n  userCode: string;\n  packedInputs = true;\n  packedOutput = true;\n\n  constructor(\n      xShape: number[], radius: number, bias: number, alpha: number,\n      beta:
 number) {\n    const rad = radius;\n    const maxD = xShape[3] - 1;\n    this.outputShape = xShape;\n\n    // optimize pow(bias + alpha * sum, -beta)\n    // src: https://github.com/tensorflow/tensorflow/..\n    //
blob/26033a1644a9c4a5fbe3170ab2e864b6a4ccd4ca/..\n    // tensorflow/core/kernels/mkl_lrn_op.cc#L320\n    let powOperator;\n    const basis = `float(${bias}) + float(${alpha}) * sum`;\n    if (beta === 0.5) {\n      powOperator = `inversesqrt(${basis})`;\n    } else if (beta === 1.0) {\n      powOperator = `1.0/(${basis})`;\n    } else {\n      powOperator = `exp(log(${basis}) * float(-${beta}));`;\n    }\n\n    this.userCode = `\n      void main() {\n        ivec4 coords = getOutputCoords();\n        int b = coords.x;\n        int r = coords.y;\n        int c = coords.z;\n        int d = coords.w;\n\n        bool hasNextCol = d < ${this.outputShape[3]};\n        bool hasNextRow = c < ${this.outputShape[2]};\n\n        vec4 sum = vec4(0.);\n        vec4 xFragAtOutputCoords =
 getX(b, r, c, d);\n\n        vec4 xAtOutputCoords = vec4(\n          getChannel(xFragAtOutputCoords, vec2(c, d)),\n
    hasNextCol ?\n            getChannel(xFragAtOutputCoords, vec2(c, d + 1)) : 0.0,\n          hasNextRow ?\n
getChannel(xFragAtOutputCoords , vec2(c + 1, d)) : 0.0,\n          (hasNextRow && hasNextCol) ?\n
getChannel(xFragAtOutputCoords, vec2(c + 1, d + 1)) : 0.0\n        );\n\n        int firstChannel = d - ${rad};\n
vec2 cache = vec2(0.);\n        if(firstChannel >= 0){\n          vec4 firstChannelFrag = getX(b, r, c, firstChannel);\n
  cache.x = getChannel(firstChannelFrag, vec2(c, firstChannel));\n          if(hasNextRow){\n            cache.y =
getChannel(firstChannelFrag, vec2(c + 1, firstChannel));\n          }\n        }\n\n        ivec2 depth = ivec2(d, d + 1);\n
    for (int j = - ${rad}; j <= ${rad}; j++) {\n          ivec2 idx = depth + j;\n          bvec2 aboveLowerBound =
greaterThanEqual(idx, ivec2(0));\n
          bvec2 belowUpperBound = lessThanEqual(idx, ivec2(${maxD}));\n\n          bool depthInRange =
aboveLowerBound.x && belowUpperBound.x;\n          bool depthPlusOneInRange = aboveLowerBound.y &&
belowUpperBound.y;\n\n          if(depthInRange || depthPlusOneInRange){\n            vec4 z = vec4(0.);\n            vec4
xFragAtCurrentDepth;\n            z.xz = cache.xy;\n            if(depthPlusOneInRange && hasNextCol){\n
xFragAtCurrentDepth = idx.y != d ?\n                getX(b, r, c, idx.y) : xFragAtOutputCoords;\n              z.y =
getChannel(xFragAtCurrentDepth, vec2(c, idx.y));\n              if(hasNextRow){\n                z.w =
getChannel(xFragAtCurrentDepth, vec2(c + 1, idx.y));\n              }\n            }\n            cache.xy = z.yw;\n
sum += z * z;\n          }\n        }\n        vec4 result = xAtOutputCoords * ${powOperator};\n        setOutput(result);\n
  }\n    `;\n  }\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights
 Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n *
http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
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==========================================================================\n
*/\n\nimport {env, KernelConfig, KernelFunc, LRN, LRNAttrs, LRNInputs, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL} from '../backend_webgl';\nimport {LRNProgram} from '../lrn_gpu';\nimport {LRNPackedProgram} from '../lrn_packed_gpu';\n\nexport const lrn =\n    (args: {inputs: LRNInputs, backend: MathBackendWebGL,
 attrs: LRNAttrs}):\n        TensorInfo => {\n        const {inputs, backend, attrs} = args;\n        const {x} = inputs;\n
      const {depthRadius, bias, alpha, beta} = attrs;\n\n        const program =
env().getBool('WEBGL_PACK_NORMALIZATION') ?\n            new LRNPackedProgram(x.shape, depthRadius, bias, alpha, beta) :\n            new LRNProgram(x.shape, depthRadius, bias, alpha, beta);\n        return backend.runWebGLProgram(program, [x], x.dtype);\n    };\n\n// tslint:disable-next-line: variable-name\nexport const LRNConfig: KernelConfig = {\n  kernelName: LRN,\n  backendName: 'webgl',\n  kernelFunc: lrn as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable
 law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========================================================================\n
*/\n\nimport {GPGPUProgram} from './gpgpu_math';\n\nexport class LRNGradProgram implements GPGPUProgram {\n  variableNames = ['inputImage', 'outputImage', 'dy'];\n  outputShape: number[] = [];\n  userCode: string;\n  depthRadius: number;\n  bias: number;\n  alpha: number;\n  beta: number;\n  depth: number;\n\n  constructor(\n      inputShape: number[], depthRadius: number, bias: number, alpha: number,\n      beta: number) {\n    this.outputShape = inputShape;\n    this.depth = inputShape[3];\n    this.depthRadius = depthRadius;\n    this.bias = bias;\n    this.alpha = alpha;\n    this.beta = beta;\n    this.userCode
    = `\n      void main() {\n        ivec4 coords = getOutputCoords();\n        int b = coords[0];\n        int r = coords[1];\n
    int c = coords[2];\n\n        float result = 0.0;\n        for (int d = 0; d < ${this.depth}; ++d) {\n          int depthBegin = int(max(0.0, float(d - ${depthRadius})));\n          int depthEnd = int(min(float(${this.depth}),\n              float(d + ${depthRadius} + 1)));\n\n          const int MIN_DEPTH_BEGIN = 0;\n          const int MAX_DEPTH_END = ${this.depth};\n\n          float norm = 0.0;\n          for (int k = MIN_DEPTH_BEGIN; k < MAX_DEPTH_END; ++k) {\n            if (k < depthBegin){\n              continue;\n            }\n            else if (k >= depthBegin && k < depthEnd) {\n              norm += getInputImage(b, r, c, k) * getInputImage(b, r, c, k);\n            }\n            else {\n
      break;\n            }\n          }\n\n          norm = float(${alpha}) * norm + float(${bias});\n\n          for(int k = MIN_DEPTH_BEGIN;
 k < MAX_DEPTH_END; ++k){\n            if (k < depthBegin){\n              continue;\n            }\n            else if (k >= depthBegin && k < depthEnd){\n              float dyi = -2.0 * float(${alpha})\n                * float(${beta})\n                * getInputImage(b ,r ,c, k) * getOutputImage(b, r, c, d)\n                / norm;\n              if (k == d) {\n                dyi += pow(norm, -1.0 * ${beta});\n              }\n              if (k == coords[3]) {\n                dyi *= getDy(b, r, c, d);\n
 result += dyi;\n              }\n            }\n            else {\n              break;\n            }\n          }\n      }\n
setOutput(result);\n    }\n    `;\n  }\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n
 *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
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*/\n\nimport {KernelConfig, KernelFunc, LRNGrad, LRNGradAttrs, LRNGradInputs, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL} from '../backend_webgl';\nimport {LRNGradProgram} from '../lrn_grad_gpu';\n\nexport const lrnGrad = (args: {\n inputs: LRNGradInputs,\n backend: MathBackendWebGL,\n attrs: LRNGradAttrs\n}): TensorInfo => {\n const {inputs, backend, attrs} = args;\n const {x, y, dy} = inputs;\n const {depthRadius, bias, alpha, beta} = attrs;\n\n const program = new LRNGradProgram(x.shape, depthRadius, bias, alpha, beta);\n return backend.runWebGLProgram(program, [x, y, dy], x.dtype);\n};\n\n// tslint:disable-next-line: variable-name\nexport const LRNGradConfig: KernelConfig = {\n kernelName: LRNGrad,\n backendName: 'webgl',\n kernelFunc: lrnGrad as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n*/\n\nimport {KernelFunc,
  Max, MaxAttrs, MaxInputs, TensorInfo} from '@tensorflow/tfjs-core';\nimport {backend_util, KernelConfig, TypedArray, util} from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL} from '../backend_webgl';\nimport {maxImplCPU} from '../kernel_utils/shared';\n\nimport {maxImpl} from './Max_impl';\nimport {transposeImpl, transposeImplCPU} from './Transpose_impl';\n\nexport function max(\n args: {inputs: MaxInputs, backend: MathBackendWebGL, attrs: MaxAttrs}):\n   TensorInfo {\n const {inputs, backend, attrs} = args;\n const {x} = inputs;\n const {reductionIndices, keepDims} = attrs;\n\n const xRank = x.shape.length;\n\n const origAxes = util.parseAxisParam(reductionIndices, x.shape);\n let axes = origAxes;\n const permutedAxes = backend_util.getAxesPermutation(axes, xRank);\n const maxInputIsTransposed = permutedAxes != null;\n const shouldExecuteOnCPU = backend.shouldExecuteOnCPU([x]);\n\n let maxInput = x;\n if (maxInputIsTransposed) {\n   if (shouldExecuteOnCPU)
  {\n   const xTexData = backend.texData.get(maxInput.dataId);\n   const values = xTexData.values as TypedArray;\n\n   const newShape: number[] = new Array(xRank);\n   for (let i = 0; i < newShape.length; i++)
  {\n   newShape[i] = x.shape[permutedAxes[i]];\n   }\n   const maxInputValues =\n   transposeImplCPU(values, x.shape, x.dtype, permutedAxes, newShape);\n\n   maxInput = backend.makeTensorInfo(newShape, x.dtype);\n   const maxInputData = backend.texData.get(maxInput.dataId);\n   maxInputData.values = maxInputValues;\n   } else {\n   maxInput = transposeImpl(x, permutedAxes, backend);\n   }\n\n   axes = backend_util.getInnerMostAxes(axes.length, xRank);\n }\n\n backend_util.assertAxesAreInnerMostDims('max', axes, xRank);\n const [maxOutShape, reduceShape] =\n   backend_util.computeOutAndReduceShapes(maxInput.shape, axes);\n\n let outShape = maxOutShape;\n if (keepDims) {\n   // rather than reshape at the end, set the target
  shape here.\n   outShape = backend_util.expandShapeToKeepDim(maxOutShape, origAxes);\n }\n\n let out;\n if (shouldExecuteOnCPU) {\n   const xTexData = backend.texData.get(maxInput.dataId);\n   const values = xTexData.values as TypedArray;\n\n   const outValues =\n   maxImplCPU(values, util.sizeFromShape(reduceShape), outShape, x.dtype);\n\n   out = backend.makeTensorInfo(outShape, x.dtype);\n   const outData = backend.texData.get(out.dataId);\n   outData.values = outValues;\n } else {\n   out = maxImpl(maxInput, reduceShape, outShape, backend);\n }\n\n if (maxInputIsTransposed) {\n   backend.disposeIntermediateTensorInfo(maxInput);\n }\n\n return out;\n}\n\nexport const maxConfig: KernelConfig = {\n kernelName: Max,\n backendName: 'webgl',\n kernelFunc: max as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in

compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==========\n */\nimport {backend_util, KernelConfig, KernelFunc, MaxPool, MaxPoolAttrs, MaxPoolInputs, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL} from '../backend_webgl';\nimport {Pool2DProgram} from '../pool_gpu';\nimport {assertNotComplex} from '../webgl_util';\nimport {identity} from './Identity';\n\nexport function maxPool(args: {\n inputs: MaxPoolInputs,\n backend: MathBackendWebGL,\n attrs: MaxPoolAttrs\n}): TensorInfo {\n const {inputs, backend, attrs} = args;\n const {x} = inputs;\n assertNotComplex(x, 'maxPool');\n const {filterSize, strides, pad, dimRoundingMode} = attrs;\n const dilations = 1;\n\n util.assert(\n   backend_util.eitherStridesOrDilationsAreOne(strides, dilations),\n   () => 'Error in maxPool: Either strides or dilations must be 1. ' +\n   `Got strides ${strides} and dilations '${dilations}'`);\n\n const convInfo = backend_util.computePool2DInfo(\n   x.shape as [number, number, number, number], filterSize, strides,\n   dilations, pad, dimRoundingMode);\n if (convInfo.filterWidth === 1 && convInfo.filterHeight === 1 &&\n   util.arraysEqual(convInfo.inShape, convInfo.outShape)) {\n   return identity({inputs: {x}, backend});\n }\n const maxPoolProgram = new Pool2DProgram(convInfo, 'max', false);\n return backend.runWebGLProgram(maxPoolProgram, [x], x.dtype);\n}\n\nexport const maxPoolConfig: KernelConfig = {\n kernelName: MaxPool,\n backendName: 'webgl',\n kernelFunc: maxPool as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==========\n */\nimport {backend_util, KernelConfig, KernelFunc, MaxPool3D, MaxPool3DAttrs, MaxPool3DInputs, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL} from '../backend_webgl';\nimport {Pool3DProgram} from '../pool_gpu';\n\nexport
 function maxPool3d(args: {\n inputs: MaxPool3DInputs,\n backend: MathBackendWebGL,\n attrs: MaxPool3DAttrs\n}): TensorInfo {\n const {inputs, backend, attrs} = args;\n const {x} = inputs;\n const {filterSize, strides, pad, dataFormat, dimRoundingMode} = attrs;\n const dilations: [number, number, number] = [1, 1, 1];\n\n const convInfo = backend_util.computePool3DInfo(\n   x.shape as [number, number, number, number, number], filterSize, strides,\n   dilations, pad, dimRoundingMode, dataFormat);\n const maxPoolProgram = new Pool3DProgram(convInfo, 'max', false);\n return backend.runWebGLProgram(maxPoolProgram, [x], x.dtype);\n}\n\nexport const maxPool3DConfig: KernelConfig = {\n kernelName: MaxPool3D,\n backendName: 'webgl',\n kernelFunc: maxPool3d as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2017 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance
 with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==========\n

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*/\n\nimport {backend_util} from '@tensorflow/tfjs-core';\nimport {GPGPUProgram} from
'./gpgpu_math';\n\nexport class MaxPool2DBackpropProgram implements GPGPUProgram {\n  variableNames =
['dy', 'maxPos'];\n  outputShape: number[];\n  userCode: string;\n\n  constructor(convInfo:
backend_util.Conv2DInfo) {\n    this.outputShape = convInfo.inShape;\n    const strideHeight =
convInfo.strideHeight;\n    const strideWidth = convInfo.strideWidth;\n    const dilationHeight
 = convInfo.dilationHeight;\n    const effectiveFilterHeight = convInfo.effectiveFilterHeight;\n    const
effectiveFilterWidth = convInfo.effectiveFilterWidth;\n\n    const padTop = effectiveFilterHeight - 1 -
convInfo.padInfo.top;\n    const padLeft = effectiveFilterWidth - 1 - convInfo.padInfo.left;\n\n    const lastIndex =
effectiveFilterHeight * effectiveFilterWidth - 1;\n    this.userCode = `\n      const ivec2 pads = ivec2(${padTop},
${padLeft});\n\n      void main() {\n        ivec4 coords = getOutputCoords();\n        int b = coords[0];\n        int d =
coords[3];\n\n        ivec2 dyRCCorner = coords.yz - pads;\n        int dyRCorner = dyRCCorner.x;\n        int
dyCCorner = dyRCCorner.y;\n\n        // Convolve dy(?, ?, d) with pos mask(:, :, d) to get dx(xR, xC, d).\n        // ? =
to be determined. : = across all values in that axis.\n        float dotProd = 0.0;\n        for (int wR = 0; wR <
${effectiveFilterHeight};\n          wR += ${dilationHeight}) {\n          float
 dyR = float(dyRCorner + wR) / ${strideHeight}.0;\n\n          if (dyR < 0.0 || dyR >= ${convInfo.outHeight}.0 ||
fract(dyR) > 0.0) {\n            continue;\n          }\n          int idyR = int(dyR);\n\n          for (int wC = 0; wC <
${effectiveFilterWidth}; wC++) {\n            float dyC = float(dyCCorner + wC) / ${strideWidth}.0;\n\n            if
(dyC < 0.0 || dyC >= ${convInfo.outWidth}.0 ||\n                fract(dyC) > 0.0) {\n              continue;\n            }\n
 int idyC = int(dyC);\n\n            float dyValue = getDy(b, idyR, idyC, d);\n            int maxPosValue = ${lastIndex} -
int(getMaxPos(b, idyR, idyC, d));\n\n            // Get the current value, check it against the value from the\n            //
position matrix.\n            int curPosValue = wR * ${effectiveFilterWidth} + wC;\n            float mask =
float(maxPosValue == curPosValue ? 1.0 : 0.0);\n\n            dotProd += dyValue * mask;\n          }\n        }\n
setOutput(dotProd);\n
    }\n    `;\n  }\n}\n\nexport class MaxPool3DBackpropProgram implements GPGPUProgram {\n  variableNames =
['dy', 'maxPos'];\n  outputShape: number[];\n  userCode: string;\n\n  constructor(convInfo:
backend_util.Conv3DInfo) {\n    this.outputShape = convInfo.inShape;\n    const strideDepth =
convInfo.strideDepth;\n    const strideHeight = convInfo.strideHeight;\n    const strideWidth =
convInfo.strideWidth;\n    const dilationDepth = convInfo.dilationDepth;\n    const dilationHeight =
convInfo.dilationHeight;\n    const dilationWidth = convInfo.dilationWidth;\n    const effectiveFilterDepth =
convInfo.effectiveFilterDepth;\n    const effectiveFilterHeight = convInfo.effectiveFilterHeight;\n    const
effectiveFilterWidth = convInfo.effectiveFilterWidth;\n\n    const padFront = effectiveFilterDepth - 1 -
convInfo.padInfo.front;\n    const padTop = effectiveFilterHeight - 1 - convInfo.padInfo.top;\n    const padLeft =
effectiveFilterWidth - 1 - convInfo.padInfo.left;\n\n    const lastIndex
 =\n        effectiveFilterDepth * effectiveFilterHeight * effectiveFilterWidth - 1;\n    this.userCode = `\n      const
ivec3 pads = ivec3(${padFront}, ${padTop}, ${padLeft});\n\n      void main() {\n        ivec5 coords =
getOutputCoords();\n        int batch = coords.x;\n        int ch = coords.u;\n\n        ivec3 dyCorner = ivec3(coords.y,
coords.z, coords.w) - pads;\n        int dyDCorner = dyCorner.x;\n        int dyRCorner = dyCorner.y;\n        int
dyCCorner = dyCorner.z;\n\n        // Convolve dy(?, ?, ?, ch) with pos mask(:, :, :, d) to get\n        // dx(xD, xR, xC,
ch).\n        // ? = to be determined. : = across all values in that axis.\n        float dotProd = 0.0;\n\n        for (int wD =
0; wD < ${effectiveFilterDepth};\n          wD += ${dilationDepth}) {\n          float dyD = float(dyDCorner + wD) /
${strideDepth}.0;\n\n          if (dyD < 0.0 || dyD >= ${convInfo.outDepth}.0 || fract(dyD) > 0.0) {\n
continue;\n          }\n          int idyD = int(dyD);\n\n
          for (int wR = 0; wR < ${effectiveFilterHeight};\n            wR += ${dilationHeight}) {\n            float dyR =
float(dyRCorner + wR) / ${strideHeight}.0;\n\n            if (dyR < 0.0 || dyR >= ${convInfo.outHeight}.0 ||\n
fract(dyR) > 0.0) {\n              continue;\n            }\n            int idyR = int(dyR);\n\n            for (int wC = 0; wC <
${effectiveFilterWidth};\n              wC += ${dilationWidth}) {\n              float dyC = float(dyCCorner + wC) /
${strideWidth}.0;\n\n              if (dyC < 0.0 || dyC >= ${convInfo.outWidth}.0 ||\n                  fract(dyC) > 0.0) {\n
          continue;\n              }\n              int idyC = int(dyC);\n\n              float dyValue = getDy(batch, idyD, idyR,
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idyC, ch);\n int maxPosValue = ${lastIndex} -\n int(getMaxPos(batch, idyD, idyR, idyC, ch));\n\n // Get the current value, check it against the value from the\n // position matrix.\n int curPosValue =\n wD * ${effectiveFilterHeight} * ${effectiveFilterWidth} +\n wR * ${effectiveFilterWidth} + wC;\n float mask = float(maxPosValue == curPosValue ? 1.0 : 0.0);\n\n dotProd += dyValue * mask;\n }\n }\n }\n setOutput(dotProd);\n }\n `;\n }\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations
 under the License.\n *
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/\nimport {backend_util, KernelConfig, KernelFunc, MaxPool3DGrad, MaxPool3DGradAttrs, MaxPool3DGradInputs, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL} from '../backend_webgl';\nimport {MaxPool3DBackpropProgram} from '../max_pool_backprop_gpu';\nimport {Pool3DProgram} from '../pool_gpu';\n\nexport function maxPool3DGrad(args: {\n inputs: MaxPool3DGradInputs,\n backend: MathBackendWebGL,\n attrs: MaxPool3DGradAttrs\n}): TensorInfo {\n const {inputs, backend, attrs} = args;\n const {dy, input} = inputs;\n const x = input;\n const {filterSize, strides, pad, dimRoundingMode} = attrs;\n const dilations: [number, number, number] = [1, 1, 1];\n\n const convInfo = backend_util.computePool3DInfo(\n x.shape as [number, number, number, number, number], filterSize, strides,\n dilations, pad, dimRoundingMode);\n\n const maxPool3dPositionsProgram =\n new Pool3DProgram(convInfo, 'max', true / get positions */);\n const maxPool3dPositions =\n backend.runWebGLProgram(maxPool3dPositionsProgram, [x], x.dtype);\n const maxPoolBackpropProgram = new MaxPool3DBackpropProgram(convInfo);\n const result = backend.runWebGLProgram(\n maxPoolBackpropProgram, [dy, maxPool3dPositions], x.dtype);\n backend.disposeIntermediateTensorInfo(maxPool3dPositions);\n return result;\n}\n\nexport const maxPoolGrad3DConfig: KernelConfig = {\n kernelName: MaxPool3DGrad,\n backendName: 'webgl',\n kernelFunc: maxPool3DGrad as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under
 the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
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*/\nimport {backend_util, KernelConfig, KernelFunc, MaxPoolGrad, MaxPoolGradAttrs, MaxPoolGradInputs, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL} from '../backend_webgl';\nimport {MaxPool2DBackpropProgram} from '../max_pool_backprop_gpu';\nimport {Pool2DProgram} from '../pool_gpu';\nimport {assertNotComplex} from '../webgl_util';\n\nexport function maxPoolGrad(args: {\n inputs: MaxPoolGradInputs,\n backend: MathBackendWebGL,\n attrs: MaxPoolGradAttrs\n}): TensorInfo {\n const {inputs, backend, attrs} = args;\n const {dy, input, output} = inputs;\n const x = input;\n assertNotComplex([input, output], 'maxPoolGrad');\n const {filterSize,
 strides, pad, dimRoundingMode} = attrs;\n\n const convInfo = backend_util.computePool2DInfo(\n x.shape as [number, number, number, number], filterSize, strides,\n 1 /* dilations */, pad, dimRoundingMode);\n const getPositions = true;\n const maxPoolPositionsProgram =\n new Pool2DProgram(convInfo, 'max', getPositions);\n const maxPoolPositions: TensorInfo =\n

backend.runWebGLProgram(maxPoolPositionsProgram, [x], x.dtype);\n\n const maxPoolBackPropProgram = new MaxPool2DBackpropProgram(convInfo);\n const result = backend.runWebGLProgram(\n maxPoolBackPropProgram, [dy, maxPoolPositions], x.dtype);\n backend.disposeIntermediateTensorInfo(maxPoolPositions);\n return result;\n}\n\nexport const maxPoolGradConfig: KernelConfig = {\n kernelName: MaxPoolGrad,\n backendName: 'webgl',\n kernelFunc: maxPoolGrad as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==\n */\n\nimport {backend_util, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL} from '../backend_webgl';\nimport {Pool2DProgram} from '../pool_gpu';\n\nexport function maxPoolWithArgmaxImpl(\n x: TensorInfo, includeBatchInIndex: boolean,\n   convInfo: backend_util.Conv2DInfo,\n   backend: MathBackendWebGL): TensorInfo[] {\n let program = new Pool2DProgram(convInfo, 'max', false);\n const poolOutput = backend.runWebGLProgram(program, [x], 'float32');\n\n program = new Pool2DProgram(convInfo, 'max', true, true, includeBatchInIndex);\n const indexOutput = backend.runWebGLProgram(program, [x], 'float32');\n return [poolOutput, indexOutput];\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==\n */\n\nimport {MaxPoolWithArgmax, MaxPoolWithArgmaxAttrs, MaxPoolWithArgmaxInputs} from '@tensorflow/tfjs-core';\nimport {backend_util, KernelConfig, util} from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL} from '../backend_webgl';\n\nimport {maxPoolWithArgmaxImpl} from './MaxPoolWithArgmax_impl';\n\nexport const maxPoolWithArgmaxConfig: KernelConfig = {\n kernelName: MaxPoolWithArgmax,\n backendName: 'webgl',\n kernelFunc: ({inputs, attrs, backend}) => {\n   const {x} = inputs as MaxPoolWithArgmaxInputs;\n   const {filterSize, strides, pad, includeBatchInIndex} =\n   attrs as {} as MaxPoolWithArgmaxAttrs;\n   const webglBackend = backend as MathBackendWebGL;\n\n   util.assert(\n   x.shape.length === 4,\n   () => `Error in maxPool: input must be rank 4 but got rank ${\n            x.shape.length}.`);\n   const dilations: [number, number] = [1, 1];\n   util.assert(\n   backend_util.eitherStridesOrDilationsAreOne(strides, dilations),\n   () => 'Error in maxPool: Either strides or dilations must be 1. ' +\n   `Got strides ${strides} and dilations '${dilations}'`);\n\n   const convInfo = backend_util.computePool2DInfo(\n   x.shape as [number, number, number, number], filterSize, strides,\n   dilations, pad);\n\n   const [result, indexes] =\n   maxPoolWithArgmaxImpl(x, includeBatchInIndex, convInfo, webglBackend);\n   return [result, indexes];\n }\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific

language governing permissions and\n * limitations under the License.\n *
==========\n
*/\n\nimport {TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL} from
'../backend_webgl';\nimport {reduce} from '../kernel_utils/reduce';\nimport {reshape} from
'../kernels/Reshape';\n\nexport function meanImpl(\n x: TensorInfo, reduceShape: number[], outShape:
number[],\n backend: MathBackendWebGL): TensorInfo {\n const inSize = util.sizeFromShape(reduceShape);\n
const xSize = util.sizeFromShape(x.shape);\n const batchSize = xSize / inSize;\n const reshapedInput =\n
reshape({inputs: {x}, attrs: {shape: [batchSize, inSize]}, backend});\n\n const reduced = reduce(reshapedInput,
'float32', 'mean', backend);\n const reshapedOutput =\n reshape({inputs: {x: reduced}, attrs: {shape: outShape},
backend});\n\n backend.disposeIntermediateTensorInfo(reshapedInput);\n
backend.disposeIntermediateTensorInfo(reduced);\n\n
return reshapedOutput;\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n *
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OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language
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==========\n
*/\n\nimport {backend_util, KernelConfig, Mean, MeanAttrs, MeanInputs, TensorInfo, TypedArray, util} from
'@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL} from '../backend_webgl';\n\nimport {meanImpl} from
'./Mean_impl';\nimport
{transposeImpl, transposeImplCPU} from './Transpose_impl';\n\nexport const meanConfig: KernelConfig = {\n
kernelName: Mean,\n backendName: 'webgl',\n kernelFunc: ({inputs, attrs, backend}) => {\n const {x} = inputs
as MeanInputs;\n const {keepDims, axis} = attrs as {} as MeanAttrs;\n const webglBackend = backend as
MathBackendWebGL;\n\n const xRank = x.shape.length;\n const origAxes = util.parseAxisParam(axis,
x.shape);\n\n let axes = origAxes;\n const permutedAxes = backend_util.getAxesPermutation(axes, xRank);\n
const meanInputIsTransposed = permutedAxes != null;\n const shouldExecuteOnCPU =
webglBackend.shouldExecuteOnCPU([x]);\n\n const intermediates: TensorInfo[] = [];\n\n let meanInput = x;\n
if (meanInputIsTransposed) {\n if (shouldExecuteOnCPU) {\n const xTexData =
webglBackend.texData.get(meanInput.dataId);\n const values = xTexData.values as TypedArray;\n\n const
newShape: number[] = new Array(xRank);\n
for (let i = 0; i < newShape.length; i++) {\n newShape[i] = x.shape[permutedAxes[i]];\n }\n
const meanInputValues =\n transposeImplCPU(values, x.shape, x.dtype, permutedAxes, newShape);\n\n
meanInput = webglBackend.makeTensorInfo(newShape, x.dtype);\n const meanInputData =
webglBackend.texData.get(meanInput.dataId);\n meanInputData.values = meanInputValues;\n } else {\n
meanInput = transposeImpl(x, permutedAxes, webglBackend);\n }\n\n intermediates.push(meanInput);\n
axes = backend_util.getInnerMostAxes(axes.length, xRank);\n }\n\n
backend_util.assertAxesAreInnerMostDims('sum', axes, xRank);\n const [meanOutShape, reduceShape] =\n
backend_util.computeOutAndReduceShapes(meanInput.shape, axes);\n\n let outShape = meanOutShape;\n if
(keepDims) {\n // rather than reshape at the end, set the target shape here.\n outShape =
backend_util.expandShapeToKeepDim(meanOutShape,
origAxes);\n }\n\n const out = meanImpl(meanInput, reduceShape, outShape, webglBackend);\n for (const i
of intermediates) {\n webglBackend.disposeIntermediateTensorInfo(i);\n }\n\n return out;\n }\n};\n","/**\n *
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WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {backend_util, KernelConfig, KernelFunc, Min, MinAttrs, MinInputs, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL} from '../backend_webgl';\nimport {reduce} from '../kernel_utils/reduce';\n\nimport {reshape} from './Reshape';\nimport {transpose} from './Transpose';\n\nexport function min(\n args: {inputs: MinInputs, backend: MathBackendWebGL, attrs: MinAttrs}):\n TensorInfo {\n const {inputs, backend, attrs} = args;\n const {x} = inputs;\n const {axis, keepDims} = attrs;\n\n const xRank = x.shape.length;\n\n const origAxes = util.parseAxisParam(axis, x.shape);\n let axes = origAxes;\n const permutedAxes = backend_util.getAxesPermutation(axes, xRank);\n let permutedX = x;\n if (permutedAxes != null) {\n permutedX = transpose({inputs: {x}, backend, attrs: {perm: permutedAxes}});\n axes = backend_util.getInnerMostAxes(axes.length, x.shape.length);\n }\n\n backend_util.assertAxesAreInnerMostDims('min', axes, xRank);\n const [outShape, reduceShape] =\n backend_util.computeOutAndReduceShapes(permutedX.shape, axes);\n const inSize = util.sizeFromShape(reduceShape);\n const a2D =\n reshape({inputs: {x: permutedX}, backend, attrs: {shape: [-1, inSize]}});\n const reduced = reduce(a2D, a2D.dtype, 'min', backend);\n\n let res;\n if (keepDims) {\n const newShape = backend_util.expandShapeToKeepDim(outShape, origAxes);\n res = reshape({inputs: {x: reduced}, backend, attrs: {shape: newShape}});\n } else {\n res = reshape({inputs: {x: reduced}, backend, attrs: {shape: outShape}});\n }\n\n backend.disposeIntermediateTensorInfo(a2D);\n backend.disposeIntermediateTensorInfo(reduced);\n\n if (permutedAxes != null) {\n backend.disposeIntermediateTensorInfo(permutedX);\n }\n\n return res;\n}\n\nexport const minConfig: KernelConfig = {\n kernelName: Min,\n backendName: 'webgl',\n kernelFunc: min as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {GPGPUProgram} from './gpgpu_math';\nimport {getCoordsDataType} from './shader_compiler';\n\nexport class MirrorPadProgram implements GPGPUProgram {\n variableNames = ['x'];\n outputShape: number[];\n userCode: string;\n\n constructor(\n xShape: number[], paddings: Array<[number, number]>,\n mode: 'reflect'|'symmetric') {\n this.outputShape = paddings.map(\n (p, i) => p[0] /* beforePad */ + xShape[i] + p[1] /* afterPad */);\n const rank = xShape.length;\n const dtype = getCoordsDataType(rank);\n\n const start = paddings.map(p => p[0]).join(',');\n const end = paddings.map((p, i) => p[0] + xShape[i]).join(',');\n const unpackedCoords =\n ['coords[0]', 'coords[1]', 'coords[2]', 'coords[3]'].slice(0, rank);\n const offset = mode === 'reflect' ? 0 : 1;\n\n if (rank === 1) {\n this.userCode = `\n int start = ${start};\n int end = ${end};\n\n void main() {\n int outC = getOutputCoords();\n if (outC < start) {\n outC = start * 2 - outC - ${offset};\n } else if(outC >= end) {\n outC = (end - 1) * 2 - outC + ${offset};\n }\n setOutput(getX(outC - start));\n }\n `;\n return;\n }\n this.userCode = `\n ${dtype} start = ${dtype}(${start});\n ${dtype} end = ${dtype}(${end});\n\n void main() {\n ${dtype} outC = getOutputCoords();\n for (int i = 0; i < ${rank}; i++) {\n if (outC[i] < start[i]) {\n outC[i] = start[i] * 2 - outC[i] - ${offset};\n } else if(outC[i] >= end[i]) {\n outC[i] = (end[i] - 1) * 2 - outC[i] + ${offset};\n }\n }\n ${dtype} coords = outC - start;\n setOutput(getX(${unpackedCoords}));\n }\n `;\n }\n}\n","/**\n * @license\n * Copyright 2020 Google LLC.

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==========================================================================\n
*/\n\nimport {GPGPUProgram} from './gpgpu_math';\nimport {getChannels} from './packing_util';\nimport {getCoordsDataType} from './shader_compiler';\n\n/**\n * Example shader code for\n * `mirrorPad(tf.tensor1d([1, 2, 3], 'int32'), [[2, 2]], 'reflect')`\n * ```\n *    const int start = int(2);\n *    const int end = int(5);\n *\n *    void main() {\n *      int outputLoc = getOutputCoords();\n *      vec4 result = vec4(0.);\n *\n *      int rc = outputLoc;\n *\n *
 int source = rc;\n *      if (source < start) {\n *        source = start * 2 - source - 0;\n *      } else if (source >= end) {\n *        source = (end - 1) * 2 - source + 0;\n *      }\n *      source -= start;\n *\n *      result[0] = getChannel(getX(source), source);\n *      rc += 1;\n *      if(rc < 6) {\n *        int source = rc;\n *        if (source < start)
 {\n *          source = start * 2 - source - 0;\n *        } else if (source >= end) {\n *          source = (end - 1) * 2 - source + 0;\n *        }\n *        source -= start;\n *\n *        result[1] = getChannel(getX(source), source);\n *      }\n *\n *      setOutput(result);\n *    }\n * ```\n */\nexport class MirrorPadPackedProgram implements GPGPUProgram {\n  variableNames = ['x'];\n  packedInputs = true;\n  packedOutput = true;\n  outputShape: number[];\n  userCode: string;\n\n  constructor(\n      xShape: number[], paddings: Array<[number, number]>,\n      mode: 'reflect'|'symmetric') {\n    this.outputShape = paddings.map(\n        (p, i) => p[0] /* beforePad */ + xShape[i] + p[1] /* afterPad */);\n    const rank = xShape.length;\n    const dtype = getCoordsDataType(rank);\n\n    const start = paddings.map(p => p[0]).join(',');\n    const end = paddings.map((p, i) => p[0] + xShape[i]).join(',');\n    const coords = getChannels('rc', rank);\n    const source
 = getChannels('source', rank);\n    const cLimit = `${coords[rank - 1]} < ${this.outputShape[rank - 1]}`;\n    const innerDims =\n        rank === 1 ? 'source' : `vec2(${source.slice(-2).join()})`;\n    const offset = mode === 'reflect' ? 0 : 1;\n\n    let mainLoop = '';\n    if (rank === 1) {\n      const padSetup = `\n        ${dtype} source = rc;\n        if (source < start) {\n          source = start * 2 - source - ${offset};\n        } else if (source >= end) {\n          source = (end - 1) * 2 - source + ${offset};\n        }\n        source -= start;\n      `;\n      mainLoop = `\n        ${dtype} rc = outputLoc;\n        ${padSetup}\n        result[0] = getChannel(getX(${source.join()}), ${innerDims});\n        ${coords[rank - 1]} += 1;\n        if(${cLimit}) {\n          ${padSetup}\n          result[1] = getChannel(getX(${source.join()}), ${innerDims});\n        }\n      `;\n    } else {\n      const padSetup = `\n        ${dtype} source = rc;\n        ${dtype} lt = ${dtype}(lessThan(source,
 start));\n        ${dtype} gte = ${dtype}(greaterThanEqual(source, end));\n        ${dtype} orig = 1 - (lt + gte);\n        source = orig * source +\n                 lt * (start * 2 - source - ${offset}) +\n                 gte * ((end - 1) * 2 - source + ${offset});\n        source -= start;\n      `;\n\n      mainLoop = `\n        ${dtype} rc = outputLoc;\n        ${padSetup}\n        result[0] = getChannel(getX(${source.join()}), ${innerDims});\n        ${coords[rank - 1]} += 1;\n        if(${cLimit}) {\n          ${padSetup}\n          result[1] = getChannel(getX(${source.join()}), ${innerDims});\n        }\n        rc = outputLoc;\n        ${coords[rank - 2]} += 1;\n        if(${coords[rank - 2]} < ${this.outputShape[rank - 2]}) {\n          ${padSetup}\n          result[2] = getChannel(getX(${source.join()}), ${innerDims});\n          ${coords[rank - 1]} += 1;\n          if(${cLimit}) {\n            ${padSetup}\n            result[3] = getChannel(getX(${source.join()}),
 ${innerDims});\n          }\n        }\n      `;\n    }\n\n    this.userCode = `\n      const ${dtype} start = ${dtype}(${start});\n      const ${dtype} end = ${dtype}(${end});\n\n      void main() {\n        ${dtype} outputLoc = getOutputCoords();\n        vec4 result = vec4(0.);\n        ${mainLoop}\n        setOutput(result);\n      }\n    `;\n  }\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You
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 * ==\n
*/\n\nimport {env, KernelConfig, KernelFunc, MirrorPad, MirrorPadAttrs, MirrorPadInputs, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL} from '../backend_webgl';\nimport {MirrorPadProgram} from '../mirror_pad_gpu';\nimport {MirrorPadPackedProgram} from '../mirror_pad_packed_gpu';\n\nexport const mirrorPadKernelFunc: (params: {\n inputs: MirrorPadInputs,\n backend: MathBackendWebGL,\n attrs: MirrorPadAttrs\n}) => TensorInfo = ({inputs, backend, attrs}) => {\n const {x} = inputs;\n const {paddings, mode} = attrs;\n\n const program = env().getBool('WEBGL_PACK_ARRAY_OPERATIONS') ?\n   new MirrorPadPackedProgram(x.shape, paddings, mode) :\n   new MirrorPadProgram(x.shape, paddings, mode);\n\n const output = backend.runWebGLProgram(program, [x], x.dtype);\n\n return output;\n};\n\nexport const mirrorPadConfig: KernelConfig = {\n kernelName: MirrorPad,\n backendName: 'webgl',\n kernelFunc: mirrorPadKernelFunc as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
 * ==\n
*/\n\nimport {KernelConfig, KernelFunc, Mod} from '@tensorflow/tfjs-core';\n\nimport {CHECK_NAN_SNIPPET} from '../binaryop_packed_gpu';\nimport {binaryKernelFunc} from '../kernel_utils/kernel_funcs_utils';\n\nconst
 MOD = `if (b == 0.0) return NAN;\n  return mod(a, b);`;\n\nconst MOD_PACKED = `\n  vec4 result = mod(a, b);\n  vec4 isNaN = vec4(equal(b, vec4(0.0)));\n  ` +\n   CHECK_NAN_SNIPPET + `\n  return result;\n`;\n\nexport const mod = binaryKernelFunc({\n opSnippet: MOD,\n packedOpSnippet: MOD_PACKED,\n});\n\nexport const modConfig: KernelConfig = {\n kernelName: Mod,\n backendName: 'webgl',\n kernelFunc: mod as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2017 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the
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 * ==\n
*/\n\nimport {GPGPUContext} from './gpgpu_context';\nimport {GPGPUProgram} from './gpgpu_math';\n\nexport class MultinomialProgram implements GPGPUProgram {\n variableNames = ['probs'];\n outputShape: number[];\n userCode: string;\n\n // Caching uniform location for speed.\n seedLoc: WebGLUniformLocation;\n\n constructor(batchSize: number, numOutcomes: number, numSamples: number) {\n   this.outputShape = [batchSize, numSamples];\n\n   this.userCode = `\n   uniform float seed;\n\n   void main() {\n   ivec2 coords = getOutputCoords();\n   int batch = coords[0];\n\n   float r = random(seed);\n   float cdf = 0.0;\n\n   for (int i = 0; i < ${numOutcomes - 1}; i++) {\n   cdf += getProbs(batch, i);\n\n   if (r < cdf) {\n   setOutput(float(i));\n   return;\n
        }\n   }\n\n   // If no other event happened, last event happened.\n   setOutput(float(${numOutcomes - 1}));\n   }\n   `;\n }\n\n getCustomSetupFunc(seed: number) {\n   return (gpgpu: GPGPUContext, webGLProgram: WebGLProgram) => {\n   if (this.seedLoc == null) {\n   this.seedLoc =

gpgpu.getUniformLocation(webGLProgram, 'seed');\n }\n gpgpu.gl.uniform1f(this.seedLoc, seed);\n };\n }\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific
language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {RealDiv} from '@tensorflow/tfjs-core';\nimport {KernelConfig} from '@tensorflow/tfjs-core';\nimport {binaryKernelFunc} from '../kernel_utils/kernel_funcs_utils';\n\n// Without the equality check div produces 0.9999 for a = b, which when\n// floored can cause errors.\nconst DIV = `\nif (a == b) {\n return 1.0;\n};\nreturn a / b;`;\n\n// We do the same as in ./binaryop_gpu, with vec4 and ivec4.\n// On Linux, the vectorized implementation produces NaNs when a and b are 0.\nconst DIV_PACKED = `\n // vec4 one = vec4(equal(a, b));\n // return one + (vec4(1.0) - one) * a / b;\n vec4 result = a / b;\n if(a.x == b.x) {\n result.x = 1.;\n }\n if(a.y == b.y) {\n result.y = 1.;\n }\n if(a.z == b.z) {\n result.z = 1.;\n }\n if(a.w == b.w) {\n result.w = 1.;\n }\n\n return result;\n`;\n\nexport const realDiv
= binaryKernelFunc(\n {opSnippet: DIV, packedOpSnippet: DIV_PACKED, checkOutOfBounds: true});\n\nexport const realDivConfig: KernelConfig = {\n kernelName: RealDiv,\n backendName: 'webgl',\n kernelFunc: realDiv,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {backend_util, KernelConfig, KernelFunc,
Softmax, SoftmaxAttrs, SoftmaxInputs, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL} from '../backend_webgl';\n\nimport {exp} from './Exp';\nimport {max} from './Max';\nimport {realDiv} from './RealDiv';\nimport {reshape} from './Reshape';\nimport {sub} from './Sub';\nimport {sum} from './Sum';\n\nexport function softmax(args: {\n inputs: SoftmaxInputs,\n backend: MathBackendWebGL,\n attrs: SoftmaxAttrs\n}): TensorInfo {\n const {inputs, backend, attrs} = args;\n const {logits} = inputs;\n const {dim} = attrs;\n\n const axes = util.parseAxisParam([dim], logits.shape);\n\n const maxLogit = max({\n inputs: {x: logits},\n backend,\n attrs: {reductionIndices: axes, keepDims: false}\n });\n\n const expandedShape = backend_util.expandShapeToKeepDim(maxLogit.shape, axes);\n\n const maxLogitsReshaped =\n reshape({inputs: {x: maxLogit}, backend, attrs: {shape: expandedShape}});\n const a =\n sub({inputs: {a: logits, b: maxLogitsReshaped},
backend}) as TensorInfo;\n const b = exp({inputs: {x: a}, backend}) as TensorInfo;\n const sumExp =\n sum({inputs: {x: b}, backend, attrs: {axis: axes, keepDims: false}});\n const sumExpReshaped =\n reshape({inputs: {x: sumExp}, backend, attrs: {shape: expandedShape}});\n\n const res =\n realDiv({inputs: {a: b, b: sumExpReshaped}, backend}) as TensorInfo;\n\n backend.disposeIntermediateTensorInfo(maxLogit);\n backend.disposeIntermediateTensorInfo(maxLogitsReshaped);\n backend.disposeIntermediateTensorInfo(a);\n backend.disposeIntermediateTensorInfo(b);\n backend.disposeIntermediateTensorInfo(sumExp);\n backend.disposeIntermediateTensorInfo(sumExpReshaped);\n\n return res;\n}\n\nexport const softmaxConfig: KernelConfig = {\n kernelName: Softmax,\n backendName: 'webgl',\n kernelFunc: softmax as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n

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{\n const {inputs, backend, attrs} = args;\n const {logits} = inputs;\n const {numSamples, seed, normalized} = attrs;\n\n const probs = normalized ?\n logits :\n softmax(\n {inputs: {logits}, backend, attrs: {dim: logits.shape.length - 1}});\n const batchSize = probs.shape[0];\n const numOutcomes = probs.shape[1];\n const program = new MultinomialProgram(batchSize, numOutcomes, numSamples);\n const customSetup = program.getCustomSetupFunc(seed);\n\n const res = backend.runWebGLProgram(program, [probs], 'int32', customSetup);\n if (!normalized) {\n backend.disposeIntermediateTensorInfo(probs);\n }\n return res;\n}\n\nexport const multinomialConfig: KernelConfig = {\n kernelName: Multinomial,\n backendName: 'webgl',\n kernelFunc: multinomial as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except
in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n===\n*/\n\nimport {backend_util, kernel_impls, KernelConfig, KernelFunc, NonMaxSuppressionV3, NonMaxSuppressionV3Attrs, NonMaxSuppressionV3Inputs, TypedArray} from '@tensorflow/tfjs-core';\n\nconst nonMaxSuppressionV3Impl = kernel_impls.nonMaxSuppressionV3Impl;\nimport {MathBackendWebGL} from '../backend_webgl';\n\nexport function nonMaxSuppressionV3(args: {\n inputs: NonMaxSuppressionV3Inputs,\n backend: MathBackendWebGL,\n attrs: NonMaxSuppressionV3Attrs\n})
{\n backend_util.warn(\n 'tf.nonMaxSuppression() in webgl locks the UI thread. ' +\n 'Call tf.nonMaxSuppressionAsync() instead');\n\n const {inputs, backend, attrs} = args;\n const {boxes, scores} = inputs;\n const {maxOutputSize, iouThreshold, scoreThreshold} = attrs;\n\n const boxesVals = backend.readSync(boxes.dataId) as TypedArray;\n const scoresVals = backend.readSync(scores.dataId) as TypedArray;\n\n const {selectedIndices} = nonMaxSuppressionV3Impl(\n boxesVals, scoresVals, maxOutputSize, iouThreshold, scoreThreshold);\n\n return backend.makeTensorInfo(\n [selectedIndices.length], 'int32', new Int32Array(selectedIndices));\n}\n\nexport const nonMaxSuppressionV3Config: KernelConfig = {\n kernelName: NonMaxSuppressionV3,\n backendName: 'webgl',\n kernelFunc: nonMaxSuppressionV3 as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n
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*/\n\nimport {backend_util, kernel_impls, KernelConfig, KernelFunc, NonMaxSuppressionV4, NonMaxSuppressionV4Attrs, NonMaxSuppressionV4Inputs, TensorInfo, TypedArray} from '@tensorflow/tfjs-core';\nconst nonMaxSuppressionV4Impl = kernel_impls.nonMaxSuppressionV4Impl;\n\nimport {MathBackendWebGL} from '../backend_webgl';\n\nexport function nonMaxSuppressionV4(args: {\n inputs: NonMaxSuppressionV4Inputs,\n backend: MathBackendWebGL,\n attrs: NonMaxSuppressionV4Attrs\n}): [TensorInfo, TensorInfo] {\n backend_util.warn(\n 'tf.nonMaxSuppression() in webgl locks the UI thread. ' +\n   'Call tf.nonMaxSuppressionAsync() instead');\n\n const {inputs, backend, attrs} = args;\n const {boxes, scores} = inputs;\n const {maxOutputSize, iouThreshold, scoreThreshold, padToMaxOutputSize} =\n   attrs;\n\n const boxesVals = backend.readSync(boxes.dataId) as TypedArray;\n const scoresVals = backend.readSync(scores.dataId) as TypedArray;\n\n const {selectedIndices, validOutputs} = nonMaxSuppressionV4Impl(\n   boxesVals, scoresVals, maxOutputSize, iouThreshold, scoreThreshold,\n   padToMaxOutputSize);\n\n return [\n   backend.makeTensorInfo(\n [selectedIndices.length], 'int32', new Int32Array(selectedIndices)),\n   backend.makeTensorInfo([], 'int32', new Int32Array([validOutputs]))\n];\n}\n\nexport const nonMaxSuppressionV4Config: KernelConfig = {\n kernelName: NonMaxSuppressionV4,\n backendName: 'webgl',\n kernelFunc: nonMaxSuppressionV4 as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {backend_util, kernel_impls, KernelConfig, KernelFunc, NonMaxSuppressionV5, NonMaxSuppressionV5Attrs, NonMaxSuppressionV5Inputs, TensorInfo, TypedArray} from '@tensorflow/tfjs-core';\n\nconst
 nonMaxSuppressionV5Impl = kernel_impls.nonMaxSuppressionV5Impl;\nimport {MathBackendWebGL} from '../backend_webgl';\n\nexport function nonMaxSuppressionV5(args: {\n inputs: NonMaxSuppressionV5Inputs,\n backend: MathBackendWebGL,\n attrs: NonMaxSuppressionV5Attrs\n}): [TensorInfo, TensorInfo] {\n backend_util.warn(\n   'tf.nonMaxSuppression() in webgl locks the UI thread. ' +\n   'Call tf.nonMaxSuppressionAsync() instead');\n\n const {inputs, backend, attrs} = args;\n const {boxes, scores} = inputs;\n const {maxOutputSize, iouThreshold, scoreThreshold, softNmsSigma} = attrs;\n\n const boxesVals = backend.readSync(boxes.dataId) as TypedArray;\n const scoresVals = backend.readSync(scores.dataId) as TypedArray;\n\n const maxOutputSizeVal = maxOutputSize;\n const iouThresholdVal = iouThreshold;\n const scoreThresholdVal = scoreThreshold;\n const softNmsSigmaVal = softNmsSigma;\n\n const {selectedIndices, selectedScores} = nonMaxSuppressionV5Impl(\n   boxesVals,
 scoresVals, maxOutputSizeVal, iouThresholdVal,\n   scoreThresholdVal, softNmsSigmaVal);\n\n return [\n   backend.makeTensorInfo(\n   [selectedIndices.length], 'int32', new Int32Array(selectedIndices)),\n   backend.makeTensorInfo(\n   [selectedScores.length], 'float32', new Float32Array(selectedScores))\n];\n}\n\nexport const nonMaxSuppressionV5Config: KernelConfig = {\n kernelName: NonMaxSuppressionV5,\n backendName: 'webgl',\n kernelFunc: nonMaxSuppressionV5 as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2017 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS
 OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *

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==========\n*/\n\nimport {GPGPUProgram} from './gpgpu_math';\n\nexport class OneHotProgram implements GPGPUProgram {\n  variableNames = ['indices'];\n  outputShape: number[];\n  userCode: string;\n\n  // Caching uniform location for speed.\n  seedLoc: WebGLUniformLocation;\n\n  constructor(\n      numIndices: number, depth: number, onValue: number, offValue: number) {\n    this.outputShape = [numIndices, depth];\n\n    this.userCode = `\n      void main() {\n        ivec2 coords = getOutputCoords();\n        int index = round(getIndices(coords.x));\n        setOutput(mix(float(${offValue}), float(${onValue}),\n                      float(index == coords.y)));\n      }\n    `;\n  }\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n==========\n*/\n\nimport {KernelConfig, KernelFunc, OneHot, OneHotAttrs, OneHotInputs, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL} from '../backend_webgl';\nimport {OneHotProgram} from '../onehot_gpu';\nimport {reshape} from './Reshape';\n\nexport const oneHot = (args: {\n  inputs: OneHotInputs,\n  backend: MathBackendWebGL,\n  attrs: OneHotAttrs\n}): TensorInfo => {\n  const {inputs, backend, attrs} = args;\n  const {indices} = inputs;\n  const {depth, onValue, offValue} = attrs;\n\n  const indicesSize = util.sizeFromShape(indices.shape);\n  const program = new OneHotProgram(indicesSize, depth, onValue, offValue);\n  const reshaped =\n      reshape({inputs: {x: indices}, backend, attrs: {shape: [indicesSize]}});\n  const result = backend.runWebGLProgram(program, [reshaped], indices.dtype);\n  backend.disposeIntermediateTensorInfo(reshaped);\n\n  const outShape = [...indices.shape, depth];\n  const out = reshape({inputs: {x: result}, backend, attrs: {shape: outShape}});\n  backend.disposeIntermediateTensorInfo(result);\n  return out;\n};\n\nexport const oneHotConfig: KernelConfig = {\n  kernelName: OneHot,\n  backendName: 'webgl',\n  kernelFunc: oneHot as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n==========\n*/\n\nimport {KernelConfig, KernelFunc, TensorInfo, ZerosLike, ZerosLikeInputs} from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL} from '../backend_webgl';\n\nimport {complex} from './Complex';\nimport {fill} from './Fill';\nimport {imag} from './Imag';\nimport {real} from './Real';\n\nexport function zerosLike(\n    args: {inputs: ZerosLikeInputs, backend: MathBackendWebGL}): TensorInfo {\n  const {inputs, backend} = args;\n  const {x} = inputs;\n\n  if (x.dtype === 'complex64') {\n    const realPart = real({inputs: {input: x}, backend});\n    const r = zerosLike({inputs: {x: realPart}, backend});\n    const imagPart = imag({inputs: {input: x}, backend});\n    const i = zerosLike({inputs: {x: imagPart}, backend});\n\n    const result = complex({inputs: {real: r, imag: i}, backend});\n\n    backend.disposeIntermediateTensorInfo(realPart);\n    backend.disposeIntermediateTensorInfo(r);\n    backend.disposeIntermediateTensorInfo(imagPart);\n    backend.disposeIntermediateTensorInfo(i);\n\n    return result;\n  } else {\n    return fill({\n      attrs: {\n        shape: x.shape,\n        dtype: x.dtype,\n        value: x.dtype === 'string' ? '' : 0\n      },\n      backend\n    });\n  }\n}\n\nexport const zerosLikeConfig: KernelConfig = {\n  kernelName: ZerosLike,\n  backendName: 'webgl',\n  kernelFunc: zerosLike as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All
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language governing permissions and\n * limitations under the License.\n *
==========\n
*/\n\nimport {GPGPUProgram} from './gpgpu_math';\nimport {getCoordsDataType} from
'./shader_compiler';\n\nexport class PadProgram implements GPGPUProgram {\n variableNames = ['x'];\n
outputShape: number[];\n userCode: string;\n\n constructor(\n xShape: number[], paddings: Array<[number,
number]>,\n constantValue: number) {\n this.outputShape = paddings.map(\n (p, i) => p[0] /* beforePad */
+ xShape[i] + p[1] /* afterPad */);\n const rank = xShape.length;\n const type = getCoordsDataType(rank);\n\n
const start = paddings.map(p => p[0]).join(',');\n const end = paddings.map((p, i) => p[0] + xShape[i]).join(',');\n
const unpackedCoords =\n ['coords[0]', 'coords[1]', 'coords[2]', 'coords[3]'].slice(0, rank);\n\n if (rank === 1)
{\n this.userCode = `\n int start = ${start};\n
int end = ${end};\n\n void main() {\n int outC = getOutputCoords();\n if (outC < start || outC
>= end) {\n setOutput(float(${constantValue}));\n } else {\n setOutput(getX(outC - start));\n
}\n }\n `;\n return;\n }\n this.userCode = `\n ${type} start = ${type}(${start});\n ${type} end =
${type}(${end});\n\n void main() {\n ${type} outC = getOutputCoords();\n if (any(lessThan(outC,
start)) || any(greaterThanEqual(outC, end))) {\n setOutput(float(${constantValue}));\n } else {\n
${type} coords = outC - start;\n setOutput(getX(${unpackedCoords}));\n }\n }\n `;\n }\n}\n","/**\n
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WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific
language governing permissions and\n * limitations under the License.\n *
==========\n
*/\n\nimport {GPGPUProgram} from './gpgpu_math';\nimport {getChannels} from './packing_util';\nimport
{getCoordsDataType} from './shader_compiler';\n\nexport class PadPackedProgram implements GPGPUProgram
{\n variableNames = ['x'];\n packedInputs = true;\n packedOutput = true;\n outputShape: number[];\n userCode:
string;\n\n constructor(\n xShape: number[], paddings: Array<[number, number]>,\n constantValue: number)
{\n this.outputShape = paddings.map(\n (p, i) => p[0] /* beforePad */ + xShape[i] +
p[1] /* afterPad */);\n const rank = xShape.length;\n const dtype = getCoordsDataType(rank);\n\n const start =
paddings.map(p => p[0]).join(',');\n const end = paddings.map((p, i) => p[0] + xShape[i]).join(',');\n const coords
= getChannels('rc', rank);\n const source = getChannels('source', rank);\n const cLimit = `${coords[rank - 1]} <
${this.outputShape[rank - 1]}`;\n const innerDims =\n rank === 1 ? 'source' : `vec2(${source.slice(-
2).join()})`;\n\n const componentSetup = [\n `${dtype} rc = outputLoc;`, `${coords[rank - 1]} += 1;\n
if(${cLimit}) {\n `,\n rank === 1 ? '' : `}\n rc = outputLoc;\n ${coords[rank - 2]} += 1;\n
if(${coords[rank - 2]} < ${this.outputShape[rank - 2]}) {`,\n rank === 1 ? '' : ` ${coords[rank - 1]} += 1;\n
if(${cLimit}) {`\n];\n\n const paddingArea = rank === 1 ?\n 'rc < start || rc >= end' :\n
'any(lessThan(rc, start)) || any(greaterThanEqual(rc, end))';\n
let mainLoop = '';\n for (let i = 0, j = rank === 1 ? 2 : 4; i < j; i++) {\n mainLoop += `\n
${componentSetup[i]}\n if (${paddingArea}) {\n result[${i}] = float(${constantValue});\n } else {\n
${dtype} source = rc - start;\n result[${i}] = getChannel(getX(${source.join()}), ${innerDims});\n }\n
`;\n }\n mainLoop += (rank === 1 ? `} ` : `}}`);\n\n this.userCode = `\n const ${dtype} start =
${dtype}(${start});\n const ${dtype} end = ${dtype}(${end});\n\n void main() {\n ${dtype} outputLoc =
getOutputCoords();\n vec4 result = vec4(0.);\n ${mainLoop}\n setOutput(result);\n }\n `;\n
}\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache
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may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n

*\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ========== */\n\nimport {env, KernelConfig, KernelFunc, PadV2, PadV2Attrs, PadV2Inputs, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL} from '../backend_webgl';\nimport {PadProgram} from '../pad_gpu';\nimport {PadPackedProgram} from '../pad_packed_gpu';\n\nexport const padV2 =\n (args: {inputs: PadV2Inputs, backend: MathBackendWebGL, attrs: PadV2Attrs}):\n TensorInfo => {\n const {inputs, backend, attrs} = args;\n const {x} = inputs;\n const {paddings, constantValue} = attrs;\n\n const program = env().getBool('WEBGL_PACK_ARRAY_OPERATIONS') ?\n new PadPackedProgram(x.shape, paddings, constantValue) :\n new PadProgram(x.shape, paddings, constantValue);\n return backend.runWebGLProgram(program, [x], x.dtype);\n };\n\nexport const padV2Config: KernelConfig = {\n kernelName: PadV2,\n backendName: 'webgl',\n kernelFunc: padV2 as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ========== */\n\nimport {KernelConfig, KernelFunc, Pow} from '@tensorflow/tfjs-core';\n\nimport {CHECK_NAN_SNIPPET} from '../binaryop_packed_gpu';\nimport {binaryKernelFunc} from '../kernel_utils/kernel_funcs_utils';\n\nconst POW = `\n if(a < 0.0 && floor(b) < b){\n return NAN;\n }\n if (b == 0.0) {\n return 1.0;\n }\n return (round(mod(b, 2.0)) != 1) ?\n pow(abs(a), b) : sign(a) * pow(abs(a), b);\n`;\n\nconst POW_PACKED = `\n // isModRound1 has 1 for components with round(mod(b, 2.0)) == 1, 0 otherwise.\n vec4 isModRound1 = vec4(equal(round(mod(b, 2.0)), ivec4(1)));\n vec4 multiplier = sign(a) * isModRound1 + (vec4(1.0) - isModRound1);\n vec4 result = multiplier * pow(abs(a), b);\n\n // Ensure that a^0 = 1, including 0^0 = 1 as this correspond to TF and JS\n bvec4 isExpZero = equal(b, vec4(0.0));\n result.r = isExpZero.r ? 1.0 : result.r;\n result.g = isExpZero.g ? 1.0 : result.g;\n result.b = isExpZero.b ? 1.0 : result.b;\n result.a = isExpZero.a ? 1.0 : result.a;\n\n vec4 isNaN = vec4(lessThan(a, vec4(0.0))) * vec4(lessThan(floor(b), b));\n ` +\n CHECK_NAN_SNIPPET + `\n return result;\n`;\n\nexport const pow =\n binaryKernelFunc({opSnippet: POW, packedOpSnippet: POW_PACKED});\n\nexport const powConfig: KernelConfig = {\n kernelName: Pow,\n backendName: 'webgl',\n kernelFunc: pow as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ========== */\n\nimport {KernelConfig, KernelFunc, Range, RangeAttrs, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL} from '../backend_webgl';\nimport {rangeImplCPU} from '../kernel_utils/shared';\n\nexport const range =\n (args: {backend: MathBackendWebGL, attrs: RangeAttrs}): TensorInfo => {\n const {backend, attrs} = args;\n const {start, stop, step, dtype} = attrs;\n const values = rangeImplCPU(start, stop, step,

dtype);\n return backend.makeTensorInfo([values.length], dtype, values);\n };\n\nexport const rangeConfig: KernelConfig = {\n kernelName: Range,\n backendName: 'webgl',\n kernelFunc: range as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version
2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n
*/\n\nimport {KernelConfig, Reciprocal} from '@tensorflow/tfjs-core';\nimport {unaryKernelFunc} from '../kernel_utils/kernel_funcs_utils';\n\nconst RECIPROCAL = `return 1.0 / x;`;\n\nexport const reciprocal = unaryKernelFunc({opSnippet: RECIPROCAL});\n\nexport const reciprocalConfig: KernelConfig = {\n kernelName: Reciprocal,\n backendName: 'webgl',\n kernelFunc: reciprocal,\n};\n","/**\n
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==========\n
*/\n\nimport {KernelConfig, KernelFunc, Relu} from '@tensorflow/tfjs-core';\nimport {unaryKernelFunc} from '../kernel_utils/kernel_funcs_utils';\nimport {CHECK_NAN_SNIPPET} from '../unaryop_gpu';\n\nconst RELU = CHECK_NAN_SNIPPET + `\n  return (x < 0.0) ? 0.0 : x;\n`;\n\nconst RELU_PACKED
 = `\n  vec4 result = x * vec4(greaterThanEqual(x, vec4(0.0)));\n  bvec4 isNaN = isnan(x);\n\n  result.r = isNaN.r ? x.r : result.r;\n  result.g = isNaN.g ? x.g : result.g;\n  result.b = isNaN.b ? x.b : result.b;\n  result.a = isNaN.a ? x.a : result.a;\n\n  return result;\n`;\n\nexport const relu =\n   unaryKernelFunc({opSnippet: RELU, packedOpSnippet: RELU_PACKED});\n\nexport const reluConfig: KernelConfig = {\n kernelName: Relu,\n backendName: 'webgl',\n kernelFunc: relu as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS
 OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n
*/\n\nimport {KernelConfig, KernelFunc, Relu6} from '@tensorflow/tfjs-core';\nimport {unaryKernelFunc} from '../kernel_utils/kernel_funcs_utils';\nimport {CHECK_NAN_SNIPPET} from '../unaryop_gpu';\n\nconst RELU6 = CHECK_NAN_SNIPPET + `\n  return (x < 0.0) ? 0.0 : min(6.0, x);\n`;\n\nconst RELU6_PACKED = `\n  vec4 result = min(x, vec4(6.)) * vec4(greaterThanEqual(x, vec4(0.0)));\n  bvec4 isNaN = isnan(x);\n\n  result.r = isNaN.r ? x.r : result.r;\n  result.g = isNaN.g ? x.g : result.g;\n  result.b = isNaN.b ? x.b : result.b;\n  result.a = isNaN.a ? x.a : result.a;\n\n  return result;\n`;\n\nexport const relu6 =\n   unaryKernelFunc({opSnippet: RELU6, packedOpSnippet: RELU6_PACKED});\n\nexport const relu6Config: KernelConfig = {\n kernelName: Relu6,\n backendName:
 'webgl',\n kernelFunc: relu6 as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2017 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing,

software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {GPGPUProgram} from './gpgpu_math';\n\nexport class ResizeBilinearProgram implements GPGPUProgram {\n variableNames = ['A'];\n outputShape: number[] = [];\n userCode: string;\n\n constructor(\n   inputShape: [number, number, number, number], newHeight: number,\n   newWidth: number, alignCorners: boolean, halfPixelCenters: boolean) {\n   const [batch, oldHeight, oldWidth, depth] = inputShape;\n   this.outputShape = [batch, newHeight, newWidth, depth];\n\n   const effectiveInSize: [number, number] = [\n   (alignCorners && newHeight > 1) ? oldHeight - 1 : oldHeight,\n   (alignCorners && newWidth > 1) ? oldWidth - 1 : oldWidth\n   ];\n\n   const effectiveOutSize: [number, number] = [\n   (alignCorners && newHeight > 1) ? newHeight - 1 : newHeight,\n   (alignCorners && newWidth > 1) ? newWidth - 1 : newWidth\n   ];\n\n   let sourceFracIndexRC: string;\n   if (halfPixelCenters) {\n   sourceFracIndexRC =\n   `(vec2(yRC) + vec2(0.5)) * effectiveInputOverOutputRatioRC` +\n   ` - vec2(0.5)`;\n   } else {\n   sourceFracIndexRC = `vec2(yRC) * effectiveInputOverOutputRatioRC`;\n   }\n\n   this.userCode = `\n   const vec2 effectiveInputOverOutputRatioRC
 = vec2(\n ${effectiveInSize[0] / effectiveOutSize[0]},\n ${effectiveInSize[1] / effectiveOutSize[1]});\n
  const vec2 inputShapeRC = vec2(${oldHeight}.0, ${oldWidth}.0);\n\n   void main() {\n   ivec4 coords = getOutputCoords();\n   int b = coords[0];\n   int d = coords[3];\n   ivec2 yRC = coords.yz;\n\n   // Fractional source index.\n   vec2 sourceFracIndexRC = ${sourceFracIndexRC};\n\n   // Compute the four integer indices.\n   ivec2 sourceFloorRC = ivec2(max(sourceFracIndexRC, vec2(0.0)));\n   ivec2 sourceCeilRC = ivec2(\n   min(inputShapeRC - 1.0, ceil(sourceFracIndexRC)));\n\n   float topLeft = getA(b, sourceFloorRC.x, sourceFloorRC.y, d);\n   float bottomLeft = getA(b, sourceCeilRC.x, sourceFloorRC.y, d);\n
  float topRight = getA(b, sourceFloorRC.x, sourceCeilRC.y, d);\n   float bottomRight = getA(b, sourceCeilRC.x, sourceCeilRC.y, d);\n\n   vec2 fracRC = sourceFracIndexRC
 - vec2(sourceFloorRC);\n\n   float top = topLeft + (topRight - topLeft) * fracRC.y;\n   float bottom = bottomLeft + (bottomRight - bottomLeft) * fracRC.y;\n   float newValue = top + (bottom - top) * fracRC.x;\n\n
  setOutput(newValue);\n   }\n   `;\n }\n}\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n *
http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n
 */\n\nimport {GPGPUProgram} from './gpgpu_math';\n\nexport class ResizeBilinearPackedProgram implements GPGPUProgram {\n variableNames = ['A'];\n packedInputs = true;\n packedOutput = true;\n outputShape: number[] = [];\n userCode: string;\n\n constructor(\n   inputShape: [number, number, number, number], newHeight: number,\n   newWidth: number, alignCorners: boolean, halfPixelCenters: boolean) {\n   const [batch, oldHeight, oldWidth, depth] = inputShape;\n   this.outputShape = [batch, newHeight, newWidth, depth];\n\n   const effectiveInSize: [number, number] = [\n   (alignCorners && newHeight > 1) ? oldHeight - 1 : oldHeight,\n   (alignCorners && newWidth > 1) ? oldWidth - 1 : oldWidth\n   ];\n\n   const effectiveOutSize: [number, number] = [\n   (alignCorners && newHeight > 1) ? newHeight - 1 : newHeight,\n   (alignCorners && newWidth > 1) ? newWidth - 1 : newWidth\n   ];\n\n   let sourceFracIndexRC: string;\n   if (halfPixelCenters) {\n
  sourceFracIndexRC = `(vec3(yRC) + vec3(0.5)) * ` +\n   `effectiveInputOverOutputRatioRC - vec3(0.5)`;\n
} else {\n   sourceFracIndexRC = `vec3(yRC) * effectiveInputOverOutputRatioRC`;\n   }\n\n   this.userCode = `\n   const vec3 effectiveInputOverOutputRatioRC = vec3(\n ${effectiveInSize[0] / effectiveOutSize[0]},\n
    ${effectiveInSize[1] / effectiveOutSize[1]},\n ${effectiveInSize[1] / effectiveOutSize[1]});\n   const vec3

inputShapeRC = vec3(${oldHeight}.0, ${oldWidth}.0,\n ${oldWidth}.0);\n\n float getAValue(int b, int r, int c, int d) {\n return getChannel(getA(b, r, c, d), vec2(c, d));\n }\n\n void main() {\n ivec4 coords = getOutputCoords();\n int b = coords[0];\n int d = coords[3];\n // Calculate values for next column in yRC.z.\n ivec3 yRC = coords.yzz + ivec3(0, 0, 1);\n\n // Fractional source index.\n vec3 sourceFracIndexRC
= ${sourceFracIndexRC};\n\n // Compute the four integer indices.\n ivec3 sourceFloorRC = ivec3(max(sourceFracIndexRC, vec3(0.0)));\n ivec3 sourceCeilRC = ivec3(\n min(inputShapeRC - 1.0, ceil(sourceFracIndexRC)));\n\n // Should we calculate next column and row elements in 2x2 packed cell.\n bool hasNextCol = d < ${depth - 1};\n bool hasNextRow = coords.z < ${newWidth - 1};\n\n // In parallel, construct four corners for all four components in\n // packed 2x2 cell.\n vec4 topLeft = vec4(\n getAValue(b, sourceFloorRC.x, sourceFloorRC.y, d),\n hasNextCol ? getAValue(b, sourceFloorRC.x, sourceFloorRC.y, d + 1)\n : 0.0,\n hasNextRow ? getAValue(b, sourceFloorRC.x, sourceFloorRC.z, d)\n : 0.0,\n (hasNextRow && hasNextCol) ?\n getAValue(b, sourceFloorRC.x, sourceFloorRC.z, d + 1) : 0.0);\n\n vec4 bottomLeft = vec4(\n getAValue(b, sourceCeilRC.x, sourceFloorRC.y, d),\n hasNextCol ? getAValue(b, sourceCeilRC.x, sourceFloorRC.y, d + 1)\n : 0.0,\n hasNextRow ? getAValue(b, sourceCeilRC.x, sourceFloorRC.z, d)\n : 0.0,\n (hasNextRow && hasNextCol) ?\n getAValue(b, sourceCeilRC.x, sourceFloorRC.z, d + 1) : 0.0);\n\n vec4 topRight = vec4(\n getAValue(b, sourceFloorRC.x, sourceCeilRC.y, d),\n hasNextCol ? getAValue(b, sourceFloorRC.x, sourceCeilRC.y, d + 1)\n : 0.0,\n hasNextRow ? getAValue(b, sourceFloorRC.x, sourceCeilRC.z, d)\n : 0.0,\n (hasNextRow && hasNextCol) ?\n getAValue(b, sourceFloorRC.x, sourceCeilRC.z, d + 1) : 0.0);\n\n vec4 bottomRight = vec4(\n getAValue(b, sourceCeilRC.x, sourceCeilRC.y, d),\n hasNextCol ? getAValue(b, sourceCeilRC.x, sourceCeilRC.y, d + 1)\n : 0.0,\n hasNextRow
? getAValue(b, sourceCeilRC.x, sourceCeilRC.z, d)\n : 0.0,\n (hasNextRow && hasNextCol) ?\n getAValue(b, sourceCeilRC.x, sourceCeilRC.z, d + 1) : 0.0);\n\n vec3 fracRC = sourceFracIndexRC - vec3(sourceFloorRC);\n\n vec4 top = mix(topLeft, topRight, fracRC.yyzz);\n vec4 bottom = mix(bottomLeft, bottomRight, fracRC.yyzz);\n vec4 newValue = mix(top, bottom, fracRC.x);\n\n setOutput(newValue);\n }\n `;\n }\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY
KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n */\n\nimport {env, KernelConfig, KernelFunc, ResizeBilinear, ResizeBilinearAttrs, ResizeBilinearInputs, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL} from '../backend_webgl';\nimport {ResizeBilinearProgram} from '../resize_bilinear_gpu';\nimport {ResizeBilinearPackedProgram} from '../resize_bilinear_packed_gpu';\n\nexport function resizeBilinear(args: {\n inputs: ResizeBilinearInputs,\n backend: MathBackendWebGL,\n attrs: ResizeBilinearAttrs\n}): TensorInfo {\n const {inputs, backend, attrs} = args;\n const {images} = inputs;\n const {alignCorners, halfPixelCenters, size} = attrs;\n\n const [newHeight, newWidth] = size;\n\n const program = env().getBool('WEBGL_PACK_IMAGE_OPERATIONS') ?\n new ResizeBilinearPackedProgram(\n images.shape as [number, number, number, number], newHeight, newWidth,\n alignCorners, halfPixelCenters) :\n new ResizeBilinearProgram(\n images.shape as [number, number, number, number], newHeight, newWidth,\n alignCorners, halfPixelCenters);\n return backend.runWebGLProgram(program, [images], 'float32');\n}\n\nexport const resizeBilinearConfig: KernelConfig = {\n kernelName: ResizeBilinear,\n

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backendName: 'webgl',\n  kernelFunc: resizeBilinear as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS
 OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========================================================================\n
*/\n\nimport {GPGPUProgram} from './gpgpu_math';\n\nexport class ResizeBilinearBackpropProgram implements GPGPUProgram {\n  variableNames = ['dy'];\n  outputShape: number[] = [];\n  userCode: string;\n\n  constructor(\n    dyShape: [number, number, number, number],\n      inputShape: [number, number, number, number],
alignCorners: boolean) {\n    this.outputShape = inputShape;\n    const [, xHeight, xWidth, ] = inputShape;\n    const [, yHeight, yWidth] = dyShape;\n\n    // In the backwards pass, we want to find the pixels that were generated for\n    // each pixel in the input image the forward pass and add the corresponding\n    // coefficient from dy to the gradient (with some interpolation).\n\n    const effectiveXSize: [number, number] = [\n      (alignCorners
 && yHeight > 1) ? xHeight - 1 : xHeight,\n      (alignCorners && yWidth > 1) ? xWidth - 1 : xWidth\n    ];\n\n
const effectiveYSize: [number, number] = [\n      (alignCorners && yHeight > 1) ? yHeight - 1 : yHeight,\n
(alignCorners && yWidth > 1) ? yWidth - 1 : yWidth\n    ];\n\n    const heightScale = effectiveXSize[0] /
effectiveYSize[0];\n    const widthScale = effectiveXSize[1] / effectiveYSize[1];\n\n    const invHeightScale = 1 /
heightScale;\n    const invWidthScale = 1 / widthScale;\n\n    // This defines the size of the window of values around a particular\n    // index in dy that we want to search for contributions to dx.\n    const winHeight =
(Math.ceil(invHeightScale) * 2) + 2;\n    const winWidth = (Math.ceil(invWidthScale) * 2) + 2;\n\n    this.userCode
= `\n      void main() {\n        ivec4 coords = getOutputCoords();\n        int b = coords[0];\n        int d = coords[3];\n
    int r = coords[1];\n        int c = coords[2];\n\n        float accumulator
 = 0.0;\n\n        const float heightScale = float(${heightScale});\n        const float widthScale =
float(${widthScale});\n\n        const float invHeightScale = float(${invHeightScale});\n        const float
invWidthScale = float(${invWidthScale});\n\n        const int winHeight = int(${winHeight});\n        const int
winWidth = int(${winWidth});\n\n        // Compute bounds for where in dy we will look\n        float startRLerp =
floor(float(r) * invHeightScale);\n        int startDyR = int(startRLerp - float(winHeight / 2));\n\n        float startCLerp
= floor(float(c) * invWidthScale);\n        int startDyC = int(startCLerp - float(winWidth / 2));\n\n        // Loop over
dy\n        for (int dyROffset = 0; dyROffset < winHeight; dyROffset++) {\n          int dyR = dyROffset +
startDyR;\n\n          // Guard against the window exceeding the bounds of dy\n          if (dyR < 0 || dyR >=
${yHeight}) {\n            continue;\n          }\n\n          for (int dyCOffset = 0; dyCOffset
 < winWidth; dyCOffset++) {\n            int dyC = dyCOffset + startDyC;\n\n            // Guard against the window
exceeding the bounds of dy\n            if (dyC < 0 || dyC >= ${yWidth}) {\n              continue;\n            }\n\n
float dxR = float(dyR) * heightScale;\n            int topDxRIndex = int(floor(dxR));\n            int bottomDxRIndex =
int(min(ceil(dxR), ${xHeight - 1}.0));\n            float dxRLerp = dxR - float(topDxRIndex);\n            float
inverseDxRLerp = 1.0 - dxRLerp;\n\n            float dxC = float(dyC) * widthScale;\n            int leftDxCIndex =
int(floor(dxC));\n            int rightDxCIndex = int(min(ceil(dxC), ${xWidth - 1}.0));\n            float dxCLerp = dxC -
float(leftDxCIndex);\n            float inverseDxCLerp = 1.0 - dxCLerp;\n\n            if (r == topDxRIndex && c ==
leftDxCIndex) {\n              // topLeft\n              accumulator +=\n                getDy(b, dyR, dyC, d) * inverseDxRLerp
* inverseDxCLerp;\n
  }\n\n            if (r == topDxRIndex && c == rightDxCIndex) {\n              // topRight\n              accumulator +=
getDy(b, dyR, dyC, d) * inverseDxRLerp * dxCLerp;\n            }\n\n            if (r == bottomDxRIndex && c ==
leftDxCIndex) {\n              // bottomLeft\n              accumulator += getDy(b, dyR, dyC, d) * dxRLerp *
inverseDxCLerp;\n            }\n\n            if (r == bottomDxRIndex && c == rightDxCIndex) {\n              //
bottomRight\n              accumulator += getDy(b, dyR, dyC, d) * dxRLerp * dxCLerp;\n            }\n          }\n        }\n
```

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// End loop over dy\n\n setOutput(accumulator);\n }\n `;\n }\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ============================================================================\n */\n\nimport {KernelConfig, KernelFunc, ResizeBilinearGrad, ResizeBilinearGradAttrs, ResizeBilinearGradInputs, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL} from '../backend_webgl';\nimport {ResizeBilinearBackpropProgram} from '../resize_bilinear_backprop_gpu';\n\nexport function resizeBilinearGrad(args: {\n inputs: ResizeBilinearGradInputs,\n backend: MathBackendWebGL,\n attrs: ResizeBilinearGradAttrs\n}): TensorInfo {\n const {inputs, backend, attrs} = args;\n const {images, dy} = inputs;\n const {alignCorners} = attrs;\n\n const program = new ResizeBilinearBackpropProgram(\n dy.shape as [number, number, number, number],\n images.shape as [number, number, number, number], alignCorners);\n\n return backend.runWebGLProgram(program, [dy], dy.dtype);\n}\n\nexport const resizeBilinearGradConfig: KernelConfig = {\n kernelName: ResizeBilinearGrad,\n backendName: 'webgl',\n kernelFunc: resizeBilinearGrad as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ============================================================================\n */\n\nimport {GPGPUProgram} from './gpgpu_math';\n\nexport class ResizeNearestNeighborProgram implements GPGPUProgram {\n variableNames = ['A'];\n outputShape: number[] = [];\n userCode: string;\n\n constructor(\n inputShape: [number, number, number, number], newHeight: number,\n newWidth: number, alignCorners: boolean, halfPixelCenters: boolean) {\n const [batch, oldHeight, oldWidth, depth] = inputShape;\n this.outputShape = [batch, newHeight, newWidth, depth];\n\n const effectiveInSize: [number, number] = [\n (alignCorners && newHeight > 1) ? oldHeight - 1 : oldHeight,\n (alignCorners && newWidth > 1) ? oldWidth - 1 : oldWidth\n ];\n\n const effectiveOutSize: [number, number] = [\n (alignCorners && newHeight > 1) ? newHeight - 1 : newHeight,\n (alignCorners && newWidth > 1) ? newWidth - 1 : newWidth\n ];\n\n // When align corners is false,\n we rounds the value with floor.\n const roundBase = alignCorners ? '0.5' : '0.0';\n\n let sourceFracIndexRC: string;\n if (halfPixelCenters) {\n sourceFracIndexRC =\n `max((vec2(yRC) + vec2(0.5)) * effectiveInputOverOutputRatioRC` +\n `, vec2(0.0))`;\n } else {\n sourceFracIndexRC = `vec2(yRC) * effectiveInputOverOutputRatioRC`;\n }\n this.userCode = `\n const vec2 effectiveInputOverOutputRatioRC = vec2(\n ${effectiveInSize[0] / effectiveOutSize[0]},\n ${effectiveInSize[1] / effectiveOutSize[1]});\n const vec2 inputShapeRC = vec2(${oldHeight}.0, ${oldWidth}.0);\n\n void main() {\n ivec4 coords = getOutputCoords();\n int b = coords[0];\n int d = coords[3];\n ivec2 yRC = coords.yz;\n\n // Fractional source index.\n vec2 sourceFracIndexRC = ${sourceFracIndexRC};\n\n // Compute the coordinators of nearest neighbor point.\n ivec2 sourceNearestRC = ivec2(\n min(inputShapeRC - 1.0, floor(sourceFracIndexRC + ${roundBase})));\n float newValue = getA(b, sourceNearestRC.x, sourceNearestRC.y, d);\n\n setOutput(newValue);\n }\n `;\n }\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a
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 for (int dyCOffset = 0; dyCOffset < winWidth; dyCOffset++) {\n          int dyC = dyCOffset + startDyC;\n\n
// Guard against the window exceeding the bounds of dy\n          if (dyC < 0 || dyC >= ${yWidth}) {\n
continue;\n          }\n\n          float sourceFracRow =\n              float(${effectiveXSize[0]}) *\n
(float(dyR) / float(${effectiveYSize[0]}));\n\n          float sourceFracCol =\n              float(${effectiveXSize[1]})
*\n              (float(dyC)
 / float(${effectiveYSize[1]}));\n\n          int sourceNearestRow = int(min(\n              float(int(${xHeight}) - 1),\n
          ${alignCorners} ? float(round(sourceFracRow)) :\n                                float(floor(sourceFracRow))));\n\n
      int sourceNearestCol = int(min(\n              float(int(${xWidth}) - 1),\n              ${alignCorners} ?
float(round(sourceFracCol)) :\n                                float(floor(sourceFracCol))));\n\n          if (r ==
sourceNearestRow && c == sourceNearestCol) {\n              accumulator += getDy(b, dyR, dyC, d);\n          }\n
      }\n      }\n      // End loop over dy\n\n      setOutput(accumulator);\n    }\n    `;\n  }\n}\n","/**\n * @license\n *
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the License.\n *
==========================================================================\n
*/\n\nimport {KernelConfig, KernelFunc, ResizeNearestNeighborGrad, ResizeNearestNeighborGradAttrs,
ResizeNearestNeighborGradInputs, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL}
from '../backend_webgl';\nimport {ResizeNearestNeigborBackpropProgram} from
'../resize_nearest_neighbor_backprop_gpu';\n\nexport function resizeNearestNeighborGrad(args: {\n  inputs:
ResizeNearestNeighborGradInputs,\n  backend: MathBackendWebGL,\n  attrs:
ResizeNearestNeighborGradAttrs\n}): TensorInfo {\n  const {inputs, backend, attrs} =
 args;\n  const {images, dy} = inputs;\n  const {alignCorners} = attrs;\n\n  const program = new
ResizeNearestNeigborBackpropProgram(\n      dy.shape as [number, number, number, number],\n      images.shape
as [number, number, number, number], alignCorners);\n  return backend.runWebGLProgram(program, [dy],
dy.dtype);\n}\n\nexport const resizeNearestNeighborGradConfig: KernelConfig = {\n  kernelName:
ResizeNearestNeighborGrad,\n  backendName: 'webgl',\n  kernelFunc: resizeNearestNeighborGrad as {} as
KernelFunc\n};\n","/**\n * @license\n * Copyright 2017 Google LLC. All Rights Reserved.\n * Licensed under the
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 CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing
permissions and\n * limitations under the License.\n *
==========================================================================\n
*/\n\nimport {GPGPUProgram} from './gpgpu_math';\nimport {getCoordsDataType} from
'./shader_compiler';\n\nexport class ReverseProgram implements GPGPUProgram {\n  variableNames = ['x'];\n
outputShape: number[];\n  userCode: string;\n\n  constructor(xShape: number[], axis: number[]) {\n    const rank =
xShape.length;\n    if (rank > 4) {\n      throw new Error(\n          `WebGL backend: Reverse of rank-${rank} tensor
is not yet supported`);\n    }\n    this.outputShape = xShape;\n\n    if (rank === 1) {\n      this.userCode = `\n
void main() {\n          int coord = getOutputCoords();\n          setOutput(getX(${xShape[0]} - coord - 1));\n        }\n
      `;\n      return;\n    }\n    const getInCoord = (i: number) => {\n      if (axis.indexOf(i)
 !== -1 && xShape[i] !== 1) {\n        return `${xShape[i]} - coords[${i}] - 1`;\n      }\n      return `coords[${i}]`;\n
};\n    const inCoords = xShape.map((_, i) => getInCoord(i)).join(',');\n    const type =
getCoordsDataType(rank);\n\n    this.userCode = `\n      void main() {\n        ${type} coords = getOutputCoords();\n
```

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    setOutput(getX(${inCoords}));\n      }\n    `;\n  }\n}\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions
 and\n * limitations under the License.\n *
 ==========================================================================\n
 */\n\nimport {GPGPUProgram} from './gpgpu_math';\nimport {getChannels} from './packing_util';\nimport {getCoordsDataType} from './shader_compiler';\n\nexport class ReversePackedProgram implements GPGPUProgram {\n  variableNames = ['x'];\n  outputShape: number[];\n  userCode: string;\n  packedInputs = true;\n  packedOutput = true;\n\n  constructor(xShape: number[], axis: number[]) {\n    const rank = xShape.length;\n    if (rank > 4) {\n      throw new Error(\n          `WebGL backend: Reverse of rank-${rank} tensor is not yet supported`);\n    }\n    this.outputShape = xShape;\n    const channels = getChannels('rc', rank);\n    const nextColumn =\n        `${channels[rank - 1]} + 1 < ${this.outputShape[rank - 1]}`;\n    const nextRow = `${channels[rank - 2]} + 1 < ${this.outputShape[rank - 2]}`;\n    const type = getCoordsDataType(rank);\n    if (rank === 1) {\n
      this.userCode = `\n        void main(){\n          int rc = getOutputCoords();\n          vec4 result = vec4(0.);\n result.r = getChannel(getX(${xShape[0]} - rc - 1),\n            ${xShape[0]} - rc - 1);\n          if(${nextColumn}){\n
      result.g = getChannel(getX(${xShape[0]} - (rc  + 1) - 1),\n              ${xShape[0]} - (rc  + 1) - 1);\n          }\n
  setOutput(result);\n        }\n      `;\n    } else {\n      this.userCode = `\n        void main() {\n          ${type} rc = getOutputCoords();\n          vec4 result = vec4(0.);\n          result.r = ${getR(channels.slice())};\n
 if(${nextColumn}){\n            result.g = ${getG(channels.slice())};\n          }\n          if(${nextRow}) {\n
 result.b = ${getB(channels.slice())};\n            if(${nextColumn}) {\n              result.a = ${getA(channels.slice())};\n
        }\n          }\n          setOutput(result);\n        }\n      `;\n    }\n\n    function getR(channels: string[]):
 string {\n      return getChannel(channels);\n    }\n\n    function getG(channels: string[]): string {\n      channels[rank
 - 1] = '(' + channels[rank - 1] + ` + 1)`;\n      return getChannel(channels);\n    }\n\n    function getB(channels:
 string[]): string {\n      channels[rank - 2] = '(' + channels[rank - 2] + ` + 1)`;\n      return getChannel(channels);\n
 }\n\n    function getA(channels: string[]): string {\n      channels[rank - 1] = '(' + channels[rank - 1] + ` + 1)`;\n
 channels[rank - 2] = '(' + channels[rank - 2] + ` + 1)`;\n      return getChannel(channels);\n    }\n\n    function
 getChannel(channels: string[]): string {\n      const inCoordsArray = xShape.map((_, i) => getInCoord(i,
 channels));\n      const inCoords = inCoordsArray.join(',');\n      const innerDims = inCoordsArray.slice(-
 2).join(',');\n      return `getChannel(getX(${inCoords}), vec2(${innerDims}))`;\n    }\n\n    function getInCoord(i:
 number, channels1: string[]): string {\n      if (axis.indexOf(i)
  !== -1 && xShape[i] !== 1) {\n        return `${xShape[i]} - ${channels1[i]} - 1`;\n      } else {\n        return
 `${channels1[i]}`;\n      }\n    }\n  }\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights
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 OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language
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 ==========================================================================\n
 */\n\nimport {env, KernelConfig, KernelFunc, Reverse, ReverseAttrs, ReverseInputs, TensorInfo, util} from
 '@tensorflow/tfjs-core';\n\nimport
  {MathBackendWebGL} from '../backend_webgl';\nimport {ReverseProgram} from '../reverse_gpu';\nimport
 {ReversePackedProgram} from '../reverse_packed_gpu';\n\nimport {identity} from './Identity';\n\nexport function
```

reverse(args: {\n inputs: ReverseInputs,\n backend: MathBackendWebGL,\n attrs: ReverseAttrs\n}): TensorInfo {\n const {inputs, backend, attrs} = args;\n const {x} = inputs;\n const {dims} = attrs;\n\n const xRank = x.shape.length;\n\n const $dims = util.parseAxisParam(dims, x.shape);\n if (xRank === 0) {\n   return identity({inputs: {x}, backend});\n }\n\n const program = env().getBool('WEBGL_PACK_ARRAY_OPERATIONS') ?\n   new ReversePackedProgram(x.shape, $dims) :\n   new ReverseProgram(x.shape, $dims);\n\n return backend.runWebGLProgram(program, [x], x.dtype);\n}\n\nexport const reverseConfig: KernelConfig = {\n kernelName: Reverse,\n backendName: 'webgl',\n kernelFunc: reverse as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==\n */\n\nimport {backend_util} from '@tensorflow/tfjs-core';\n\nimport {GPGPUProgram} from './gpgpu_math';\n\nexport class RotateProgram implements GPGPUProgram {\n variableNames = ['Image'];\n outputShape: number[] = [];\n userCode: string;\n\n constructor(\n   imageShape: [number, number, number, number], radians: number,\n   fillValue: number|[number, number, number],\n   center: number|[number, number]) {\n   const imageHeight = imageShape[1];\n   const imageWidth = imageShape[2];\n   const sinFactor = Math.sin(radians).toFixed(3);\n   const cosFactor = Math.cos(radians).toFixed(3);\n   this.outputShape = imageShape;\n\n   const [centerX, centerY] =\n   backend_util.getImageCenter(center, imageHeight, imageWidth);\n   const centerXString = centerX.toFixed(3);\n   const centerYString = centerY.toFixed(3);\n\n   let fillSnippet = '';\n   if (typeof fillValue === 'number') {\n   fillSnippet = `float outputValue = ${fillValue.toFixed(2)};`;\n   } else {\n   fillSnippet = `\n        vec3 fill = vec3(${fillValue.join(',')});\n        float outputValue = fill[coords[3]];`;\n   }\n\n   this.userCode = `\n   void main() {\n   ivec4 coords = getOutputCoords();\n   int x = coords[2];\n   int y = coords[1];\n   float coordXFloat = (float(x) - ${centerXString}) * ${\n   cosFactor} - (float(y) - ${centerYString}) * ${sinFactor};\n   float coordYFloat = (float(x) - ${centerXString}) * ${\n   sinFactor} + (float(y) - ${centerYString}) * ${cosFactor};\n   int coordX = int(round(coordXFloat + ${centerXString}));\n   int coordY = int(round(coordYFloat + ${centerYString}));\n ${fillSnippet}\n   if(coordX >= 0 && coordX < ${imageWidth} && coordY >= 0 && coordY < ${\n   imageHeight}) {\n   outputValue = getImage(coords[0], coordY, coordX, coords[3]);\n   }\n   setOutput(outputValue);\n   }\n   `;\n }\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==\n */\n\nimport {KernelConfig, Tensor4D} from '@tensorflow/tfjs-core';\nimport {RotateWithOffset, RotateWithOffsetAttrs, RotateWithOffsetInputs} from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL} from '../backend_webgl';\nimport {RotateProgram} from '../rotate_gpu';\n\nexport const rotateWithOffsetConfig: KernelConfig = {\n kernelName: RotateWithOffset,\n backendName: 'webgl',\n kernelFunc: ({inputs, attrs, backend}) => {\n   const {image} = inputs as RotateWithOffsetInputs;\n   const {radians, fillValue, center} = attrs as {} as RotateWithOffsetAttrs;\n   const webglBackend = backend as MathBackendWebGL;\n\n   const program = new RotateProgram(\n   (image as Tensor4D).shape, radians, fillValue, center);\n   const output = webglBackend.runWebGLProgram(program, [image], image.dtype);\n   return output;\n }\n};\n","/**\n *

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ScatterNdInputs, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL} from '../backend_webgl';\nimport {ScatterProgram} from '../scatter_gpu';\nimport {reshape} from './Reshape';\n\nexport function scatterNd(args: {\n inputs: ScatterNdInputs,\n backend: MathBackendWebGL,\n attrs: ScatterNdAttrs\n}): TensorInfo {\n const {inputs, backend, attrs} = args;\n const {indices, updates} = inputs;\n const {shape} = attrs;\n\n const {sliceRank, numUpdates, sliceSize, strides, outputSize} =\n backend_util.calculateShapes(updates, indices, shape);\n\n const flattenShape = [outputSize / sliceSize, sliceSize];\n\n if (outputSize === 0) {\n   return backend.makeTensorInfo(shape, indices.dtype);\n }\n\n const flattenIndices = reshape(\n   {inputs: {x: indices}, backend, attrs: {shape: [numUpdates, sliceRank]}});\n const flattenX = reshape(\n   {inputs: {x: updates}, backend, attrs: {shape: [numUpdates, sliceSize]}});\n\n const defaultValue = backend.makeTensorInfo(\n   [], 'float32', new Float32Array([0])); // scalar(0)\n const program = new ScatterProgram(\n   numUpdates, sliceRank, flattenIndices.shape.length, flattenX.shape.length,\n   strides, flattenShape);\n const res =\n backend.runWebGLProgram(\n   program, [flattenX, flattenIndices, defaultValue], flattenX.dtype);\n\n const reshaped = reshape({inputs: {x: res}, backend, attrs: {shape}});\n\n backend.disposeIntermediateTensorInfo(flattenIndices);\n backend.disposeIntermediateTensorInfo(flattenX);\n backend.disposeIntermediateTensorInfo(res);\n backend.disposeIntermediateTensorInfo(defaultValue);\n\n return reshaped;\n}\n\nexport const scatterNdConfig: KernelConfig = {\n kernelName: ScatterNd,\n backendName: 'webgl',\n kernelFunc: scatterNd as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2017 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with
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==\n */\n\nimport {GPGPUProgram} from './gpgpu_math';\nimport {getCoordsDataType} from './shader_compiler';\n\nexport class SelectProgram implements GPGPUProgram {\n variableNames = ['c', 'a', 'b'];\n outputShape: number[];\n userCode: string;\n\n constructor(cRank: number, shape: number[], rank: number) {\n   this.outputShape = shape;\n\n   let cCoords;\n   let abCoords;\n   if (rank > 4) {\n   throw Error(`Where for rank ${rank} is not yet supported`);\n   }\n\n   if (rank === 1) {\n   abCoords = `resRC`;\n   cCoords = `resRC`;\n   } else {\n   const currentCoords = ['resRC.x', 'resRC.y', 'resRC.z', 'resRC.w'];\n   const cCoordVars = [];\n   const abCoordVars = [];\n   for (let i = 0; i < shape.length; i++) {\n   abCoordVars.push(`${currentCoords[i]}`);\n   if (i < cRank) {\n   cCoordVars.push(`${currentCoords[i]}`);\n   }\n   }\n   cCoords = cCoordVars.join();\n   abCoords = abCoordVars.join();\n   }\n\n   const dtype = getCoordsDataType(rank);\n\n   this.userCode = `\n      void main() {\n        ${dtype} resRC = getOutputCoords();\n        float cVal = getC(${cCoords});\n        if (cVal >= 1.0) {\n          setOutput(getA(${abCoords}));\n        } else {\n          setOutput(getB(${abCoords}));\n        }\n      }\n    `;\n }\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may
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==\n */\n\nimport {KernelConfig, KernelFunc, Select, SelectInputs, TensorInfo, upcastType} from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL} from '../backend_webgl';\nimport {SelectProgram} from

'../select_gpu';\n\nexport function select(args: {inputs: SelectInputs, backend: MathBackendWebGL}):\n TensorInfo {\n const {inputs, backend} = args;\n const {condition, t, e} = inputs;\n\n const program =\n   new SelectProgram(condition.shape.length,
 t.shape, t.shape.length);\n return backend.runWebGLProgram(\n   program, [condition, t, e], upcastType(t.dtype, e.dtype));\n}\n\nexport const selectConfig: KernelConfig = {\n kernelName: Select,\n backendName: 'webgl',\n kernelFunc: select as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n
 */\n\nimport {backend_util, KernelConfig, Selu} from '@tensorflow/tfjs-core';\n\nimport {unaryKernelFunc} from '../kernel_utils/kernel_funcs_utils';\n\nconst SELU = `\n  // Stable and Attracting Fixed Point (0, 1) for Normalized Weights.\n  // see: https://arxiv.org/abs/1706.02515\n  float scaleAlpha = ${backend_util.SELU_SCALEALPHA};\n  float scale = ${backend_util.SELU_SCALE};\n  return (x >= 0.0) ? scale * x : scaleAlpha * (exp(x) - 1.0);\n`;\n\nexport const selu = unaryKernelFunc({opSnippet: SELU});\n\nexport const seluConfig: KernelConfig = {\n kernelName: Selu,\n backendName: 'webgl',\n kernelFunc: selu,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed
 to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n
*/\n\nimport {KernelConfig, Sigmoid} from '@tensorflow/tfjs-core';\nimport {unaryKernelFunc} from '../kernel_utils/kernel_funcs_utils';\n\nconst SIGMOID = `return 1.0 / (1.0 + exp(-1.0 * x));`;\n\nexport const sigmoid = unaryKernelFunc({opSnippet: SIGMOID});\n\nexport const sigmoidConfig: KernelConfig = {\n kernelName: Sigmoid,\n backendName: 'webgl',\n kernelFunc: sigmoid,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License
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==\n
*/\n\nimport {KernelConfig, Sign} from '@tensorflow/tfjs-core';\n\nimport {unaryKernelFunc} from '../kernel_utils/kernel_funcs_utils';\n\n// Sign does not propagate NANs.\nconst SIGN = `\n  if (isnan(x)) { return 0.0; }\n  return sign(x);\n`;\n\nexport const sign = unaryKernelFunc({opSnippet: SIGN});\n\nexport const signConfig: KernelConfig = {\n kernelName: Sign,\n backendName: 'webgl',\n kernelFunc: sign,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License,
 Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *

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=============================================================================\n
*/\n\nimport {KernelConfig, Sin} from '@tensorflow/tfjs-core';\n\nimport {CHECK_NAN_SNIPPET_UNARY,
unaryKernelFunc} from '../kernel_utils/kernel_funcs_utils';\n\nconst SIN = CHECK_NAN_SNIPPET_UNARY +
`\n  return sin(x);\n`;\n\nexport const sin = unaryKernelFunc({opSnippet: SIN});\n\nexport const sinConfig:
KernelConfig = {\n  kernelName: Sin,\n  backendName: 'webgl',\n  kernelFunc:
 sin,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache
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BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the
License for the specific language governing permissions and\n * limitations under the License.\n *
=============================================================================\n
*/\n\nimport {KernelConfig, Sinh} from '@tensorflow/tfjs-core';\nimport {unaryKernelFunc} from
'../kernel_utils/kernel_funcs_utils';\n\nconst SINH = `\n  float e2x = exp(x);\n  return (e2x - 1.0 / e2x) /
2.0;\n`;\n\nexport const sinh = unaryKernelFunc({opSnippet: SINH});\n\nexport
 const sinhConfig: KernelConfig = {\n  kernelName: Sinh,\n  backendName: 'webgl',\n  kernelFunc:
sinh,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the
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on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or
implied.\n * See the License for the specific language governing permissions and\n * limitations under the
License.\n *
=============================================================================\n
*/\n\nimport {KernelConfig, Softplus} from '@tensorflow/tfjs-core';\nimport {unaryKernelFunc} from
'../kernel_utils/kernel_funcs_utils';\n\nconst SOFTPLUS
 = `\n  float epsilon = 1.1920928955078125e-7;\n  float threshold = log(epsilon) + 2.0;\n\n  bool too_large = x > -
threshold;\n  bool too_small = x < threshold;\n\n  float result;\n  float exp_x = exp(x);\n\n  if (too_large){\n    result
= x;\n  }\n  else if (too_small){\n    result = exp_x;\n  }\n  else{\n    result = log(exp_x + 1.0);\n  }\n  return
result;\n`;\n\nexport const softplus = unaryKernelFunc({opSnippet: SOFTPLUS});\n\nexport const softplusConfig:
KernelConfig = {\n  kernelName: Softplus,\n  backendName: 'webgl',\n  kernelFunc: softplus,\n};\n","/**\n *
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=============================================================================\n
*/\n\nimport {backend_util, KernelConfig, KernelFunc, SpaceToBatchND, SpaceToBatchNDAttrs,
SpaceToBatchNDInputs, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL} from
'../backend_webgl';\n\nimport {padV2} from './PadV2';\nimport {reshape} from './Reshape';\nimport {transpose}
from './Transpose';\n\nexport const spaceToBatchND = (args: {\n  inputs: SpaceToBatchNDInputs,\n  backend:
MathBackendWebGL,\n  attrs: SpaceToBatchNDAttrs\n}): TensorInfo => {\n  const {inputs, backend, attrs} =
args;\n  const {x} = inputs;\n  const {blockShape, paddings} = attrs;\n\n  util.assert(\n      x.shape.length <= 4,\n
() => 'spaceToBatchND for rank > 4 with a WebGL backend not ' +\n          'implemented
 yet');\n\n  const prod = blockShape.reduce((a, b) => a * b);\n\n  const completePaddings: Array<[number, number]>
= [[0, 0]];\n  completePaddings.push(...paddings as Array<[number, number]>);\n  for (let i = 1 +
blockShape.length; i < x.shape.length; ++i) {\n    completePaddings.push([0, 0]);\n  }\n\n  const toDispose = [];\n\n
```

const paddedX = padV2({\n inputs: {x},\n backend,\n attrs: {paddings: completePaddings, constantValue: 0}\n });\n\n const reshapedPaddedShape =\n backend_util.getReshaped(paddedX.shape, blockShape, prod, false);\n\n const permutedReshapedPaddedPermutation = backend_util.getPermuted(\n reshapedPaddedShape.length, blockShape.length, false);\n\n const flattenShape =\n backend_util.getReshapedPermuted(paddedX.shape, blockShape, prod, false);\n\n const reshapedPaddedX = reshape(\n {inputs: {x: paddedX}, backend, attrs: {shape: reshapedPaddedShape}});\n\n const paddedXT = transpose({\n inputs: {x: reshapedPaddedX},\n backend,\n attrs: {perm: permutedReshapedPaddedPermutation}\n });\n\n const result =\n reshape({inputs: {x: paddedXT}, backend, attrs: {shape: flattenShape}});\n\n toDispose.push(paddedX);\n toDispose.push(reshapedPaddedX);\n toDispose.push(paddedXT);\n\n toDispose.forEach(t => backend.disposeIntermediateTensorInfo(t));\n\n return result;\n};\n\nexport const spaceToBatchNDConfig: KernelConfig = {\n kernelName: SpaceToBatchND,\n backendName: 'webgl',\n kernelFunc: spaceToBatchND as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES
OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {backend_util, KernelConfig, KernelFunc, SparseToDense, SparseToDenseAttrs, SparseToDenseInputs, TensorInfo} from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL} from '../backend_webgl';\nimport {ScatterProgram} from '../scatter_gpu';\nimport {reshape} from './Reshape';\n\nexport function sparseToDense(args: {\n inputs: SparseToDenseInputs,\n backend: MathBackendWebGL,\n attrs: SparseToDenseAttrs\n}): TensorInfo {\n const {inputs, backend, attrs} = args;\n const {sparseIndices, sparseValues, defaultValue} = inputs;\n const {outputShape} = attrs;\n\n const {sliceRank, numUpdates, strides, outputSize} =\n backend_util.calculateShapes(sparseValues, sparseIndices, outputShape);\n\n const sumDupeIndices = false;\n
const program = new ScatterProgram(\n numUpdates, sliceRank, sparseIndices.shape.length,\n sparseValues.shape.length, strides, [outputSize, 1], sumDupeIndices);\n\n const res = backend.runWebGLProgram(\n program, [sparseValues, sparseIndices, defaultValue], sparseValues.dtype);\n\n const reshaped =\n reshape({inputs: {x: res}, backend, attrs: {shape: outputShape}});\n\n backend.disposeIntermediateTensorInfo(res);\n return reshaped;\n}\n\nexport const sparseToDenseConfig: KernelConfig = {\n kernelName: SparseToDense,\n backendName: 'webgl',\n kernelFunc: sparseToDense as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing,
software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {backend_util, KernelConfig, KernelFunc, SplitV, SplitVAttrs, SplitVInputs, TensorInfo, util} from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL} from '../backend_webgl';\nimport {slice} from './Slice';\n\nexport function splitV(\n args:\n {inputs: SplitVInputs, backend: MathBackendWebGL, attrs: SplitVAttrs}):\n TensorInfo[] {\n const {inputs, backend, attrs} = args;\n const {x} = inputs;\n const {numOrSizeSplits, axis} = attrs;\n\n const $axis = util.parseAxisParam(axis, x.shape)[0];\n const splitSizes = backend_util.prepareSplitSize(x, numOrSizeSplits, $axis);\n\n const xRank = x.shape.length;\n const

begin = new Array(xRank).fill(0);\n const size = x.shape.slice();\n\n return splitSizes.map(s => {\n   const sliceSize = [...size];\n   sliceSize[$axis] = s;\n   const sliceT =\n   slice({inputs: {x}, backend, attrs: {begin, size: sliceSize}});\n   begin[$axis] += s;\n   return sliceT;\n });\n}\n\nexport const splitVConfig: KernelConfig = {\n kernelName: SplitV,\n backendName: 'webgl',\n kernelFunc: splitV as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {KernelConfig, KernelFunc, Sqrt} from '@tensorflow/tfjs-core';\nimport {unaryKernelFunc} from '../kernel_utils/kernel_funcs_utils';\n\nconst SQRT = `return sqrt(x);`;\n\nexport const sqrt = unaryKernelFunc({opSnippet: SQRT});\n\nexport const sqrtConfig: KernelConfig = {\n kernelName: Sqrt,\n backendName: 'webgl',\n kernelFunc: sqrt as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {KernelConfig, Square} from '@tensorflow/tfjs-core';\n\nimport {unaryKernelFunc} from '../kernel_utils/kernel_funcs_utils';\n\nconst SQUARE = `return x * x;`;\n\nexport const square = unaryKernelFunc({opSnippet: SQUARE});\n\nexport const squareConfig: KernelConfig = {\n kernelName: Square,\n backendName: 'webgl',\n kernelFunc: square,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\n\nimport {KernelConfig, KernelFunc, Step, StepAttrs, TensorInfo, UnaryInputs} from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL} from '../backend_webgl';\nimport {CHECK_NAN_SNIPPET, UnaryOpProgram} from '../unaryop_gpu';\n\nexport function step(\n   {inputs, attrs, backend}:\n   {inputs: UnaryInputs, attrs: StepAttrs, backend: MathBackendWebGL}):\n   TensorInfo {\n const {x} = inputs;\n const opSnippet = CHECK_NAN_SNIPPET + `\n    return x > 0.0 ? 1.0 : float(${attrs.alpha});\n  `;\n\n const program = new UnaryOpProgram(x.shape, opSnippet);\n\n return backend.runWebGLProgram(program, [x], x.dtype);\n}\n\nexport const\n stepConfig: KernelConfig = {\n kernelName: Step,\n backendName: 'webgl',\n kernelFunc: step as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2017 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *

```
=============================================================================\n
*/\n\nimport {GPGPUProgram} from './gpgpu_math';\nimport {getCoordsDataType} from
'./shader_compiler';\n\nexport class StridedSliceProgram implements GPGPUProgram
 {\n  variableNames = ['x'];\n  outputShape: number[];\n  userCode: string;\n\n  constructor(begin: number[], strides:
number[], size: number[]) {\n    this.outputShape = size;\n    const rank = size.length;\n    const inputDtype =
getCoordsDataType(size.length);\n    const dtype = getCoordsDataType(size.length);\n\n    let newCoords = '';\n    if
(rank === 1) {\n      newCoords = 'coords * strides + begin';\n    } else {\n      let outputAxis = 0;\n      newCoords
=\n          size.map((_, i) => {\n            outputAxis++;\n            return size.length === 1 ?\n                `coords
* strides[${i}] + begin[${i}]` :\n                `coords[${outputAxis - 1}] * strides[${i}] + begin[${i}]`;\n
})\n            .join(',');\n    }\n\n    this.userCode = `\n      ${inputDtype} begin = ${inputDtype}(${begin});\n
${inputDtype} strides = ${inputDtype}(${strides});\n\n      void main() {\n        ${dtype} coords =
getOutputCoords();\n        setOutput(getX(${newCoords}));\n
    }\n    `;\n  }\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under
the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the
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Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed
on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or
implied.\n * See the License for the specific language governing permissions and\n * limitations under the
License.\n *
=============================================================================\n
*/\n\nimport {buffer, KernelConfig, KernelFunc, Rank, slice_util, StridedSlice, StridedSliceAttrs,
StridedSliceInputs, TensorBuffer, TensorInfo, TypedArray} from '@tensorflow/tfjs-core';\n\nimport
{MathBackendWebGL} from '../backend_webgl';\nimport
 {stridedSliceImplCPU} from '../kernel_utils/shared';\nimport {StridedSliceProgram} from
'../strided_slice_gpu';\n\nimport {reshape} from './Reshape';\nimport {slice} from './Slice';\n\nexport function
stridedSlice(args: {\n  inputs: StridedSliceInputs,\n  backend: MathBackendWebGL,\n  attrs: StridedSliceAttrs\n}):
TensorInfo {\n  const {inputs, backend, attrs} = args;\n  const {x} = inputs;\n  const {\n    begin,\n    end,\n
strides,\n    beginMask,\n    endMask,\n    ellipsisMask,\n    newAxisMask,\n    shrinkAxisMask\n  } = attrs;\n\n
const {nonStrided, $begin, $strides, size, newShape, outShape} =\n      slice_util.sliceInfo(\n          x.shape, begin,
end, strides, beginMask, endMask, ellipsisMask,\n          newAxisMask, shrinkAxisMask);\n\n  const $x =
reshape({inputs: {x}, backend, attrs: {shape: newShape}});\n\n  let result;\n  if (nonStrided) {\n    const sliced =\n
  slice({inputs: {x: $x}, backend, attrs: {begin: $begin, size}});\n    result = reshape({inputs:
 {x: sliced}, backend, attrs: {shape: outShape}});\n\n    backend.disposeIntermediateTensorInfo(sliced);\n  } else if
(outShape.some(axis => axis === 0)) {\n    result = backend.makeTensorInfo(outShape, x.dtype, []);\n  } else {\n
const shouldExecuteOnCPU = backend.shouldExecuteOnCPU([$x]);\n    if (shouldExecuteOnCPU) {\n      const
xTexData = backend.texData.get($x.dataId);\n      const values = xTexData.values as TypedArray;\n      const xBuf
= buffer($x.shape, $x.dtype, values) as TensorBuffer<Rank>;\n      const resultValues =\n
stridedSliceImplCPU(outShape, xBuf, $strides, $begin);\n      result = backend.makeTensorInfo(outShape, $x.dtype,
resultValues.values);\n    } else {\n      const program = new StridedSliceProgram($begin, $strides, outShape);\n
result = backend.runWebGLProgram(program, [$x], $x.dtype);\n    }\n  }\n\n  const resultReshaped =\n
reshape({inputs: {x: result}, backend, attrs: {shape: outShape}});\n\n
backend.disposeIntermediateTensorInfo($x);\n
  backend.disposeIntermediateTensorInfo(result);\n\n  return resultReshaped;\n}\n\nexport const stridedSliceConfig:
KernelConfig = {\n  kernelName: StridedSlice,\n  backendName: 'webgl',\n  kernelFunc: stridedSlice as {} as
KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the
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License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n *
Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed
```

on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {KernelConfig,
Tan} from '@tensorflow/tfjs-core';\n\nimport {unaryKernelFunc} from '../kernel_utils/kernel_funcs_utils';\n\nconst TAN = `return tan(x);`;\n\nexport const tan = unaryKernelFunc({opSnippet: TAN});\n\nexport const tanConfig: KernelConfig = {\n kernelName: Tan,\n backendName: 'webgl',\n kernelFunc: tan,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {KernelConfig, Tanh} from '@tensorflow/tfjs-core';\nimport {unaryKernelFunc} from '../kernel_utils/kernel_funcs_utils';\n\nconst TANH = `\n float e2x = exp(-2.0 * abs(x));\n return sign(x) * (1.0 - e2x) / (1.0 + e2x);\n`;\n\nexport const tanh = unaryKernelFunc({opSnippet: TANH});\n\nexport const tanhConfig: KernelConfig = {\n kernelName: Tanh,\n backendName: 'webgl',\n kernelFunc: tanh,\n};\n","/**\n * @license\n * Copyright 2017 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the
License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {GPGPUProgram} from './gpgpu_math';\nimport {getCoordsDataType} from './shader_compiler';\n\nexport class TileProgram implements GPGPUProgram {\n variableNames = ['A'];\n outputShape: number[];\n userCode: string;\n rank: number;\n\n constructor(aShape: number[], reps: number[]) {\n const outputShape: number[] = new Array(aShape.length);\n for (let i = 0; i < outputShape.length; i++) {\n outputShape[i] = aShape[i] * reps[i];\n }\n this.outputShape = outputShape;\n this.rank = outputShape.length;\n const dtype = getCoordsDataType(this.rank);\n const sourceCoords = getSourceCoords(aShape);\n\n this.userCode = `\n void main() {\n ${dtype} resRC = getOutputCoords();\n setOutput(getA(${sourceCoords}));\n }\n `;\n }\n}\n\nfunction getSourceCoords(aShape:
number[]): string {\n const rank = aShape.length;\n if (rank > 5) {\n throw Error(`Tile for rank ${rank} is not yet supported`);\n }\n if (rank === 1) {\n return `imod(resRC, ${aShape[0]})`;\n }\n\n const currentCoords = ['resRC.x', 'resRC.y', 'resRC.z', 'resRC.w', 'resRC.u'];\n\n const sourceCoords = [];\n for (let i = 0; i < aShape.length; i++) {\n sourceCoords.push(`imod(${currentCoords[i]}, ${aShape[i]})`);\n }\n return sourceCoords.join();\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express
or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {buffer, KernelConfig, KernelFunc, TensorInfo, Tile, TileAttrs, TileInputs, util} from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL} from '../backend_webgl';\nimport {tileImplCPU} from

'../kernel_utils/shared';\nimport {TileProgram} from '../tile_gpu';\n\nexport function tile(\n params: {inputs: TileInputs, backend: MathBackendWebGL, attrs: TileAttrs}):\n TensorInfo {\n const {inputs, backend, attrs} = params;\n const {x} = inputs;\n const {reps} = attrs;\n\n if (x.dtype === 'string') {\n // Even thought string tensor is always on CPU, just to be consistent on how\n // to access tensor data.\n const data = backend.readSync(x.dataId) as Uint8Array[];\n const decodedData = data.map(d => util.decodeString(d));\n const buf = buffer(x.shape,
x.dtype, decodedData);\n const outBuf = tileImplCPU(buf, reps);\n return backend.makeTensorInfo(outBuf.shape, outBuf.dtype, outBuf.values);\n }\n\n const program = new TileProgram(x.shape, reps);\n const output = backend.runWebGLProgram(program, [x], x.dtype);\n\n return output;\n}\n\nexport const tileConfig: KernelConfig = {\n kernelName: Tile,\n backendName: 'webgl',\n kernelFunc: tile as {} as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n */\n\nimport {KernelConfig, KernelFunc, NumericDataType, TensorInfo, TopK, TopKAttrs, TopKInputs, TypedArray} from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL} from '../backend_webgl';\nimport {topKImplCPU} from '../kernel_utils/shared';\n\nexport function topK(\n args: {inputs: TopKInputs, backend: MathBackendWebGL, attrs: TopKAttrs}):\n TensorInfo[] {\n const {inputs, backend, attrs} = args;\n const {x} = inputs;\n const {k, sorted} = attrs;\n\n const xVals = backend.readSync(x.dataId) as TypedArray;\n const [allTopKVals, allTopKIndices] =\n topKImplCPU(xVals, x.shape, x.dtype as NumericDataType, k, sorted);\n\n return [\n backend.makeTensorInfo(\n allTopKVals.shape, allTopKVals.dtype, allTopKVals.values),\n backend.makeTensorInfo(\n allTopKIndices.shape, allTopKIndices.dtype, allTopKIndices.values)\n];\n}\n\nexport const topKConfig: KernelConfig = {\n kernelName: TopK,\n backendName: 'webgl',\n kernelFunc: topK as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the License);\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an AS IS BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n */\n\nimport {KernelConfig, KernelFunc, TensorInfo, Unique, UniqueAttrs, UniqueInputs} from '@tensorflow/tfjs-core';\n\nimport {MathBackendWebGL}
from '../backend_webgl';\nimport {uniqueImplCPU} from '../kernel_utils/shared';\nimport {assertNotComplex} from '../webgl_util';\n\nexport function unique(\n args:\n {inputs: UniqueInputs, attrs: UniqueAttrs, backend: MathBackendWebGL}):\n TensorInfo[] {\n const {inputs, attrs, backend} = args;\n const {axis} = attrs;\n const {x} = inputs;\n assertNotComplex(x, 'unique');\n\n // For now, always forward calculation to the CPU backend.\n console.warn(\n 'WARNING: ',\n 'UI might be locked temporarily as data is being downloaded');\n const values = backend.readSync(x.dataId);\n const {outputValues, outputShape, indices} =\n uniqueImplCPU(values, axis, x.shape, x.dtype);\n return [\n backend.makeTensorInfo(outputShape, x.dtype, outputValues),\n backend.makeTensorInfo([indices.length], 'int32', indices),\n];\n}\n\nexport const uniqueConfig: KernelConfig = {\n kernelName: Unique,\n backendName: 'webgl',\n kernelFunc: unique as {}
as KernelFunc,\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the

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```
      float sumValue = 0.0;\n\n      for (int i = 0; i < ${windowSizeNearestVec4}; i += 4) {\n        int inIdx =
inOffset + i;\n        vec4 values = vec4(\n          getValue(batch, inIdx),\n          getValue(batch, inIdx + 1),\n
  getValue(batch, inIdx + 2),\n          getValue(batch, inIdx + 3)\n        );\n\n        vec4 segFilter = vec4(\n
int(getSegmentIdAtIndex(inIdx)) == currentSeg ? 1 : 0,\n          int(getSegmentIdAtIndex(inIdx + 1)) ==
currentSeg ? 1 : 0,\n          int(getSegmentIdAtIndex(inIdx + 2)) == currentSeg ? 1 : 0,\n
int(getSegmentIdAtIndex(inIdx + 3)) == currentSeg ? 1 : 0\n        );\n\n        ${updateSnippet}\n      }\n\n      int
inIdx = inOffset + ${windowSizeNearestVec4};\n      if (${windowSizeVec4Remainder === 1}) {\n        vec4
values = vec4(\n          getValue(batch, inIdx),\n          initializationValue,\n          initializationValue,\n
initializationValue\n
      );\n\n        int inIdxSeg = int(getSegmentIdAtIndex(inIdx));\n\n        vec4 segFilter = vec4(\n
int(getSegmentIdAtIndex(inIdx)) == currentSeg ? 1 : 0,\n          0,\n          0,\n          0\n        );\n\n
${updateSnippet}\n      } else if (${windowSizeVec4Remainder === 2}) {\n        vec4 values = vec4(\n
getValue(batch, inIdx),\n          getValue(batch, inIdx + 1),\n          initializationValue,\n
initializationValue\n        );\n\n        vec4 segFilter = vec4(\n          int(getSegmentIdAtIndex(inIdx)) ==
currentSeg ? 1 : 0,\n          int(getSegmentIdAtIndex(inIdx + 1)) == currentSeg ? 1 : 0,\n          0,\n          0\n
  );\n\n        ${updateSnippet}\n      } else if (${windowSizeVec4Remainder === 3}) {\n        vec4 values =
vec4(\n          getValue(batch, inIdx),\n          getValue(batch, inIdx + 1),\n          getValue(batch, inIdx + 2),\n
    initializationValue\n
      );\n\n        vec4 segFilter = vec4(\n          int(getSegmentIdAtIndex(inIdx)) == currentSeg ? 1 : 0,\n
int(getSegmentIdAtIndex(inIdx + 1)) == currentSeg ? 1 : 0,\n          int(getSegmentIdAtIndex(inIdx + 2)) ==
currentSeg ? 1 : 0,\n          0\n        );\n\n        ${updateSnippet}\n      }\n      setOutput(${returnValue});\n
    }\n    `;\n  }\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the
Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the
License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n *
Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed
on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or
implied.\n * See the License for the specific language governing permissions
 and\n * limitations under the License.\n *
==========================================================================\n
*/\n\nimport {backend_util, DataType, KernelConfig, KernelFunc, sumOutType, TensorInfo,
UnsortedSegmentSum, UnsortedSegmentSumAttrs, UnsortedSegmentSumInputs, util} from '@tensorflow/tfjs-
core';\n\nimport {MathBackendWebGL} from '../backend_webgl';\nimport {SegmentOpProgram} from
'../segment_gpu';\n\nimport {range} from './Range';\nimport {reshape} from './Reshape';\nimport {tile} from
'./Tile';\nimport {transpose} from './Transpose';\n\nexport function unsortedSegmentSum(args: {\n  inputs:
UnsortedSegmentSumInputs,\n  backend: MathBackendWebGL,\n  attrs: UnsortedSegmentSumAttrs\n}):
TensorInfo {\n  const {inputs, backend, attrs} = args;\n  const {x, segmentIds} = inputs;\n  const {numSegments} =
attrs;\n\n  const xRank = x.shape.length;\n\n  const toDispose = [];\n\n  let axis = 0;\n  const permutation =
backend_util.getAxesPermutation([axis], xRank);\n  let
 permutedX = x;\n  if (permutation != null) {\n    permutedX = transpose({inputs: {x}, backend, attrs: {perm:
permutation}});\n    toDispose.push(permutedX);\n    axis = backend_util.getInnerMostAxes(1, xRank)[0];\n  }\n\n
const outShape = backend_util.segment_util.computeOutShape(\n      permutedX.shape, axis, numSegments);\n
const inSize = util.sizeFromShape([permutedX.shape[axis]]);\n  const a2D =\n      reshape({inputs: {x: permutedX},
backend, attrs: {shape: [-1, inSize]}});\n  toDispose.push(a2D);\n\n  const outputDType =
sumOutType(x.dtype);\n\n  const segOpCompute =\n      (x: TensorInfo, segOpType: 'unsortedSegmentSum',
segmentIds: TensorInfo,\n       dtype: DataType, numSegments: number): TensorInfo => {\n        const batchSize =
x.shape[0];\n        const inSize = x.shape[1];\n        const windowSize =\n
backend_util.segment_util.segOpComputeOptimalWindowSize(\n              inSize, numSegments);\n        const
segOpInfo = {windowSize, inSize, batchSize, numSegments};\n
```

const program = new SegmentOpProgram(segOpInfo, segOpType);\n const output = backend.compileAndRun(program, [x, segmentIds], dtype);\n toDispose.push(output);\n // No need to run another GPGPU program.\n if (output.shape[1] === numSegments) {\n return output;\n }\n const rangeInfo = range({\n backend,\n attrs: {start: 0, stop: numSegments, step: 1, dtype: 'float32'}\n });\n const tileInfo = tile({\n inputs: {x: rangeInfo},\n backend,\n attrs: {reps: [inSize / windowSize]}\n });\n\n toDispose.push(rangeInfo);\n toDispose.push(tileInfo);\n\n const result =\n segOpCompute(output, segOpType, tileInfo, dtype, numSegments);\n return result;\n };\n\n const segOpResult = segOpCompute(\n a2D, 'unsortedSegmentSum', segmentIds, outputDType, numSegments);\n\n const reshaped =\n reshape({inputs: {x: segOpResult},
backend, attrs: {shape: outShape}});\n\n let result = reshaped;\n if (permutation != null) {\n toDispose.push(reshaped);\n const perm = backend_util.getUndoAxesPermutation(permutation);\n result = transpose({inputs: {x: result}, backend, attrs: {perm}});\n }\n\n toDispose.forEach(t => backend.disposeIntermediateTensorInfo(t));\n return result;\n}\n\nexport const unsortedSegmentSumConfig: KernelConfig = {\n kernelName: UnsortedSegmentSum,\n backendName: 'webgl',\n kernelFunc: unsortedSegmentSum as {} as KernelFunc\n};\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n
* WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n
*/\nimport {KernelConfig, registerKernel} from '@tensorflow/tfjs-core';\n\nimport {_fusedMatMulConfig} from './kernels/_FusedMatMul';\nimport {absConfig} from './kernels/Abs';\nimport {acosConfig} from './kernels/Acos';\nimport {acoshConfig} from './kernels/Acosh';\nimport {addConfig} from './kernels/Add';\nimport {addNConfig} from './kernels/AddN';\nimport {allConfig} from './kernels/All';\nimport {anyConfig} from './kernels/Any';\nimport {argMaxConfig} from './kernels/ArgMax';\nimport {argMinConfig} from './kernels/ArgMin';\nimport {asinConfig} from './kernels/Asin';\nimport {asinhConfig} from './kernels/Asinh';\nimport {atanConfig} from './kernels/Atan';\nimport {atan2Config} from './kernels/Atan2';\nimport {atanhConfig}
from './kernels/Atanh';\nimport {avgPoolConfig} from './kernels/AvgPool';\nimport {avgPool3DConfig} from './kernels/AvgPool3D';\nimport {avgPoolGrad3DConfig} from './kernels/AvgPool3DGrad';\nimport {avgPoolGradConfig} from './kernels/AvgPoolGrad';\nimport {batchMatMulConfig} from './kernels/BatchMatMul';\nimport {batchNormConfig} from './kernels/BatchNorm';\nimport {batchToSpaceNDConfig} from './kernels/BatchToSpaceND';\nimport {bincountConfig} from './kernels/Bincount';\nimport {castConfig} from './kernels/Cast';\nimport {ceilConfig} from './kernels/Ceil';\nimport {clipByValueConfig} from './kernels/ClipByValue';\nimport {complexConfig} from './kernels/Complex';\nimport {complexAbsConfig} from './kernels/ComplexAbs';\nimport {concatConfig} from './kernels/Concat';\nimport {conv2DConfig} from './kernels/Conv2D';\nimport {conv2DBackpropFilterConfig} from './kernels/Conv2DBackpropFilter';\nimport {conv2DBackpropInputConfig} from './kernels/Conv2DBackpropInput';\nimport {conv3DConfig} from
'./kernels/Conv3D';\nimport {conv3DBackpropFilterV2Config} from './kernels/Conv3DBackpropFilterV2';\nimport {conv3DBackpropInputConfig} from './kernels/Conv3DBackpropInputV2';\nimport {cosConfig} from './kernels/Cos';\nimport {coshConfig} from './kernels/Cosh';\nimport {cropAndResizeConfig} from './kernels/CropAndResize';\nimport {cumsumConfig} from './kernels/Cumsum';\nimport {denseBincountConfig} from './kernels/DenseBincount';\nimport {depthToSpaceConfig} from './kernels/DepthToSpace';\nimport {depthwiseConv2dNativeConfig} from './kernels/DepthwiseConv2dNative';\nimport {depthwiseConv2dNativeBackpropFilterConfig} from './kernels/DepthwiseConv2dNativeBackpropFilter';\nimport

{depthwiseConv2dNativeBackpropInputConfig} from './kernels/DepthwiseConv2dNativeBackpropInput';\nimport {diagConfig} from './kernels/Diag';\nimport {dilation2DConfig} from './kernels/Dilation2D';\nimport {eluConfig} from './kernels/Elu';\nimport {eluGradConfig} from './kernels/EluGrad';\nimport {equalConfig} from './kernels/Equal';\nimport {erfConfig} from './kernels/Erf';\nimport {expConfig} from './kernels/Exp';\nimport {expandDimsConfig} from './kernels/ExpandDims';\nimport {expm1Config} from './kernels/Expm1';\nimport {fftConfig} from './kernels/FFT';\nimport {fillConfig} from './kernels/Fill';\nimport {flipLeftRightConfig} from './kernels/FlipLeftRight';\nimport {floorConfig} from './kernels/Floor';\nimport {floorDivConfig} from './kernels/FloorDiv';\nimport {fromPixelsConfig} from './kernels/FromPixels';\nimport {fusedConv2DConfig} from './kernels/FusedConv2D';\nimport {fusedDepthwiseConv2DConfig} from './kernels/FusedDepthwiseConv2D';\nimport {gatherNdConfig} from './kernels/GatherNd';\nimport {gatherV2Config} from './kernels/GatherV2';\nimport {greaterConfig} from './kernels/Greater';\nimport {greaterEqualConfig} from './kernels/GreaterEqual';\nimport {identityConfig} from './kernels/Identity';\nimport {ifftConfig} from './kernels/IFFT';\nimport {imagConfig} from './kernels/Imag';\nimport {isFiniteConfig} from './kernels/IsFinite';\nimport {isInfConfig} from './kernels/IsInf';\nimport {isNaNConfig} from './kernels/IsNaN';\nimport {leakyReluConfig} from './kernels/LeakyRelu';\nimport {lessConfig} from './kernels/Less';\nimport {lessEqualConfig} from './kernels/LessEqual';\nimport {linSpaceConfig} from './kernels/LinSpace';\nimport {logConfig} from './kernels/Log';\nimport {log1pConfig} from './kernels/Log1p';\nimport {logicalAndConfig} from './kernels/LogicalAnd';\nimport {logicalNotConfig} from './kernels/LogicalNot';\nimport {logicalOrConfig} from './kernels/LogicalOr';\nimport {LRNConfig} from './kernels/LRN';\nimport {LRNGradConfig} from './kernels/LRNGrad';\nimport {maxConfig} from './kernels/Max';\nimport {maximumConfig} from './kernels/Maximum';\nimport {maxPoolConfig} from './kernels/MaxPool';\nimport {maxPool3DConfig} from './kernels/MaxPool3D';\nimport {maxPoolGrad3DConfig} from './kernels/MaxPool3DGrad';\nimport {maxPoolGradConfig} from './kernels/MaxPoolGrad';\nimport {maxPoolWithArgmaxConfig} from './kernels/MaxPoolWithArgmax';\nimport {meanConfig} from './kernels/Mean';\nimport {minConfig} from './kernels/Min';\nimport {minimumConfig} from './kernels/Minimum';\nimport {mirrorPadConfig} from './kernels/MirrorPad';\nimport {modConfig} from './kernels/Mod';\nimport {multinomialConfig} from './kernels/Multinomial';\nimport {multiplyConfig} from './kernels/Multiply';\nimport {negConfig} from './kernels/Neg';\nimport {nonMaxSuppressionV3Config} from './kernels/NonMaxSuppressionV3';\nimport {nonMaxSuppressionV4Config} from './kernels/NonMaxSuppressionV4';\nimport {nonMaxSuppressionV5Config} from './kernels/NonMaxSuppressionV5';\nimport {notEqualConfig} from './kernels/NotEqual';\nimport {oneHotConfig} from './kernels/OneHot';\nimport {onesLikeConfig} from './kernels/OnesLike';\nimport {packConfig} from './kernels/Pack';\nimport {padV2Config} from './kernels/PadV2';\nimport {powConfig} from './kernels/Pow';\nimport {preluConfig} from './kernels/Prelu';\nimport {prodConfig} from './kernels/Prod';\nimport {rangeConfig} from './kernels/Range';\nimport {realConfig} from './kernels/Real';\nimport {realDivConfig} from './kernels/RealDiv';\nimport {reciprocalConfig} from './kernels/Reciprocal';\nimport {reluConfig} from './kernels/Relu';\nimport {relu6Config} from './kernels/Relu6';\nimport {reshapeConfig} from './kernels/Reshape';\nimport {resizeBilinearConfig} from './kernels/ResizeBilinear';\nimport {resizeBilinearGradConfig} from './kernels/ResizeBilinearGrad';\nimport {resizeNearestNeighborConfig} from './kernels/ResizeNearestNeighbor';\nimport {resizeNearestNeighborGradConfig} from './kernels/ResizeNearestNeighborGrad';\nimport {reverseConfig} from './kernels/Reverse';\nimport {rotateWithOffsetConfig} from './kernels/RotateWithOffset';\nimport {roundConfig} from './kernels/Round';\nimport {rsqrtConfig} from './kernels/Rsqrt';\nimport {scatterNdConfig} from './kernels/ScatterNd';\nimport {selectConfig} from './kernels/Select';\nimport {seluConfig} from './kernels/Selu';\nimport {sigmoidConfig} from './kernels/Sigmoid';\nimport {signConfig} from './kernels/Sign';\nimport {sinConfig} from './kernels/Sin';\nimport {sinhConfig} from './kernels/Sinh';\nimport {sliceConfig} from './kernels/Slice';\nimport {softmaxConfig} from './kernels/Softmax';\nimport {softplusConfig} from './kernels/Softplus';\nimport {spaceToBatchNDConfig} from './kernels/SpaceToBatchND';\nimport

{sparseToDenseConfig} from './kernels/SparseToDense';\nimport {splitVConfig} from './kernels/SplitV';\nimport {sqrtConfig} from './kernels/Sqrt';\nimport {squareConfig} from './kernels/Square';\nimport {squaredDifferenceConfig} from './kernels/SquaredDifference';\nimport {stepConfig} from './kernels/Step';\nimport {stridedSliceConfig} from './kernels/StridedSlice';\nimport {subConfig} from './kernels/Sub';\nimport {sumConfig} from './kernels/Sum';\nimport {tanConfig} from './kernels/Tan';\nimport {tanhConfig} from './kernels/Tanh';\nimport {tileConfig}
from './kernels/Tile';\nimport {topKConfig} from './kernels/TopK';\nimport {transposeConfig} from './kernels/Transpose';\nimport {uniqueConfig} from './kernels/Unique';\nimport {unpackConfig} from './kernels/Unpack';\nimport {unsortedSegmentSumConfig} from './kernels/UnsortedSegmentSum';\nimport {zerosLikeConfig} from './kernels/ZerosLike';\n\n// List all kernel configs here\nconst kernelConfigs: KernelConfig[] = [\n LRNConfig,\n LRNGradConfig,\n _fusedMatMulConfig,\n absConfig,\n acosConfig,\n acoshConfig,\n addConfig,\n addNConfig,\n allConfig,\n anyConfig,\n argMaxConfig,\n argMinConfig,\n asinConfig,\n asinhConfig,\n atan2Config,\n atanConfig,\n atanhConfig,\n avgPool3DConfig,\n avgPoolConfig,\n avgPoolGrad3DConfig,\n avgPoolGradConfig,\n batchMatMulConfig,\n batchNormConfig,\n batchToSpaceNDConfig,\n bincountConfig,\n castConfig,\n ceilConfig,\n clipByValueConfig,\n complexAbsConfig,\n complexConfig,\n concatConfig,\n conv2DBackpropFilterConfig,\n conv2DBackpropInputConfig,\n conv2DConfig,\n conv3DBackpropFilterV2Config,\n conv3DBackpropInputConfig,\n conv3DConfig,\n cosConfig,\n coshConfig,\n cropAndResizeConfig,\n cumsumConfig,\n denseBincountConfig,\n depthToSpaceConfig,\n depthwiseConv2dNativeBackpropFilterConfig,\n depthwiseConv2dNativeBackpropInputConfig,\n depthwiseConv2dNativeConfig,\n diagConfig,\n dilation2DConfig,\n eluConfig,\n eluGradConfig,\n equalConfig,\n erfConfig,\n expConfig,\n expandDimsConfig,\n expm1Config,\n fftConfig,\n fillConfig,\n flipLeftRightConfig,\n floorConfig,\n floorDivConfig,\n fromPixelsConfig,\n fusedConv2DConfig,\n fusedDepthwiseConv2DConfig,\n gatherNdConfig,\n gatherV2Config,\n greaterConfig,\n greaterEqualConfig,\n identityConfig,\n ifftConfig,\n imagConfig,\n isFiniteConfig,\n isInfConfig,\n isNaNConfig,\n leakyReluConfig,\n lessConfig,\n lessEqualConfig,\n linSpaceConfig,\n log1pConfig,\n logConfig,\n logicalAndConfig,\n logicalNotConfig,\n logicalOrConfig,\n maxConfig,\n maxPool3DConfig,\n maxPoolConfig,\n maxPoolGrad3DConfig,\n maxPoolGradConfig,\n maxPoolWithArgmaxConfig,\n maximumConfig,\n meanConfig,\n minConfig,\n minimumConfig,\n mirrorPadConfig,\n modConfig,\n multinomialConfig,\n multiplyConfig,\n negConfig,\n nonMaxSuppressionV3Config,\n nonMaxSuppressionV4Config,\n nonMaxSuppressionV5Config,\n notEqualConfig,\n oneHotConfig,\n onesLikeConfig,\n packConfig,\n padV2Config,\n powConfig,\n preluConfig,\n prodConfig,\n rangeConfig,\n realConfig,\n realDivConfig,\n reciprocalConfig,\n relu6Config,\n reluConfig,\n reshapeConfig,\n resizeBilinearConfig,\n resizeBilinearGradConfig,\n resizeNearestNeighborConfig,\n resizeNearestNeighborGradConfig,\n reverseConfig,\n rotateWithOffsetConfig,\n roundConfig,\n rsqrtConfig,\n scatterNdConfig,\n selectConfig,\n seluConfig,\n sigmoidConfig,\n signConfig,\n sinConfig,\n sinhConfig,\n sliceConfig,\n softmaxConfig,\n softplusConfig,\n spaceToBatchNDConfig,\n sparseToDenseConfig,\n splitVConfig,\n sqrtConfig,\n squareConfig,\n squaredDifferenceConfig,\n stepConfig,\n stridedSliceConfig,\n subConfig,\n sumConfig,\n tanConfig,\n tanhConfig,\n tileConfig,\n topKConfig,\n transposeConfig,\n uniqueConfig,\n unpackConfig,\n unsortedSegmentSumConfig,\n zerosLikeConfig\n];\n\nfor (const kernelConfig of kernelConfigs) {\n registerKernel(kernelConfig);\n}\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the

License for the specific language governing permissions and\n * limitations under the License.\n *\n * ==========\n */\n\n/* tslint:disable */\n\n/** Properties of an Any. */\nexport declare interface IAny {\n /** Any typeUrl */\n typeUrl?: (string|null);\n\n /** Any value */\n value?: (Uint8Array|null);\n}\n\n/** DataType enum. */\nexport enum DataType {\n 'DT_INVALID' = 0,\n 'DT_FLOAT' = 1,\n 'DT_DOUBLE' = 2,\n 'DT_INT32' = 3,\n 'DT_UINT8' = 4,\n 'DT_INT16' = 5,\n 'DT_INT8' = 6,\n 'DT_STRING' = 7,\n 'DT_COMPLEX64' = 8,\n 'DT_INT64' = 9,\n 'DT_BOOL' = 10,\n 'DT_QINT8' = 11,\n 'DT_QUINT8' = 12,\n 'DT_QINT32' = 13,\n 'DT_BFLOAT16' = 14,\n 'DT_FLOAT_REF' = 101,\n 'DT_DOUBLE_REF' = 102,\n 'DT_INT32_REF' = 103,\n 'DT_UINT8_REF' = 104,\n 'DT_INT16_REF' = 105,\n 'DT_INT8_REF' = 106,\n 'DT_STRING_REF' = 107,\n 'DT_COMPLEX64_REF' = 108,\n 'DT_INT64_REF' = 109,\n 'DT_BOOL_REF' = 110,\n 'DT_QINT8_REF' = 111,\n 'DT_QUINT8_REF' = 112,\n 'DT_QINT32_REF' = 113,\n 'DT_BFLOAT16_REF' = 114\n}\n\n/** Properties of a TensorShape. */\nexport declare interface ITensorShape {\n /** TensorShape dim */\n dim?: (TensorShape.IDim[]|null);\n\n /** TensorShape unknownRank */\n unknownRank?: (boolean|null);\n}\n\nexport namespace TensorShape {\n /** Properties of a Dim. */\n export declare interface IDim {\n /** Dim size */\n size?: (number|string|null);\n\n /** Dim name */\n name?: (string|null);\n }\n}\n\n/** Properties of a Tensor. */\nexport declare interface ITensor {\n /** Tensor dtype */\n dtype?: (DataType|null);\n\n /** Tensor tensorShape */\n tensorShape?: (ITensorShape|null);\n\n /** Tensor versionNumber */\n versionNumber?: (number|null);\n\n /** Tensor tensorContent */\n tensorContent?: (Uint8Array|null);\n\n /** Tensor floatVal */\n floatVal?: (number[]|null);\n\n /** Tensor doubleVal */\n doubleVal?: (number[]|null);\n\n /** Tensor intVal */\n intVal?: (number[]|null);\n\n /** Tensor stringVal */\n stringVal?: (Uint8Array[]|null);\n\n /** Tensor scomplexVal */\n scomplexVal?: (number[]|null);\n\n /** Tensor int64Val */\n int64Val?: ((number | string)[]|null);\n\n /** Tensor boolVal */\n boolVal?: (boolean[]|null);\n\n /** Tensor uint32Val */\n uint32Val?: (number[]|null);\n\n /** Tensor uint64Val */\n uint64Val?: ((number | string)[]|null);\n}\n\n/** Properties of an AttrValue. */\nexport declare interface IAttrValue {\n /** AttrValue list */\n list?: (AttrValue.IListValue|null);\n\n /** AttrValue s */\n s?: (string|null);\n\n /** AttrValue i */\n i?: (number|string|null);\n\n /** AttrValue f */\n f?: (number|null);\n\n /** AttrValue b */\n b?: (boolean|null);\n\n /** AttrValue type */\n type?: (DataType|null);\n\n /** AttrValue shape */\n shape?: (ITensorShape|null);\n\n /** AttrValue tensor */\n tensor?: (ITensor|null);\n\n /** AttrValue placeholder */\n placeholder?: (string|null);\n\n /** AttrValue func */\n func?: (INameAttrList|null);\n}\n\nexport namespace AttrValue {\n /** Properties of a ListValue. */\n export declare interface IListValue {\n /** ListValue s */\n s?: (string[]|null);\n\n /** ListValue i */\n i?: ((number | string)[]|null);\n\n /** ListValue f */\n f?: (number[]|null);\n\n /** ListValue b */\n b?: (boolean[]|null);\n\n /** ListValue type */\n type?: (DataType[]|null);\n\n /** ListValue shape */\n shape?: (ITensorShape[]|null);\n\n /** ListValue tensor */\n tensor?: (ITensor[]|null);\n\n /** ListValue func */\n func?: (INameAttrList[]|null);\n }\n}\n\n/** Properties of a NameAttrList. */\nexport declare interface INameAttrList {\n /** NameAttrList name */\n name?: (string|null);\n\n /** NameAttrList attr */\n attr?: ({[k: string]: IAttrValue}|null);\n}\n\n/** Properties of a NodeDef. */\nexport declare interface INodeDef {\n /** NodeDef name */\n name?: (string|null);\n\n /** NodeDef op */\n op?: (string|null);\n\n /** NodeDef input */\n input?: (string[]|null);\n\n /** NodeDef device */\n device?: (string|null);\n\n /** NodeDef attr */\n attr?: ({[k: string]: IAttrValue}|null);\n}\n\n/** Properties of a VersionDef. */\nexport declare interface IVersionDef {\n /** VersionDef producer */\n producer?: (number|null);\n\n /** VersionDef minConsumer */\n minConsumer?: (number|null);\n\n /** VersionDef badConsumers */\n badConsumers?: (number[]|null);\n}\n\n/** Properties of a GraphDef. */\nexport declare interface IGraphDef {\n /** GraphDef node */\n node?: (INodeDef[]|null);\n\n /** GraphDef versions */\n versions?: (IVersionDef|null);\n\n /** GraphDef library */\n library?: (IFunctionDefLibrary|null);\n}\n\n/** Properties of a CollectionDef. */\nexport declare interface ICollectionDef {\n /** CollectionDef nodeList */\n nodeList?: (CollectionDef.INodeList|null);\n\n /** CollectionDef bytesList */\n bytesList?: (CollectionDef.IBytesList|null);\n\n /** CollectionDef

int64List */\n int64List?: (CollectionDef.IInt64List|null);\n\n /** CollectionDef floatList */\n floatList?: (CollectionDef.IFloatList|null);\n\n /** CollectionDef anyList */\n anyList?: (CollectionDef.IAnyList|null);\n}\n\nexport namespace CollectionDef {\n /** Properties of a NodeList. */\n export declare interface INodeList {\n   /** NodeList value */\n   value?: (string[]|null);\n }\n\n /** Properties of a BytesList. */\n export declare interface IBytesList {\n   /** BytesList value */\n   value?: (Uint8Array[]|null);\n }\n\n /** Properties of an Int64List. */\n export declare interface IInt64List {\n   /** Int64List value */\n   value?: ((number | string)[]|null);\n }\n\n /** Properties of a FloatList. */\n export declare interface IFloatList {\n   /** FloatList value */\n   value?: (number[]|null);\n }\n\n /** Properties of an AnyList. */\n export declare interface IAnyList {\n   /** AnyList value */\n   value?: (IAny[]|null);\n }\n}\n\n/** Properties of a SaverDef. */\nexport declare interface ISaverDef {\n /** SaverDef filenameTensorName */\n filenameTensorName?: (string|null);\n\n /** SaverDef saveTensorName */\n saveTensorName?: (string|null);\n\n /** SaverDef restoreOpName */\n restoreOpName?: (string|null);\n\n /** SaverDef maxToKeep */\n maxToKeep?: (number|null);\n\n /** SaverDef sharded */\n sharded?: (boolean|null);\n\n /** SaverDef keepCheckpointEveryNHours */\n keepCheckpointEveryNHours?: (number|null);\n\n /** SaverDef version */\n version?: (SaverDef.CheckpointFormatVersion|null);\n}\n\nexport namespace SaverDef {\n /** CheckpointFormatVersion enum. */\n export enum CheckpointFormatVersion {'LEGACY' = 0, 'V1' = 1, 'V2' = 2}\n}\n\n/** Properties of a TensorInfo. */\nexport declare interface ITensorInfo {\n /** TensorInfo name */\n name?: (string|null);\n\n /** TensorInfo cooSparse */\n cooSparse?: (TensorInfo.ICooSparse|null);\n\n /** TensorInfo dtype */\n dtype?: (DataType|null);\n\n /** TensorInfo tensorShape */\n tensorShape?: (ITensorShape|null);\n}\n\nexport namespace TensorInfo {\n /** Properties of a CooSparse. */\n export declare interface ICooSparse {\n   /** CooSparse valuesTensorName */\n   valuesTensorName?: (string|null);\n\n   /** CooSparse indicesTensorName */\n   indicesTensorName?: (string|null);\n\n   /** CooSparse denseShapeTensorName */\n   denseShapeTensorName?: (string|null);\n }\n}\n\n/** Properties of a SignatureDef. */\nexport declare interface ISignatureDef {\n /** SignatureDef inputs */\n inputs?: ({[k: string]: ITensorInfo}|null);\n\n /** SignatureDef outputs */\n outputs?: ({[k: string]: ITensorInfo}|null);\n\n /** SignatureDef methodName */\n methodName?: (string|null);\n}\n\n/** Properties of an AssetFileDef. */\nexport declare interface IAssetFileDef {\n /** AssetFileDef tensorInfo */\n tensorInfo?: (ITensorInfo|null);\n\n /** AssetFileDef filename */\n filename?: (string|null);\n}\n\n/** Properties of an OpDef. */\nexport
 declare interface IOpDef {\n /** OpDef name */\n name?: (string|null);\n\n /** OpDef inputArg */\n inputArg?: (OpDef.IArgDef[]|null);\n\n /** OpDef outputArg */\n outputArg?: (OpDef.IArgDef[]|null);\n\n /** OpDef attr */\n attr?: (OpDef.IAttrDef[]|null);\n\n /** OpDef deprecation */\n deprecation?: (OpDef.IOpDeprecation|null);\n\n /** OpDef summary */\n summary?: (string|null);\n\n /** OpDef description */\n description?: (string|null);\n\n /** OpDef isCommutative */\n isCommutative?: (boolean|null);\n\n /** OpDef isAggregate */\n isAggregate?: (boolean|null);\n\n /** OpDef isStateful */\n isStateful?: (boolean|null);\n\n /** OpDef allowsUninitializedInput */\n allowsUninitializedInput?: (boolean|null);\n}\n\nexport namespace OpDef {\n /** Properties of an ArgDef. */\n export declare interface IArgDef {\n   /** ArgDef name */\n   name?: (string|null);\n\n   /** ArgDef description */\n   description?: (string|null);\n\n   /** ArgDef type */\n   type?: (DataType|null);\n\n   /** ArgDef typeAttr */\n   typeAttr?: (string|null);\n\n   /** ArgDef numberAttr */\n   numberAttr?: (string|null);\n\n   /** ArgDef typeListAttr */\n   typeListAttr?: (string|null);\n\n   /** ArgDef isRef */\n   isRef?: (boolean|null);\n }\n\n /** Properties of an AttrDef. */\n export declare interface IAttrDef {\n   /** AttrDef name */\n   name?: (string|null);\n\n   /** AttrDef type */\n   type?: (string|null);\n\n   /** AttrDef defaultValue */\n   defaultValue?: (IAttrValue|null);\n\n   /** AttrDef description */\n   description?: (string|null);\n\n   /** AttrDef hasMinimum */\n   hasMinimum?: (boolean|null);\n\n   /** AttrDef minimum */\n   minimum?: (number|string|null);\n\n   /** AttrDef allowedValues */\n   allowedValues?: (IAttrValue|null);\n }\n\n /** Properties of an OpDeprecation. */\n export declare interface IOpDeprecation {\n   /** OpDeprecation version */\n   version?: (number|null);\n\n   /** OpDeprecation explanation

*/\n explanation?: (string|null);\n }\n}\n\n/** Properties of an OpList. */\nexport declare interface IOpList {\n /** OpList op */\n op?: (IOpDef[]|null);\n}\n\n/** Properties of a MetaGraphDef. */\nexport declare interface IMetaGraphDef {\n /** MetaGraphDef metaInfoDef */\n metaInfoDef?: (MetaGraphDef.IMetaInfoDef|null);\n\n /** MetaGraphDef graphDef */\n graphDef?: (IGraphDef|null);\n\n /** MetaGraphDef saverDef */\n saverDef?: (ISaverDef|null);\n\n /** MetaGraphDef collectionDef */\n collectionDef?: ({[k: string]: ICollectionDef}|null);\n\n /** MetaGraphDef signatureDef */\n signatureDef?: ({[k: string]: ISignatureDef}|null);\n\n /** MetaGraphDef assetFileDef */\n assetFileDef?: (IAssetFileDef[]|null);\n}\n\nexport namespace MetaGraphDef {\n /** Properties of a MetaInfoDef. */\n export declare interface IMetaInfoDef {\n   /** MetaInfoDef metaGraphVersion */\n metaGraphVersion?: (string|null);\n\n   /** MetaInfoDef strippedOpList */\n   strippedOpList?: (IOpList|null);\n\n   /** MetaInfoDef anyInfo */\n   anyInfo?: (IAny|null);\n\n   /** MetaInfoDef tags */\n   tags?: (string[]|null);\n\n   /** MetaInfoDef tensorflowVersion */\n   tensorflowVersion?: (string|null);\n\n   /** MetaInfoDef tensorflowGitVersion */\n   tensorflowGitVersion?: (string|null);\n }\n}\n\n/** Properties of a SavedModel. */\nexport declare interface ISavedModel {\n /** SavedModel savedModelSchemaVersion */\n savedModelSchemaVersion?: (number|string|null);\n\n /** SavedModel metaGraphs */\n metaGraphs?: (IMetaGraphDef[]|null);\n}\n\n/** Properties of a FunctionDefLibrary. */\nexport declare interface IFunctionDefLibrary {\n /** FunctionDefLibrary function */\n 'function'?: (IFunctionDef[]|null);\n\n /** FunctionDefLibrary gradient */\n gradient?: (IGradientDef[]|null);\n}\n\n/** Properties of a FunctionDef. */\nexport declare interface IFunctionDef {\n /** FunctionDef signature */\n signature?: (IOpDef|null);\n\n /** FunctionDef attr */\n attr?: ({[k: string]: IAttrValue}|null);\n\n /** FunctionDef nodeDef */\n nodeDef?: (INodeDef[]|null);\n\n /** FunctionDef ret */\n ret?: ({[k: string]: string}|null);\n}\n\n/** Properties of a GradientDef. */\nexport declare interface IGradientDef {\n /** GradientDef functionName */\n functionName?: (string|null);\n\n /** GradientDef gradientFunc */\n gradientFunc?: (string|null);\n}\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n
 * limitations under the License.\n *\n ==========\n */\n\nimport {OpExecutor, OpMapper} from '../types';\n\nconst CUSTOM_OPS: {[key: string]: OpMapper} = {};\n\n/**\n * Register an Op for graph model executor. This allow you to register\n * TensorFlow custom op or override existing op.\n *\n * Here is an example of registering a new MatMul Op.\n * ```js\n * const customMatmul = (node) =>\n *   tf.matMul(\n *   node.inputs[0], node.inputs[1],\n *   node.attrs['transpose_a'], node.attrs['transpose_b']);\n *\n * tf.registerOp('MatMul', customMatmul);\n * ```\n * The inputs and attrs of the node object is based on the TensorFlow op\n * registry.\n *\n * @param name The Tensorflow Op name.\n * @param opFunc An op function which is called with the current graph node\n * during execution and needs to return a tensor or a list of tensors. The node\n * has the following attributes:\n *   - attr: A map from attribute name to its value\n *   - inputs: A list of input tensors\n *\n * @doc {heading: 'Models', subheading: 'Op Registry'}\n */\nexport function registerOp(name: string, opFunc: OpExecutor) {\n const opMapper: OpMapper = {\n tfOpName: name,\n   category: 'custom',\n   inputs: [],\n   attrs: [],\n   customExecutor: opFunc\n };\n\n CUSTOM_OPS[name] = opMapper;\n}\n\n/**\n * Retrieve the OpMapper object for the registered op.\n *\n * @param name The Tensorflow Op name.\n *\n * @doc {heading: 'Models', subheading: 'Op Registry'}\n */\nexport function getRegisteredOp(name: string): OpMapper {\n return CUSTOM_OPS[name];\n}\n\n/**\n * Deregister the Op for graph model executor.\n *\n * @param name The Tensorflow Op name.\n *\n * @doc {heading: 'Models', subheading: 'Op Registry'}\n */\nexport function deregisterOp(name: string) {\n delete CUSTOM_OPS[name];\n}\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n *

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==========================================================================\n
*/\n\nimport {clone, Tensor, util} from '@tensorflow/tfjs-core';\n\nimport {NamedTensorsMap} from
'../../data/types';\nimport {ExecutionContext} from '../../executor/execution_context';\nimport {ResourceManager}
from '../../executor/resource_manager';\nimport {Node, ValueType} from '../types';\n\nexport function
getParamValue(\n    paramName: string, node: Node, tensorMap: NamedTensorsMap,\n    context:
 ExecutionContext, resourceManager?: ResourceManager): ValueType {\n  const inputParam =
node.inputParams[paramName];\n  if (inputParam && inputParam.inputIndexStart !== undefined) {\n    const start
= inputParam.inputIndexStart;\n    const end = inputParam.inputIndexEnd === 0 ?\n        undefined :\n
(inputParam.inputIndexEnd === undefined ? start + 1 :\n
inputParam.inputIndexEnd);\n    if (inputParam.type === 'tensor') {\n      return getTensor(\n
node.inputNames[inputParam.inputIndexStart], tensorMap, context,\n          resourceManager);\n    }\n    if
(inputParam.type === 'tensors') {\n      const inputs = node.inputNames.slice(start, end);\n\n      return inputs.map(\n
      name => getTensor(name, tensorMap, context, resourceManager));\n    }\n    const tensor = getTensor(\n
node.inputNames.slice(start)[0], tensorMap, context, resourceManager);\n    const data = tensor.dataSync();\n
return inputParam.type
 === 'number' ?\n        data[0] :\n        util.toNestedArray(tensor.shape, data);\n  }\n  const attrParam =
node.attrParams[paramName];\n  return attrParam && attrParam.value;\n}\n\n/**\n * Retrieve the tensor from
tensorsMap based on input name.\n * @param name Node input name\n * @param tensorsMap Tensors map keyed
by the node\n * @param context contains tensors and information for running the current node.\n * @param
resourceManager Optional. Contains global resources of the model.\n */\nexport function getTensor(\n    name:
string, tensorsMap: NamedTensorsMap, context: ExecutionContext,\n    resourceManager?: ResourceManager):
Tensor {\n  const [nodeName, index] = parseNodeName(name);\n\n  if (resourceManager != null) {\n    const tensor
= resourceManager.getHashTableHandleByName(nodeName);\n    if (tensor != null) {\n      return tensor;\n    }\n
}\n\n  const contextId = context.currentContextIds.find(contextId => {\n    return
!!tensorsMap[getNodeNameWithContextId(nodeName,
 contextId)];\n  });\n\n  return contextId !== undefined ?\n      tensorsMap[getNodeNameWithContextId(nodeName,
contextId)][index] :\n      undefined;\n}\n\n/**\n * Retrieve the tensors based on input name for current context.\n *
@param name Node input name\n * @param tensorsMap Tensors map keyed by the node\n */\nexport function
getTensorsForCurrentContenxt(\n    name: string, tensorsMap: NamedTensorsMap,\n    context: ExecutionContext):
Tensor[] {\n  return tensorsMap[getNodeNameWithContextId(name, context.currentContextId)];\n}\n\n/**\n *
Returns the node name and index from the Node input name.\n * @param inputName The input name of the node,
in format of\n * node_name:output_index, i.e. MatMul:0, if the output_index is not set, it is\n * default to 0.\n
*/\nexport function getNodeNameAndIndex(\n    inputName: string, context?: ExecutionContext): [string, number]
{\n  const [nodeName, index] = parseNodeName(inputName);\n\n  return [\n
getNodeNameWithContextId(nodeName, context
 && context.currentContextId),\n    index\n  ];\n}\n\nfunction getNodeNameWithContextId(name: string,
contextId?: string): string {\n  return !!contextId ? `${name}-${contextId}` : name;\n}\n\nexport function
parseNodeName(name: string): [string, number] {\n  const parts = name.split(':');\n  if (parts.length === 1) {\n
return [name, 0];\n  }\n\n  const nodeName = parts[0];\n  return [nodeName, Number(parts[parts.length -
1])];\n}\n\nexport function split(arr: number[], size: number) {\n  const res = [];\n  for (let i = 0; i < arr.length; i +=
size) {\n    res.push(arr.slice(i, i + size));\n  }\n  return res;\n}\nexport function getPadding(\n    node: Node,
tensorMap: NamedTensorsMap,\n    context: ExecutionContext): ValueType {\n  let pad = getParamValue('pad',
```

node, tensorMap, context);\n if (pad === 'explicit') {\n   // This is 1d array, we need to convert it to 2d array\n pad = getParamValue('explicitPaddings', node, tensorMap, context);\n   const explicitPadding: [\n [number, number], [number, number], [number, number], [number, number]\n   ] = [[0, 0], [0, 0], [0, 0], [0, 0]];\n for (let i = 0; i < 4; i++) {\n   explicitPadding[i][0] = (pad as number[])[i * 2];\n   explicitPadding[i][1] = (pad as number[])[i * 2 + 1];\n   }\n   return explicitPadding;\n }\n return pad;\n}\n\n/**\n * Reuse the tensor if it is marked as keep, otherwise clone the tensor to\n * avoid disposal. This is important for TensorArray and TensorList ops, since\n * internally they use a tensor as the id for TensorArray and TensorList, and\n * to simplify lookup, they also use Tensor.id as the key to the internal map.\n * These id tensors have been marked as kept in the backend, we need avoid clone\n * them in order to create new Tensor.id.\n * @param tensor\n */\nexport function cloneTensor(tensor: Tensor): Tensor {\n return tensor.kept ? tensor : clone(tensor);\n}\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the
 Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {OpMapper} from '../types';\n\nexport const json: OpMapper[] = [\n {\n   'tfOpName': 'Add',\n   'category': 'arithmetic',\n   'inputs': [\n   {'start': 0, 'name': 'a', 'type': 'tensor'},\n   {'start': 1, 'name': 'b', 'type': 'tensor'},\n   ],\n   'attrs': [\n   {'tfName': 'T', 'name': 'dtype', 'type': 'dtype', 'notSupported': true}\n   ]\n },\n {\n   'tfOpName': 'AddV2',\n   'category': 'arithmetic',\n   'inputs': [\n   {'start': 0, 'name': 'a', 'type': 'tensor'},\n   {'start': 1, 'name': 'b', 'type': 'tensor'},\n   ],\n   'attrs': [\n   {'tfName': 'T', 'name': 'dtype', 'type': 'dtype', 'notSupported': true}\n   ]\n },\n {\n   'tfOpName': 'AddN',\n   'category': 'arithmetic',\n   'inputs': [{'start': 0, 'end': 0, 'name': 'tensors', 'type': 'tensors'}]\n },\n {\n   'tfOpName': 'BiasAdd',\n   'category': 'arithmetic',\n   'inputs': [\n   {'start': 0, 'name': 'a', 'type': 'tensor'},\n   {'start': 1, 'name': 'b', 'type': 'tensor'},\n   ],\n   'attrs': [\n   {'tfName': 'T', 'name': 'dtype', 'type': 'dtype', 'notSupported': true}, {\n   'tfName': 'data_format',\n   'name': 'dataFormat',\n   'type': 'string',\n   'notSupported': true\n   }\n   ]\n },\n {\n   'tfOpName': 'Sub',\n   'category': 'arithmetic',\n   'inputs': [\n   {'start': 0, 'name': 'a', 'type':
 'tensor'},\n   {'start': 1, 'name': 'b', 'type': 'tensor'},\n   ],\n   'attrs': [\n   {'tfName': 'T', 'name': 'dtype', 'type': 'dtype', 'notSupported': true}\n   ]\n },\n {\n   'tfOpName': 'RealDiv',\n   'category': 'arithmetic',\n   'inputs': [\n   {'start': 0, 'name': 'a', 'type': 'tensor'},\n   {'start': 1, 'name': 'b', 'type': 'tensor'},\n   ],\n   'attrs': [\n   {'tfName': 'T', 'name': 'dtype', 'type': 'dtype', 'notSupported': true}\n   ]\n },\n {\n   'tfOpName': 'Div',\n   'category': 'arithmetic',\n   'inputs': [\n   {'start': 0, 'name': 'a', 'type': 'tensor'},\n   {'start': 1, 'name': 'b', 'type': 'tensor'},\n   ],\n   'attrs': [\n   {'tfName': 'T', 'name': 'dtype', 'type': 'dtype', 'notSupported': true}\n   ]\n },\n {\n   'tfOpName': 'DivNoNan',\n   'category': 'arithmetic',\n   'inputs': [\n   {'start': 0, 'name': 'a', 'type': 'tensor'},\n   {'start': 1, 'name': 'b', 'type': 'tensor'},\n   ],\n   'attrs': [\n   {'tfName':
 'T', 'name': 'dtype', 'type': 'dtype', 'notSupported': true}\n   ]\n },\n {\n   'tfOpName': 'FloorDiv',\n   'category': 'arithmetic',\n   'inputs': [\n   {'start': 0, 'name': 'a', 'type': 'tensor'},\n   {'start': 1, 'name': 'b', 'type': 'tensor'},\n   ],\n   'attrs': [\n   {'tfName': 'T', 'name': 'dtype', 'type': 'dtype', 'notSupported': true}\n   ]\n },\n {\n   'tfOpName': 'Mul',\n   'category': 'arithmetic',\n   'inputs': [\n   {'start': 0, 'name': 'a', 'type': 'tensor'},\n   {'start': 1, 'name': 'b', 'type': 'tensor'},\n   ],\n   'attrs': [\n   {'tfName': 'T', 'name': 'dtype', 'type': 'dtype', 'notSupported': true}\n   ]\n },\n {\n   'tfOpName': 'Maximum',\n   'category': 'arithmetic',\n   'inputs': [\n   {'start': 0, 'name': 'a', 'type': 'tensor'},\n   {'start': 1, 'name': 'b', 'type': 'tensor'}\n   ],\n   'attrs': [\n   {'tfName': 'T', 'name': 'dtype', 'type': 'dtype',
 'notSupported': true}\n   ]\n },\n {\n   'tfOpName':
 'Minimum',\n   'category': 'arithmetic',\n   'inputs': [\n   {'start': 0, 'name': 'a', 'type': 'tensor'},\n   {'start': 1, 'name': 'b', 'type': 'tensor'}\n   ],\n   'attrs': [\n   {'tfName': 'T', 'name': 'dtype', 'type': 'dtype', 'notSupported': true}\n   ]\n },\n {\n   'tfOpName': 'Pow',\n   'category': 'arithmetic',\n   'inputs': [\n   {'start': 0, 'name': 'a', 'type':

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License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n
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* limitations under the License.\n *
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*/\n\nimport {OpMapper} from '../types';\n\nexport const json: OpMapper[] = [\n {\n 'tfOpName': 'AvgPool',\n 'category': 'convolution',\n 'inputs': [\n {'start': 0, 'name': 'x', 'type': 'tensor'},\n],\n 'attrs': [\n {'tfName': 'strides', 'name': 'strides', 'type': 'number[]'},\n {'tfName': 'padding', 'name': 'pad', 'type': 'string'}, {\n 'tfName': 'data_format',\n 'name': 'dataFormat',\n 'type': 'string',\n 'notSupported': true\n },\n {'tfName': 'ksize', 'name': 'kernelSize', 'type': 'number[]'},\n {'tfName': 'T', 'name': 'dtype', 'type': 'dtype', 'notSupported': true}\n]\n },\n {\n 'tfOpName': 'MaxPool',\n 'category': 'convolution',\n 'inputs': [\n {'start': 0, 'name': 'x', 'type': 'tensor'},\n],\n 'attrs': [\n {'tfName': 'strides', 'name': 'strides', 'type': 'number[]'},\n
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==========\n */\n\nexport const json: OpMapper[] = [\n {\n 'tfOpName': 'Fill',\n 'category': 'creation',\n 'inputs': [\n {'start': 0, 'name': 'shape', 'type': 'number[]'},\n {'start': 1, 'name': 'value', 'type': 'number'},\n],\n 'attrs': [{'tfName': 'T', 'name': 'dtype', 'type': 'dtype'}]\n },\n
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*/\n\nexport const json: OpMapper[] = [\n {\n 'tfOpName': 'NonMaxSuppressionV2',\n 'category': 'dynamic',\n 'inputs': [\n {'start': 0, 'name': 'boxes', 'type': 'tensor'},\n {'start': 1, 'name': 'scores', 'type': 'tensor'},\n {'start': 2, 'name': 'maxOutputSize', 'type': 'number'},\n {'start': 3, 'name': 'iouThreshold', 'type': 'number'}\n]\n },\n {\n 'tfOpName': 'NonMaxSuppressionV3',\n 'category': 'dynamic',\n 'inputs': [\n {'start': 0, 'name': 'boxes', 'type': 'tensor'},\n {'start': 1, 'name': 'scores', 'type': 'tensor'},\n {'start': 2, 'name': 'maxOutputSize', 'type': 'number'},\n {'start': 3, 'name': 'iouThreshold', 'type': 'number'},\n {'start': 4, 'name': 'scoreThreshold', 'type': 'number'}\n]\n },\n {\n 'tfOpName': 'NonMaxSuppressionV4',\n 'category': 'dynamic',\n 'inputs': [\n {'start': 0, 'name': 'boxes', 'type': 'tensor'},\n {'start': 1, 'name': 'scores', 'type': 'tensor'},\n
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==\n
*/\n\nexport const json: OpMapper[] = [\n {\n 'tfOpName': 'TopKV2',\n 'category': 'evaluation',\n 'inputs': [\n

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'valueDType', 'type': 'dtype'},\n]\n },\n {\n 'tfOpName': 'LookupTableImport',\n 'category': 'hash_table',\n 'inputs': [\n {'start': 0, 'name': 'tableHandle', 'type': 'tensor'},\n {'start': 1, 'name': 'keys', 'type': 'tensor'},\n {'start': 2, 'name': 'values', 'type': 'tensor'}\n],\n 'attrs': [\n {'tfName': 'Tin', 'name': 'tIn', 'type': 'dtype', 'notSupported': true}, {\n 'tfName': 'Tout',\n 'name': 'tOut',\n 'type': 'dtype',\n 'notSupported': true\n }\n]\n },\n {\n 'tfOpName': 'LookupTableImportV2',\n 'category': 'hash_table',\n 'inputs': [\n {'start': 0, 'name': 'tableHandle', 'type': 'tensor'},\n {'start': 1, 'name': 'keys', 'type': 'tensor'},\n {'start': 2, 'name': 'values', 'type': 'tensor'}\n],\n 'attrs': [\n {'tfName': 'Tin', 'name': 'tIn', 'type': 'dtype', 'notSupported': true}, {\n 'tfName': 'Tout',\n 'name': 'tOut',\n 'type': 'dtype',\n 'notSupported': true\n }\n]\n },\n {\n 'tfOpName': 'LookupTableFind',\n 'category': 'hash_table',\n 'inputs': [\n {'start': 0, 'name': 'tableHandle', 'type': 'tensor'},\n {'start': 1, 'name': 'keys', 'type': 'tensor'},\n {'start': 2, 'name': 'defaultValue', 'type': 'tensor'}\n],\n 'attrs': [\n {'tfName': 'Tin', 'name': 'tIn', 'type': 'dtype', 'notSupported': true}, {\n 'tfName': 'Tout',\n 'name': 'tOut',\n 'type': 'dtype',\n 'notSupported': true\n }\n]\n },\n {\n 'tfOpName': 'LookupTableFindV2',\n 'category': 'hash_table',\n 'inputs': [\n {'start': 0, 'name': 'tableHandle', 'type': 'tensor'},\n {'start': 1, 'name': 'keys', 'type': 'tensor'},\n {'start': 2, 'name': 'defaultValue', 'type': 'tensor'}\n],\n 'attrs': [\n {'tfName': 'Tin', 'name': 'tIn', 'type': 'dtype', 'notSupported': true}, {\n 'tfName': 'Tout',\n 'name': 'tOut',\n 'type': 'dtype',\n 'notSupported': true\n }\n]\n }\n];\n","import {OpMapper} from '../types';\n\n/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nexport const json: OpMapper[] = [\n {\n 'tfOpName': 'ResizeBilinear',\n 'category': 'image',\n 'inputs': [\n {'start': 0, 'name': 'images', 'type': 'tensor'},\n {'start': 1, 'name': 'size', 'type': 'number[]'},\n],\n 'attrs': [\n {'tfName': 'align_corners', 'name': 'alignCorners', 'type': 'bool'}, {\n 'tfName': 'half_pixel_centers',\n 'name': 'halfPixelCenters',\n 'type': 'bool'\n },\n {'tfName': 'T', 'name': 'dtype', 'type': 'dtype', 'notSupported': true}\n]\n },\n {\n 'tfOpName': 'ResizeNearestNeighbor',\n 'category': 'image',\n 'inputs': [\n {'start': 0, 'name': 'images', 'type': 'tensor'},\n {'start': 1, 'name': 'size', 'type': 'number[]'},\n],\n 'attrs': [\n {'tfName': 'align_corners', 'name': 'alignCorners', 'type': 'bool'}, {\n 'tfName': 'half_pixel_centers',\n 'name': 'halfPixelCenters',\n 'type': 'bool'\n },\n {'tfName': 'T', 'name': 'dtype', 'type': 'dtype', 'notSupported': true}\n]\n },\n {\n 'tfOpName': 'CropAndResize',\n 'category': 'image',\n 'inputs': [\n {'start': 0, 'name': 'image',\n 'type': 'tensor'},\n {'start': 1, 'name': 'boxes', 'type': 'tensor'},\n {'start': 2, 'name': 'boxInd', 'type': 'tensor'},\n {'start': 3, 'name': 'cropSize', 'type': 'number[]'},\n],\n 'attrs': [\n {'tfName': 'method', 'name': 'method', 'type': 'string'}, {\n 'tfName': 'extrapolation_value',\n 'name': 'extrapolationValue',\n 'type': 'number'\n }\n]\n }\n];\n","import {OpMapper} from '../types';\n\n/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License\n for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nexport const json: OpMapper[] = [\n {\n 'tfOpName': 'Equal',\n 'category': 'logical',\n 'inputs': [\n {'start': 0, 'name': 'a', 'type': 'tensor'},\n {'start': 1, 'name': 'b', 'type': 'tensor'},\n],\n 'attrs': [\n {'tfName': 'T', 'name': 'dtype', 'type': 'dtype', 'notSupported': true}\n]\n },\n {\n 'tfOpName': 'NotEqual',\n 'category':

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the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n */\n\nimport {OpMapper} from '../types';\n\nexport const json: OpMapper[] = [\n {\n 'tfOpName': '_FusedMatMul',\n 'category': 'matrices',\n 'inputs': [\n {'start': 0, 'name': 'a', 'type': 'tensor'},\n {'start': 1, 'name': 'b', 'type': 'tensor'},\n {'start': 2, end: 0, 'name': 'args', 'type': 'tensors'},\n],\n 'attrs': [\n {'tfName': 'num_args', 'name': 'numArgs', 'type': 'number'}, {\n 'tfName': 'fused_ops',\n 'name': 'fusedOps',\n 'type': 'string[]',\n 'defaultValue': []\n },\n {\n 'tfName': 'epsilon',\n 'name': 'epsilon',\n 'type': 'number',\n 'defaultValue': 0.0001\n
},\n {\n 'tfName': 'transpose_a',\n 'name': 'transposeA',\n 'type': 'bool',\n 'defaultValue': false\n },\n {\n 'tfName': 'transpose_b',\n 'name': 'transposeB',\n 'type': 'bool',\n 'defaultValue': false\n },\n {'tfName': 'T', 'name': 'dtype', 'type': 'dtype', 'notSupported': true}\n]\n },\n {\n 'tfOpName': 'MatMul',\n 'category': 'matrices',\n 'inputs': [\n {'start': 0, 'name': 'a', 'type': 'tensor'},\n {'start': 1, 'name': 'b', 'type': 'tensor'},\n],\n 'attrs': [\n {\n 'tfName': 'transpose_a',\n 'name': 'transposeA',\n 'type': 'bool',\n 'defaultValue': false\n },\n {\n 'tfName': 'transpose_b',\n 'name': 'transposeB',\n 'type': 'bool',\n 'defaultValue': false\n },\n {'tfName': 'T', 'name': 'dtype', 'type': 'dtype', 'notSupported': true}\n]\n },\n {\n 'tfOpName': 'BatchMatMul',\n

'category': 'matrices',\n 'inputs': [\n {'start': 0, 'name': 'a', 'type': 'tensor'},\n {'start': 1, 'name': 'b', 'type': 'tensor'},\n],\n 'attrs': [\n {\n 'tfName': 'adj_x',\n 'name': 'transposeA',\n 'type': 'bool',\n 'defaultValue': false\n },\n {\n 'tfName': 'adj_y',\n 'name': 'transposeB',\n 'type': 'bool',\n 'defaultValue': false\n },\n {'tfName': 'T', 'name': 'dtype', 'type': 'dtype', 'notSupported': true}\n]\n },\n {\n 'tfOpName': 'BatchMatMulV2',\n 'category': 'matrices',\n 'inputs': [\n {'start': 0, 'name': 'a', 'type': 'tensor'},\n {'start': 1, 'name': 'b', 'type': 'tensor'},\n],\n 'attrs': [\n {\n 'tfName': 'adj_x',\n 'name': 'transposeA',\n 'type': 'bool',\n 'defaultValue': false\n },\n {\n 'tfName': 'adj_y',\n 'name': 'transposeB',\n 'type': 'bool',\n 'defaultValue': false\n },\n {'tfName': 'T', 'name': 'dtype', 'type': 'dtype', 'notSupported': true}\n]\n },\n {\n 'tfOpName': 'Transpose',\n 'category': 'matrices',\n 'inputs': [\n {'start': 0, 'name': 'x', 'type': 'tensor'},\n {'start': 1, 'name': 'perm', 'type': 'number[]'},\n],\n 'attrs': [{\n 'tfName': 'T',\n 'name': 'dtype',\n 'type': 'dtype',\n 'notSupported': true\n }]\n }\n];\n","import {OpMapper} from '../types';\n\n/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n*/\n\nexport const json: OpMapper[] = [\n {\n 'tfOpName': 'FusedBatchNorm',\n 'category': 'normalization',\n 'inputs': [\n {'start': 0, 'name': 'x', 'type': 'tensor'},\n {'start': 1, 'name': 'scale', 'type': 'tensor'},\n {'start': 2, 'name': 'offset', 'type': 'tensor'},\n {'start': 3, 'name': 'mean', 'type': 'tensor'},\n {'start': 4, 'name': 'variance', 'type': 'tensor'},\n],\n 'attrs': [\n {\n 'tfName': 'epsilon',\n 'name': 'epsilon',\n 'type': 'number',\n 'defaultValue': 0.001\n },\n {\n 'tfName': 'data_format',\n 'name': 'dataFormat',\n 'type': 'string',\n 'notSupported': true\n }\n]\n },\n {\n 'tfOpName': 'FusedBatchNormV2',\n 'category': 'normalization',\n 'inputs':\n [\n {'start': 0, 'name': 'x', 'type': 'tensor'},\n {'start': 1, 'name': 'scale', 'type': 'tensor'},\n {'start': 2, 'name': 'offset', 'type': 'tensor'},\n {'start': 3, 'name': 'mean', 'type': 'tensor'},\n {'start': 4, 'name': 'variance', 'type': 'tensor'},\n],\n 'attrs': [\n {\n 'tfName': 'epsilon',\n 'name': 'epsilon',\n 'type': 'number',\n 'defaultValue': 0.001\n },\n {\n 'tfName': 'data_format',\n 'name': 'dataFormat',\n 'type': 'string',\n 'notSupported': true\n }\n]\n },\n {\n 'tfOpName': 'FusedBatchNormV3',\n 'category': 'normalization',\n 'inputs': [\n {'start': 0, 'name': 'x', 'type': 'tensor'},\n {'start': 1, 'name': 'scale', 'type': 'tensor'},\n {'start': 2, 'name': 'offset', 'type': 'tensor'},\n {'start': 3, 'name': 'mean', 'type': 'tensor'},\n {'start': 4, 'name': 'variance', 'type': 'tensor'},\n],\n 'attrs': [\n {\n 'tfName': 'epsilon',\n 'name': 'epsilon',\n 'type': 'number',\n 'defaultValue': 0.001\n },\n {\n 'tfName': 'data_format',\n 'name': 'dataFormat',\n 'type': 'string',\n 'notSupported': true\n }\n]\n },\n {\n 'tfOpName': 'LRN',\n 'category': 'normalization',\n 'inputs': [\n {'start': 0, 'name': 'x', 'type': 'tensor'},\n],\n 'attrs': [\n {\n 'tfName': 'depth_radius',\n 'name': 'radius',\n 'type': 'number',\n 'defaultValue': 5\n },\n {'tfName': 'bias', 'name': 'bias', 'type': 'number', 'defaultValue': 1.0},\n {\n 'tfName': 'alpha',\n 'name': 'alpha',\n 'type': 'number',\n 'defaultValue': 1.0\n },\n {\n 'tfName': 'beta',\n 'name': 'beta',\n 'type': 'number',\n 'defaultValue': 0.5\n }\n]\n },\n {\n 'tfOpName': 'Softmax',\n 'category': 'normalization',\n 'inputs':\n [{'start': 0, 'name': 'x', 'type': 'tensor'}]\n },\n {\n 'tfOpName': 'LogSoftmax',\n 'category': 'normalization',\n 'inputs': [{'start': 0, 'name': 'x', 'type': 'tensor'}]\n },\n {\n 'tfOpName': 'SparseToDense',\n 'category': 'normalization',\n 'inputs': [\n {'start': 0, 'name': 'sparseIndices', 'type': 'tensor'},\n {'start': 1, 'name': 'outputShape', 'type': 'number[]'},\n {'start': 2, 'name': 'sparseValues', 'type': 'tensor'},\n {'start': 3, 'name': 'defaultValue', 'type': 'tensor'},\n],\n 'attrs': [{\n 'tfName': 'validate_indices',\n 'name': 'validateIndices',\n 'type': 'bool',\n 'defaultValue': true,\n 'notSupported': true\n }]\n }\n];\n","import {OpMapper} from

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'category': 'reduction',\n 'inputs': [\n {'start': 0, 'name': 'x', 'type': 'tensor'},\n {'start': 1, 'name': 'axis', 'type': 'number[]'},\n],\n 'attrs': [{'tfName': 'keep_dims', 'name': 'keepDims', 'type': 'bool'}]\n },\n {\n 'tfOpName': 'All',\n 'category': 'reduction',\n 'inputs': [\n {'start': 0, 'name': 'x', 'type': 'tensor'},\n {'start': 1, 'name': 'axis', 'type': 'number[]'},\n],\n 'attrs': [{'tfName': 'keep_dims', 'name': 'keepDims', 'type': 'bool'}]\n },\n {\n 'tfOpName': 'Any',\n 'category': 'reduction',\n 'inputs': [\n {'start': 0, 'name': 'x', 'type': 'tensor'},\n {'start': 1, 'name': 'axis', 'type': 'number[]'},\n],\n 'attrs': [{'tfName': 'keep_dims', 'name': 'keepDims', 'type': 'bool'}]\n },\n {\n 'tfOpName': 'ArgMax',\n 'category': 'reduction',\n 'inputs': [\n {'start': 0, 'name': 'x', 'type': 'tensor'},\n {'start': 1, 'name': 'axis', 'type': 'number'}\n]\n },\n
{\n 'tfOpName': 'ArgMin',\n 'category': 'reduction',\n 'inputs': [\n {'start': 0, 'name': 'x', 'type': 'tensor'},\n {'start': 1, 'name': 'axis', 'type': 'number'}\n]\n },\n {\n 'tfOpName': 'Prod',\n 'category': 'reduction',\n 'inputs': [\n {'start': 0, 'name': 'x', 'type': 'tensor'},\n {'start': 1, 'name': 'axis', 'type': 'number[]'},\n],\n 'attrs': [{'tfName': 'keep_dims', 'name': 'keepDims', 'type': 'bool'}]\n },\n {\n 'tfOpName': 'Cumsum',\n 'category': 'reduction',\n 'inputs': [\n {'start': 0, 'name': 'x', 'type': 'tensor'},\n {'start': 1, 'name': 'axis', 'type': 'number'},\n],\n 'attrs': [\n {'tfName': 'exclusive', 'name': 'exclusive', 'type': 'bool'},\n {'tfName': 'reverse', 'name': 'reverse', 'type': 'bool'}\n]\n }\n];\n","import {OpMapper} from '../types';\n\n/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n
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'inputs': [\n {'start': 1, 'end': 0, 'name': 'tensors', 'type': 'tensors'},\n {'start': 0, 'name': 'axis', 'type': 'number'}\n],\n 'attrs': [{'tfName': 'N', 'name': 'n', 'type': 'number', 'defaultValue': 2}]\n\n },\n {\n 'tfOpName':

'GatherV2',\n 'category': 'slice_join',\n 'inputs': [\n {'start': 0, 'name': 'x', 'type': 'tensor'},\n {'start': 1, 'name': 'indices', 'type': 'tensor'},\n {'start': 2, 'name': 'axis', 'type': 'number', 'defaultValue': 0}\n],\n 'attrs': [{\n 'tfName': 'batch_dims',\n 'name': 'batchDims',\n 'type': 'number',\n 'defaultValue': 0\n }]\n },\n {\n 'tfOpName': 'Gather',\n 'category': 'slice_join',\n 'inputs': [\n {'start': 0, 'name': 'x', 'type': 'tensor'},\n {'start': 1, 'name': 'indices', 'type': 'tensor'},\n],\n 'attrs': [{\n 'tfName': 'validate_indices',\n 'name': 'validateIndices',\n 'type': 'bool',\n 'notSupported': true\n }]\n },\n {\n 'tfOpName': 'Reverse',\n 'category': 'slice_join',\n 'inputs': [\n {'start': 0, 'name': 'x', 'type': 'tensor'},\n {'start': 1, 'name': 'dims', 'type': 'bool[]'}\n]\n },\n {\n 'tfOpName': 'ReverseV2',\n 'category': 'slice_join',\n 'inputs': [\n {'start': 0, 'name': 'x', 'type': 'tensor'},\n {'start': 1, 'name': 'axis', 'type': 'number[]'}\n]\n },\n {\n 'tfOpName': 'Slice',\n 'category': 'slice_join',\n 'inputs': [\n {'start': 0, 'name': 'x', 'type': 'tensor'},\n {'start': 1, 'name': 'begin', 'type': 'number[]'},\n {'start': 2, 'name': 'size', 'type': 'number[]'}\n]\n },\n {\n 'tfOpName': 'StridedSlice',\n 'category': 'slice_join',\n 'inputs': [\n {'start': 0, 'name': 'x', 'type': 'tensor'},\n {'start': 1, 'name': 'begin', 'type': 'number[]'},\n {'start': 2, 'name': 'end', 'type': 'number[]'},\n {'start': 3, 'name': 'strides', 'type': 'number[]'},\n],\n 'attrs': [\n {\n 'tfName': 'begin_mask',\n 'name': 'beginMask',\n 'type': 'number',\n 'defaultValue': 0\n },\n {\n 'tfName': 'end_mask',\n 'name': 'endMask',\n 'type': 'number',\n 'defaultValue': 0\n },\n {\n 'tfName': 'new_axis_mask',\n 'name': 'newAxisMask',\n 'type': 'number',\n 'defaultValue': 0\n },\n {\n 'tfName': 'ellipsis_mask',\n 'name': 'ellipsisMask',\n 'type': 'number',\n 'defaultValue': 0\n },\n {\n 'tfName': 'shrink_axis_mask',\n 'name': 'shrinkAxisMask',\n 'type': 'number',\n 'defaultValue': 0\n }\n]\n },\n {\n 'tfOpName': 'Pack',\n 'category': 'slice_join',\n 'inputs': [\n {'start': 0, 'end': 0, 'name': 'tensors', 'type': 'tensors'},\n],\n 'attrs': [\n {'tfName': 'axis', 'name': 'axis', 'type': 'number', 'defaultValue': 0}\n]\n },\n {\n 'tfOpName': 'Unpack',\n 'category': 'slice_join',\n 'inputs': [\n {'start': 0, 'name': 'tensor', 'type': 'tensor'},\n],\n 'attrs': [\n {'tfName': 'axis', 'name': 'axis', 'type': 'number', 'defaultValue': 0}, {\n 'tfName': 'num',\n 'name': 'num',\n 'type': 'number',\n 'defaultValue': 0,\n 'notSupported': true\n }\n]\n },\n {\n 'tfOpName': 'Tile',\n 'category': 'slice_join',\n 'inputs': [\n {'start': 0, 'name': 'x', 'type': 'tensor'},\n {'start': 1, 'name': 'reps', 'type': 'number[]'}\n]\n },\n {\n 'tfOpName': 'Split',\n 'category': 'slice_join',\n 'inputs': [\n {'start': 0, 'name': 'axis', 'type': 'number', 'defaultValue': 0},\n {'start': 1, 'name': 'x', 'type': 'tensor'},\n],\n 'attrs': [{\n 'tfName': 'num_split',\n 'name': 'numOrSizeSplits',\n 'type': 'number',\n 'defaultValue': 1\n }]\n },\n {\n 'tfOpName': 'SplitV',\n 'category': 'slice_join',\n 'inputs': [\n {'start': 0, 'name': 'x', 'type': 'tensor'},\n {'start': 1, 'name': 'numOrSizeSplits', 'type': 'number[]'},\n {'start': 2, 'name': 'axis', 'type': 'number', 'defaultValue': 0}\n]\n },\n {\n 'tfOpName': 'ScatterNd',\n 'category': 'slice_join',\n 'inputs': [\n {'start': 0, 'name': 'indices', 'type': 'tensor'},\n {'start': 1, 'name': 'values', 'type': 'tensor'},\n {'start': 2, 'name': 'shape', 'type': 'number[]'}\n]\n },\n {\n 'tfOpName': 'GatherNd',\n 'category': 'slice_join',\n 'inputs': [\n {'start': 0, 'name': 'x', 'type': 'tensor'},\n {'start': 1, 'name': 'indices', 'type': 'tensor'}\n]\n },\n {\n 'tfOpName': 'SparseToDense',\n 'category': 'slice_join',\n 'inputs': [\n {'start': 0, 'name': 'sparseIndices', 'type': 'tensor'},\n {'start': 1, 'name': 'outputShape', 'type': 'number[]'},\n {'start': 2, 'name': 'sparseValues', 'type': 'tensor'},\n {'start': 3, 'name': 'defaultValue', 'type': 'tensor'},\n],\n 'attrs': [{\n 'tfName': 'validate_indices',\n 'name': 'validateIndices',\n 'type': 'bool',\n 'defaultValue': false,\n 'notSupported': true\n }]\n }\n];\n","import {OpMapper} from '../types';\n\n/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n

*/\n\nexport
const json: OpMapper[] = [\n {\n   'tfOpName': 'FFT',\n   'category': 'spectral',\n   'inputs': [{'start': 0, 'name': 'x', 'type': 'tensor'}]\n },\n {\n   'tfOpName': 'IFFT',\n   'category': 'spectral',\n   'inputs': [{'start': 0, 'name': 'x', 'type': 'tensor'}]\n },\n {\n   'tfOpName': 'RFFT',\n   'category': 'spectral',\n   'inputs': [\n   {'start': 0, 'name': 'x', 'type': 'tensor'}, {\n   'start': 1,\n   'name': 'fft_length',\n   'type': 'number',\n   'notSupported': true\n   }\n   ]\n },\n {\n   'tfOpName': 'IRFFT',\n   'category': 'spectral',\n   'inputs': [\n   {'start': 0, 'name': 'x', 'type': 'tensor'}, {\n   'start': 1,\n   'name': 'fft_length',\n   'type': 'number',\n   'notSupported': true\n   }\n   ]\n }\n];\n","import {OpMapper} from '../types';\n\n/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may
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OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language
governing permissions and\n * limitations under the License.\n *
==\n
*/\n\nexport const json: OpMapper[] = [\n {\n   'tfOpName': 'Cast',\n   'category': 'transformation',\n   'inputs': [\n
{'start': 0, 'name': 'x', 'type': 'tensor'},\n   ],\n   'attrs': [\n   {\n   'tfName': 'SrcT',\n   'name': 'sdtype',\n
'type': 'dtype',\n   'notSupported': true\n   },\n   {'tfName': 'DstT', 'name': 'dtype', 'type': 'dtype'}\n   ]\n },\n
{\n   'tfOpName': 'ExpandDims',\n
    'category': 'transformation',\n   'inputs': [\n   {'start': 0, 'name': 'x', 'type': 'tensor'},\n   {'start': 1, 'name': 'axis',
'type': 'number'}\n   ]\n },\n {\n   'tfOpName': 'MirrorPad',\n   'category': 'transformation',\n   'inputs': [\n
{'start': 0, 'name': 'x', 'type': 'tensor'},\n   {'start': 1, 'name': 'padding', 'type': 'number[]'},\n   ],\n   'attrs': [{'tfName':
'mode', 'name': 'mode', 'type': 'string'}]\n },\n {\n   'tfOpName': 'Pad',\n   'category': 'transformation',\n   'inputs':
[\n   {'start': 0, 'name': 'x', 'type': 'tensor'},\n   {'start': 1, 'name': 'padding', 'type': 'number[]'},\n   ],\n   'attrs': [{\n
      'tfName': 'constant_value',\n   'name': 'constantValue',\n   'type': 'number',\n   'defaultValue': 0\n   }]\n },\n
{\n   'tfOpName': 'PadV2',\n   'category': 'transformation',\n   'inputs': [\n   {'start': 0, 'name': 'x', 'type': 'tensor'},\n
      {'start': 1, 'name': 'padding', 'type': 'number[]'},
  {\n   'start': 2,\n   'name': 'constantValue',\n   'type': 'number',\n   'defaultValue': 0\n   }\n   ]\n },\n
{\n   'tfOpName': 'Reshape',\n   'category': 'transformation',\n   'inputs': [\n   {'start': 0, 'name': 'x', 'type':
'tensor'},\n   {'start': 1, 'name': 'shape', 'type': 'number[]'}\n   ]\n },\n {\n   'tfOpName': 'Squeeze',\n   'category':
'transformation',\n   'inputs': [\n   {'start': 0, 'name': 'x', 'type': 'tensor'},\n   ],\n   'attrs': [{\n   'tfName': 'axis',\n
'tfDeprecatedName': 'squeeze_dims',\n   'name': 'axis',\n   'type': 'number[]'\n   }]\n },\n {\n   'tfOpName':
'SpaceToBatchND',\n   'category': 'transformation',\n   'inputs': [\n   {'start': 0, 'name': 'x', 'type': 'tensor'},\n
{'start': 1, 'name': 'blockShape', 'type': 'number[]'},\n   {'start': 2, 'name': 'paddings', 'type': 'number[]'}\n   ]\n },\n
{\n   'tfOpName': 'BatchToSpaceND',\n   'category': 'transformation',\n   'inputs':
  [\n   {'start': 0, 'name': 'x', 'type': 'tensor'},\n   {'start': 1, 'name': 'blockShape', 'type': 'number[]'},\n   {'start': 2,
'name': 'crops', 'type': 'number[]'}\n   ]\n },\n {\n   'tfOpName': 'DepthToSpace',\n   'category': 'transformation',\n
'inputs': [\n   {'start': 0, 'name': 'x', 'type': 'tensor'},\n   ],\n   'attrs': [\n   {'tfName': 'block_size', 'name':
'blockSize', 'type': 'number'},\n   {'tfName': 'data_format', 'name': 'dataFormat', 'type': 'string'}\n   ]\n },\n {\n
'tfOpName': 'BroadcastTo',\n   'category': 'transformation',\n   'inputs': [\n   {'start': 0, 'name': 'x', 'type': 'tensor'},\n
    {'start': 1, 'name': 'shape', 'type': 'number[]'},\n   ],\n   'attrs': []\n }\n];\n","/**\n * @license\n * Copyright 2018
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language governing permissions and\n * limitations under the License.\n *
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*/\n\nimport {DataType, env} from '@tensorflow/tfjs-core';\n\nimport * as tensorflow from
'../data/compiled_api';\n\nimport {getRegisteredOp} from './custom_op/register';\nimport {getNodeNameAndIndex}
from './executors/utils';\nimport * as arithmetic from './op_list/arithmetic';\nimport * as basicMath from
'./op_list/basic_math';\nimport * as control from './op_list/control';\nimport * as convolution from
'./op_list/convolution';\nimport * as creation from './op_list/creation';\nimport * as dynamic from
'./op_list/dynamic';\nimport
 * as evaluation from './op_list/evaluation';\nimport * as graph from './op_list/graph';\nimport * as hashTable from
'./op_list/hash_table';\nimport * as image from './op_list/image';\nimport * as logical from './op_list/logical';\nimport
* as matrices from './op_list/matrices';\nimport * as normalization from './op_list/normalization';\nimport * as
reduction from './op_list/reduction';\nimport * as sliceJoin from './op_list/slice_join';\nimport * as spectral from
'./op_list/spectral';\nimport * as transformation from './op_list/transformation';\nimport {Graph, InputParamValue,
Node, OpMapper, ParamValue} from './types';\n\nexport class OperationMapper {\n  private static _instance:
OperationMapper;\n\n  private opMappers: {[key: string]: OpMapper};\n\n  // Singleton instance for the mapper\n
public static get Instance() {\n    return this._instance || (this._instance = new this());\n  }\n\n  // Loads the op
mapping from the JSON file.\n  private constructor() {\n    const ops
 = [\n      arithmetic, basicMath, control, convolution, creation, dynamic,\n      evaluation, logical, image, graph,
matrices, normalization, reduction,\n      sliceJoin, spectral, transformation, hashTable\n    ];\n    const mappersJson:
OpMapper[] = [].concat(...ops.map(op => op.json));\n\n    this.opMappers = mappersJson.reduce<{[key: string]:
OpMapper}>(\n        (map, mapper: OpMapper) => {\n          map[mapper.tfOpName] = mapper;\n          return
map;\n        },\n        {});\n  }\n\n  // Converts the model inference graph from Tensorflow GraphDef to local\n  //
representation for TensorFlow.js API\n  transformGraph(\n      graph: tensorflow.IGraphDef,\n      signature:
tensorflow.ISignatureDef = {}): Graph {\n    const tfNodes = graph.node;\n    const placeholders: Node[] = [];\n
const weights: Node[] = [];\n    const initNodes: Node[] = [];\n    const nodes = tfNodes.reduce<{[key: string]:
Node}>((map, node) => {\n      map[node.name] = this.mapNode(node);\n      if (node.op.startsWith('Placeholder'))
 {\n        placeholders.push(map[node.name]);\n      } else if (node.op === 'Const') {\n
weights.push(map[node.name]);\n      } else if (node.input == null || node.input.length === 0) {\n
initNodes.push(map[node.name]);\n      }\n      return map;\n    }, {});\n\n    let inputs: Node[] = [];\n    const outputs:
Node[] = [];\n    let inputNodeNameToKey: {[key: string]: string} = {};\n    let outputNodeNameToKey: {[key:
string]: string} = {};\n    if (signature != null) {\n      inputNodeNameToKey =
this.mapSignatureEntries(signature.inputs);\n      outputNodeNameToKey =
this.mapSignatureEntries(signature.outputs);\n    }\n    const allNodes = Object.keys(nodes);\n
allNodes.forEach(key => {\n      const node = nodes[key];\n      node.inputNames.forEach(name => {\n        const
[nodeName, ] = getNodeNameAndIndex(name);\n        node.inputs.push(nodes[nodeName]);\n
nodes[nodeName].children.push(node);\n      });\n    });\n\n    // if
 signature has not outputs set, add any node that does not have\n    // outputs.\n    if
(Object.keys(outputNodeNameToKey).length === 0) {\n      allNodes.forEach(key => {\n        const node =
nodes[key];\n        if (node.children.length === 0) {\n          outputs.push(node);\n        }\n      });\n    } else {\n
Object.keys(outputNodeNameToKey).forEach(name => {\n        const [nodeName, ] =
getNodeNameAndIndex(name);\n        const node = nodes[nodeName];\n        if (node != null) {\n
node.signatureKey = outputNodeNameToKey[name];\n          outputs.push(node);\n        }\n      });\n    }\n\n    if
(Object.keys(inputNodeNameToKey).length > 0) {\n      Object.keys(inputNodeNameToKey).forEach(name => {\n
    const [nodeName, ] = getNodeNameAndIndex(name);\n        const node = nodes[nodeName];\n        if (node) {\n
        node.signatureKey = inputNodeNameToKey[name];\n          inputs.push(node);\n        }\n      });\n    } else {\n
 inputs = placeholders;\n
    }\n\n    let functions = {};\n    if (graph.library != null && graph.library.function != null) {\n      functions =
graph.library.function.reduce((functions, func) => {\n        functions[func.signature.name] =
this.mapFunction(func);\n        return functions;\n      }, {} as {[key: string]: Graph});\n    }\n\n    const result: Graph
=\n        {nodes, inputs, outputs, weights, placeholders, signature, functions};\n\n    if (initNodes.length > 0) {\n
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result.initNodes = initNodes;\n  }\n\n  return result;\n }\n\n private mapSignatureEntries(entries: {[k: string]: tensorflow.ITensorInfo}) {\n  return Object.keys(entries || {})\n  .reduce<{[key: string]: string}>((prev, curr) => {\n  prev[entries[curr].name] = curr;\n  return prev;\n  }, {});\n }\n\n private mapNode(node: tensorflow.INodeDef): Node {\n  // Unsupported ops will cause an error at run-time (not parse time), since\n  // they may not be used by the actual execution subgraph.\n
  const mapper =\n  getRegisteredOp(node.op) || this.opMappers[node.op] || {} as OpMapper;\n  if (node.attr == null) {\n  node.attr = {};\n  }\n\n  const newNode: Node = {\n  name: node.name,\n  op: node.op,\n  category: mapper.category,\n  inputNames:\n  (node.input ||\n  []).map(input => input.startsWith('^') ? input.substr(1) : input),\n  inputs: [],\n  children: [],\n  inputParams: {},\n  attrParams: {},\n  rawAttrs: node.attr\n  };\n\n  if (mapper.inputs != null) {\n  newNode.inputParams =\n  mapper.inputs.reduce<{[key: string]: InputParamValue}>(\n  (map, param) => {\n  map[param.name] = {\n  type: param.type,\n  inputIndexStart: param.start,\n  inputIndexEnd: param.end\n  };\n  return map;\n  },\n  {});\n  }\n  if (mapper.attrs != null) {\n  newNode.attrParams =\n  mapper.attrs.reduce<{[key: string]: ParamValue}>((map, param) => {\n  const type = param.type;\n  let value = undefined;\n  switch (param.type) {\n  case 'string':\n  value = getStringParam(\n  node.attr, param.tfName, param.defaultValue as string);\n\n  if (value === undefined && !!param.tfDeprecatedName) {\n  value = getStringParam(\n  node.attr, param.tfDeprecatedName,\n  param.defaultValue as string);\n  }\n  break;\n  case 'string[]':\n  value = getStringArrayParam(\n  node.attr, param.tfName, param.defaultValue as string[]);\n\n  if (value === undefined && !!param.tfDeprecatedName) {\n  value = getStringArrayParam(\n  node.attr, param.tfDeprecatedName,\n  param.defaultValue as string[]);\n  }\n  break;\n  case 'number':\n  value = getNumberParam(\n  node.attr, param.tfName,\n  (param.defaultValue || 0) as number);\n  if (value === undefined && !!param.tfDeprecatedName) {\n  value = getNumberParam(\n  node.attr, param.tfDeprecatedName,\n  param.defaultValue as number);\n  }\n  break;\n  case 'number[]':\n  value = getNumericArrayParam(\n  node.attr, param.tfName, param.defaultValue as number[]);\n  if (value === undefined && !!param.tfDeprecatedName) {\n  value = getNumericArrayParam(\n  node.attr, param.tfDeprecatedName,\n  param.defaultValue as number[]);\n  }\n  break;\n  case 'bool':\n  value = getBoolParam(\n  node.attr, param.tfName, param.defaultValue as boolean);\n  if (value === undefined && !!param.tfDeprecatedName) {\n  value = getBoolParam(\n  node.attr, param.tfDeprecatedName,\n  param.defaultValue as boolean);\n  }\n  break;\n  case 'bool[]':\n  value = getBoolArrayParam(\n  node.attr, param.tfName, param.defaultValue as boolean[]);\n  if (value === undefined && !!param.tfDeprecatedName) {\n  value = getBoolArrayParam(\n  node.attr, param.tfDeprecatedName,\n  param.defaultValue as boolean[]);\n  }\n  break;\n  case 'shape':\n  value = getTensorShapeParam(\n  node.attr, param.tfName, param.defaultValue as number[]);\n  if (value === undefined && !!param.tfDeprecatedName) {\n
  value = getTensorShapeParam(\n  node.attr, param.tfDeprecatedName,\n  param.defaultValue as number[]);\n  }\n  break;\n  case 'shape[]':\n  value = getTensorShapeArrayParam(\n  node.attr, param.tfName, param.defaultValue as number[][]);\n  if (value === undefined && !!param.tfDeprecatedName) {\n  value = getTensorShapeArrayParam(\n  node.attr, param.tfDeprecatedName,\n  param.defaultValue as number[][]);\n  }\n  break;\n  case 'dtype':\n  value = getDtypeParam(\n  node.attr, param.tfName, param.defaultValue as DataType);\n  if (value === undefined && !!param.tfDeprecatedName) {\n  value = getDtypeParam(\n  node.attr, param.tfDeprecatedName,\n  param.defaultValue
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as DataType);\n }\n break;\n case 'dtype[]':\n value = getDtypeArrayParam(\n node.attr, param.tfName, param.defaultValue as DataType[]);\n if (value === undefined &&
!!param.tfDeprecatedName) {\n value = getDtypeArrayParam(\n node.attr,
param.tfDeprecatedName,\n param.defaultValue as DataType[]);\n }\n break;\n
case 'func':\n value = getFuncParam(\n node.attr, param.tfName, param.defaultValue as
string);\n if (value === undefined && !!param.tfDeprecatedName) {\n value = getFuncParam(\n
node.attr, param.tfDeprecatedName,\n param.defaultValue as string);\n }\n
break;\n case 'tensor':\n case 'tensors':\n break;\n
default:\n throw new Error(\n `Unsupported param type: ${param.type} for op:
${node.op}`);\n }\n map[param.name] = {value, type};\n return map;\n }, {});\n }\n
return newNode;\n }\n\n // map the TFunctionDef to TFJS graph object\n private mapFunction(functionDef:
tensorflow.IFunctionDef): Graph {\n const tfNodes = functionDef.nodeDef;\n const placeholders: Node[] = [];\n
const weights: Node[] = [];\n let nodes: {[key: string]: Node} = {};\n if (tfNodes != null) {\n nodes =
tfNodes.reduce<{[key: string]: Node}>((map, node) => {\n map[node.name] = this.mapNode(node);\n if
(node.op === 'Const') {\n weights.push(map[node.name]);\n }\n return map;\n }, {});\n }\n
const inputs: Node[] = [];\n const outputs: Node[] = [];\n\n functionDef.signature.inputArg.forEach(arg => {\n
const [nodeName, ] = getNodeNameAndIndex(arg.name);\n
const node: Node = {\n name: nodeName,\n op: 'Placeholder',\n inputs: [],\n inputNames: [],\n
category: 'graph',\n inputParams: {},\n attrParams: {dtype: {value: parseDtypeParam(arg.type), type:
'dtype'}},\n children: []\n };\n node.signatureKey = arg.name;\n inputs.push(node);\n
nodes[nodeName] = node;\n });\n\n const allNodes = Object.keys(nodes);\n allNodes.forEach(key => {\n
const node = nodes[key];\n node.inputNames.forEach(name => {\n const [nodeName, ] =
getNodeNameAndIndex(name);\n node.inputs.push(nodes[nodeName]);\n
nodes[nodeName].children.push(node);\n });\n });\n\n const returnNodeMap = functionDef.ret;\n\n
functionDef.signature.outputArg.forEach(output => {\n const [nodeName, index] =
getNodeNameAndIndex(returnNodeMap[output.name]);\n const node = nodes[nodeName];\n if (node != null)
{\n node.defaultOutput
= index;\n outputs.push(node);\n }\n });\n\n const signature = this.mapArgsToSignature(functionDef);\n
return {nodes, inputs, outputs, weights, placeholders, signature};\n }\n\n private
mapArgsToSignature(functionDef: tensorflow.IFunctionDef):\n tensorflow.ISignatureDef {\n return {\n
methodName: functionDef.signature.name,\n inputs: functionDef.signature.inputArg.reduce(\n (map, arg)
=> {\n map[arg.name] = this.mapArgToTensorInfo(arg);\n return map;\n },\n {} as {[key:
string]: tensorflow.ITensorInfo}),\n outputs: functionDef.signature.outputArg.reduce(\n (map, arg) => {\n
map[arg.name] = this.mapArgToTensorInfo(arg, functionDef.ret);\n return map;\n },\n {} as
{[key: string]: tensorflow.ITensorInfo}),\n };\n }\n\n private mapArgToTensorInfo(\n arg:
tensorflow.OpDef.IArgDef,\n nameMap?: {[key: string]: string}): tensorflow.ITensorInfo
{\n let name = arg.name;\n if (nameMap != null) {\n name = nameMap[name];\n }\n return {name,
dtype: arg.type};\n }\n}\n\nexport function decodeBase64(text: string): string {\n const global = env().global;\n if
(typeof global.atob !== 'undefined') {\n return global.atob(text);\n } else if (typeof Buffer !== 'undefined') {\n
return new Buffer(text, 'base64').toString();\n } else {\n throw new Error(\n 'Unable to decode base64 in this
environment. ' +\n 'Missing built-in atob() or Buffer()');\n }\n}\n\nexport function parseStringParam(s: []|string,
keepCase: boolean): string {\n const value =\n Array.isArray(s) ? String.fromCharCode.apply(null, s) :
decodeBase64(s);\n return keepCase ? value : value.toLowerCase();\n}\n\nexport function getStringParam(\n
attrs: {[key: string]: tensorflow.IAttrValue}, name: string, def: string,\n keepCase = false): string {\n const param
= attrs[name];\n if (param != null) {\n return
parseStringParam(param.s, keepCase);\n }\n return def;\n}\n\nexport function getBoolParam(\n attrs: {[key:
string]: tensorflow.IAttrValue}, name: string,\n def: boolean): boolean {\n const param = attrs[name];\n return
param ? param.b : def;\n}\n\nexport function getNumberParam(\n attrs: {[key: string]: tensorflow.IAttrValue},
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name: string,\n def: number): number {\n const param = attrs[name] || {};\n const value =\n param['i'] != null ? param['i'] : (param['f'] != null ? param['f'] : def);\n return (typeof value === 'number') ? value : parseInt(value, 10);\n}\n\nexport function parseDtypeParam(value: string|tensorflow.DataType): DataType {\n if (typeof (value) === 'string') {\n // tslint:disable-next-line:no-any\n value = tensorflow.DataType[value as any];\n }\n switch (value) {\n case tensorflow.DataType.DT_FLOAT:\n return 'float32';\n case tensorflow.DataType.DT_INT32:\n case tensorflow.DataType.DT_INT64:\n case tensorflow.DataType.DT_INT8:\n
  case tensorflow.DataType.DT_UINT8:\n return 'int32';\n case tensorflow.DataType.DT_BOOL:\n return 'bool';\n case tensorflow.DataType.DT_DOUBLE:\n return 'float32';\n case tensorflow.DataType.DT_STRING:\n return 'string';\n default:\n // Unknown dtype error will happen at runtime (instead of parse time),\n // since these nodes might not be used by the actual subgraph execution.\n return null;\n }\n}\n\nexport function getFuncParam(\n attrs: {[key: string]: tensorflow.IAttrValue}, name: string,\n def: string): string {\n const param = attrs[name];\n if (param && param.func) {\n return param.func.name;\n }\n return def;\n}\n\nexport function getDtypeParam(\n attrs: {[key: string]: tensorflow.IAttrValue}, name: string,\n def: DataType): DataType {\n const param = attrs[name];\n if (param && param.type) {\n return parseDtypeParam(param.type);\n }\n return def;\n}\n\nexport function getDtypeArrayParam(\n
  attrs: {[key: string]: tensorflow.IAttrValue}, name: string,\n def: DataType[]): DataType[] {\n const param = attrs[name];\n if (param && param.list && param.list.type) {\n return param.list.type.map(v => parseDtypeParam(v));\n }\n return def;\n}\n\nexport function parseTensorShapeParam(shape: tensorflow.ITensorShape): number[]|\n undefined {\n if (shape.unknownRank) {\n return undefined;\n }\n if (shape.dim != null) {\n return shape.dim.map(\n dim =>\n (typeof dim.size === 'number') ? dim.size : parseInt(dim.size, 10));\n }\n return [];\n}\n\nexport function getTensorShapeParam(\n attrs: {[key: string]: tensorflow.IAttrValue}, name: string,\n def?: number[]): number[]|undefined {\n const param = attrs[name];\n if (param && param.shape) {\n return parseTensorShapeParam(param.shape);\n }\n return def;\n}\n\nexport function getNumericArrayParam(\n attrs: {[key: string]: tensorflow.IAttrValue}, name: string,\n def: number[]): number[] {\n const param = attrs[name];\n if (param) {\n return ((param.list.f && param.list.f.length ? param.list.f :\n param.list.i) ||\n [])\n .map(v => (typeof v === 'number') ? v : parseInt(v, 10));\n }\n return def;\n}\n\nexport function getStringArrayParam(\n attrs: {[key: string]: tensorflow.IAttrValue}, name: string, def: string[],\n keepCase = false): string[] {\n const param = attrs[name];\n if (param && param.list && param.list.s) {\n return param.list.s.map((v) => {\n return parseStringParam(v, keepCase);\n });\n }\n return def;\n}\n\nexport function getTensorShapeArrayParam(\n attrs: {[key: string]: tensorflow.IAttrValue}, name: string,\n def: number[][]): number[][] {\n const param = attrs[name];\n if (param && param.list && param.list.shape) {\n return param.list.shape.map((v) => {\n return parseTensorShapeParam(v);\n });\n }\n return def;\n}\n\nexport function
  getBoolArrayParam(\n attrs: {[key: string]: tensorflow.IAttrValue}, name: string,\n def: boolean[]): boolean[] {\n const param = attrs[name];\n if (param && param.list && param.list.b) {\n return param.list.b;\n }\n return def;\n}\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n
*/\n\nimport {DataType, Tensor}
  from '@tensorflow/tfjs-core';\n\nimport {NamedTensorsMap} from '../../data/types';\nimport {ExecutionContext} from '../../executor/execution_context';\nimport {getTensor} from '../executors/utils';\nimport {getBoolArrayParam, getBoolParam, getDtypeArrayParam, getDtypeParam, getNumberParam, getNumericArrayParam,

getStringArrayParam, getStringParam, getTensorShapeArrayParam, getTensorShapeParam} from '../operation_mapper';\nimport {GraphNode, Node, ValueType} from '../types';\n\n/**\n * Helper class for lookup inputs and params for nodes in the model graph.\n */\nexport class NodeValueImpl implements GraphNode {\n public readonly inputs: Tensor[] = [];\n public readonly attrs: {[key: string]: ValueType} = {};\n constructor(\n private node: Node, private tensorMap: NamedTensorsMap,\n private context: ExecutionContext) {\n this.inputs = node.inputNames.map(name => this.getInput(name));\n if (node.rawAttrs != null) {\n this.attrs = Object.keys(node.rawAttrs)\n .reduce((attrs: {[key: string]: ValueType}, key) => {\n attrs[key] = this.getAttr(key);\n return attrs;\n }, {});\n }\n }\n\n /**\n * Return the value of the attribute or input param.\n * @param name String: name of attribute or input param.\n */\n private getInput(name: string): Tensor {\n return getTensor(name, this.tensorMap, this.context);\n }\n\n /**\n * Return the value of the attribute or input param.\n * @param name String: name of attribute or input param.\n */\n private getAttr(name: string, defaultValue?: ValueType): ValueType {\n const value = this.node.rawAttrs[name];\n if (value.tensor != null) {\n return getTensor(name, this.tensorMap, this.context);\n }\n if (value.i != null || value.f != null) {\n return getNumberParam(this.node.rawAttrs, name, defaultValue as number);\n }\n if (value.s != null) {\n return getStringParam(this.node.rawAttrs,
name, defaultValue as string);\n }\n if (value.b != null) {\n return getBoolParam(this.node.rawAttrs, name, defaultValue as boolean);\n }\n if (value.shape != null) {\n return getTensorShapeParam(\n this.node.rawAttrs, name, defaultValue as number[]);\n }\n if (value.type != null) {\n return getDtypeParam(this.node.rawAttrs, name, defaultValue as DataType);\n }\n if (value.list != null) {\n if (value.list.i != null || value.list.f != null) {\n return getNumericArrayParam(\n this.node.rawAttrs, name, defaultValue as number[]);\n }\n if (value.list.s != null) {\n return getStringArrayParam(\n this.node.rawAttrs, name, defaultValue as string[]);\n }\n if (value.list.shape != null) {\n return getTensorShapeArrayParam(\n this.node.rawAttrs, name, defaultValue as number[][]);\n }\n if (value.list.b != null) {\n return getBoolArrayParam(\n this.node.rawAttrs, name, defaultValue as boolean[]);\n }\n if (value.list.type != null) {\n return getDtypeArrayParam(\n this.node.rawAttrs, name, defaultValue as DataType[]);\n }\n }\n\n return defaultValue;\n }\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\n/**\n
* This file exports ops used by the converters executors. By default it\n * re-exports all ops. In a custom build this is aliased to a file that will\n * only exports ops for a given model.json.\n */\nexport * from './ops';\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {Tensor} from '@tensorflow/tfjs-core';\n//
tslint:disable-next-line: no-imports-from-dist\nimport * as tfOps from '@tensorflow/tfjs-core/dist/ops/ops_for_converter';\n\nimport {NamedTensorsMap} from '../../data/types';\nimport

{ExecutionContext} from '../../executor/execution_context';\nimport {InternalOpExecutor, Node} from '../types';\n\nimport {getParamValue} from './utils';\n\nexport const executeOp: InternalOpExecutor =\n (node: Node, tensorMap: NamedTensorsMap,\n context: ExecutionContext): Tensor[] => {\n switch (node.op) {\n case 'BiasAdd':\n case 'AddV2':\n case 'Add': {\n return [tfOps.add(\n (getParamValue('a', node, tensorMap, context) as Tensor),\n getParamValue('b', node, tensorMap, context) as Tensor)];\n }\n case 'AddN': {\n return [tfOps.addN((\n getParamValue('tensors', node, tensorMap, context) as Tensor[]))];\n }\n case 'FloorMod':\n case 'Mod':\n return [tfOps.mod(\n getParamValue('a', node, tensorMap, context) as Tensor,\n getParamValue('b', node, tensorMap, context) as Tensor)];\n case 'Mul':\n return [tfOps.mul(\n getParamValue('a', node, tensorMap, context) as Tensor,\n getParamValue('b', node, tensorMap, context) as Tensor)];\n case 'RealDiv':\n case 'Div': {\n return [tfOps.div(\n getParamValue('a', node, tensorMap, context) as Tensor,\n getParamValue('b', node, tensorMap, context) as Tensor)];\n }\n case 'DivNoNan': {\n return [tfOps.divNoNan(\n getParamValue('a', node, tensorMap, context) as Tensor,\n getParamValue('b', node, tensorMap, context) as Tensor)];\n }\n case 'FloorDiv': {\n return [tfOps.floorDiv(\n getParamValue('a', node, tensorMap, context) as Tensor,\n getParamValue('b', node, tensorMap, context) as Tensor)];\n }\n case 'Sub': {\n return [tfOps.sub(\n getParamValue('a', node, tensorMap, context) as Tensor,\n getParamValue('b', node, tensorMap, context) as Tensor)];\n }\n case 'Minimum': {\n return [tfOps.minimum(\n getParamValue('a', node, tensorMap, context) as Tensor,\n getParamValue('b', node, tensorMap, context) as Tensor)];\n }\n case 'Maximum': {\n return [tfOps.maximum(\n getParamValue('a', node, tensorMap, context) as Tensor,\n getParamValue('b', node, tensorMap, context) as Tensor)];\n }\n case 'Pow': {\n return [tfOps.pow(\n getParamValue('a', node, tensorMap, context) as Tensor,\n getParamValue('b', node, tensorMap, context) as Tensor)];\n }\n case 'SquaredDifference': {\n return [tfOps.squaredDifference(\n getParamValue('a', node, tensorMap, context)\n as Tensor,\n getParamValue('b', node, tensorMap, context) as Tensor)];\n }\n default:\n throw TypeError(`Node type ${node.op} is not implemented`);\n }\n };\n\nexport const CATEGORY = 'arithmetic';\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {Tensor} from '@tensorflow/tfjs-core';\n// tslint:disable-next-line: no-imports-from-dist\nimport * as tfOps from '@tensorflow/tfjs-core/dist/ops/ops_for_converter';\n\nimport {NamedTensorsMap} from '../../data/types';\nimport {ExecutionContext} from '../../executor/execution_context';\nimport {InternalOpExecutor, Node} from '../types';\n\nimport {getParamValue, getTensor} from './utils';\n\nexport const executeOp: InternalOpExecutor =\n (node: Node, tensorMap: NamedTensorsMap,\n context: ExecutionContext): Tensor[] => {\n switch (node.op) {\n case 'Abs':\n case 'ComplexAbs':\n return [tfOps.abs(\n getParamValue('x', node, tensorMap, context) as Tensor)];\n case 'Acos':\n return [tfOps.acos(\n getParamValue('x', node, tensorMap, context) as Tensor)];\n case 'Acosh':\n return [tfOps.acosh(\n getParamValue('x', node, tensorMap, context) as Tensor)];\n case 'Asin':\n return [tfOps.asin(\n getParamValue('x', node, tensorMap, context) as Tensor)];\n case 'Asinh':\n return [tfOps.asinh(\n getParamValue('x', node, tensorMap, context) as Tensor)];\n case 'Atan':\n return [tfOps.atan(\n getParamValue('x', node, tensorMap, context) as Tensor)];\n case 'Atan2':\n return [tfOps.atan2(\n

getParamValue('x', node, tensorMap, context) as Tensor,\n getParamValue('y', node, tensorMap, context) as Tensor)];\n case 'Atanh':\n return [tfOps.atanh(\n getParamValue('x', node, tensorMap, context) as Tensor)];\n case 'Ceil':\n return [tfOps.ceil(\n getParamValue('x', node, tensorMap, context) as Tensor)];\n case 'Complex':\n return [tfOps.complex(\n getParamValue('real', node, tensorMap, context) as Tensor,\n getParamValue('imag', node, tensorMap, context) as Tensor)];\n case 'Cos':\n return [tfOps.cos(\n getParamValue('x', node, tensorMap, context) as Tensor)];\n case 'Cosh':\n return [tfOps.cosh(\n getParamValue('x', node, tensorMap, context) as Tensor)];\n case 'Elu':\n return [tfOps.elu(\n getParamValue('x', node, tensorMap, context) as Tensor)];\n case 'Erf':\n return [tfOps.erf(\n getParamValue('x', node, tensorMap, context) as Tensor)];\n case 'Exp':\n return [tfOps.exp(\n getParamValue('x', node, tensorMap, context) as Tensor)];\n case 'Expm1': {\n return [tfOps.expm1(\n getParamValue('x', node, tensorMap, context) as Tensor)];\n }\n case 'Floor':\n return [tfOps.floor(\n getParamValue('x', node, tensorMap, context) as Tensor)];\n case 'Log':\n return [tfOps.log(\n getParamValue('x', node, tensorMap, context) as Tensor)];\n case 'Log1p': {\n return [tfOps.log1p(\n getParamValue('x', node, tensorMap, context) as Tensor)];\n }\n case 'Imag':\n return [tfOps.imag(\n getParamValue('x', node, tensorMap, context) as Tensor)];\n\n case 'Neg':\n return [tfOps.neg(\n getParamValue('x', node, tensorMap, context) as Tensor)];\n case 'Reciprocal': {\n return [tfOps.reciprocal(\n getParamValue('x', node, tensorMap, context) as Tensor)];\n }\n case 'Real':\n return [tfOps.real(\n getParamValue('x', node, tensorMap, context) as Tensor)];\n case 'Relu':\n return [tfOps.relu(\n getParamValue('x', node, tensorMap, context) as Tensor)];\n case 'Round': {\n return [tfOps.round(\n getParamValue('x', node, tensorMap, context) as Tensor)];\n }\n case 'Selu':\n return [tfOps.selu(\n getParamValue('x', node, tensorMap, context) as Tensor)];\n case 'Sigmoid':\n return [tfOps.sigmoid(\n getParamValue('x', node, tensorMap, context) as Tensor)];\n case 'Sin':\n return [tfOps.sin(\n getParamValue('x', node, tensorMap, context) as Tensor)];\n case 'Sign': {\n return [tfOps.sign(\n getParamValue('x', node, tensorMap, context) as Tensor)];\n }\n case 'Sinh': {\n return [tfOps.sinh(\n getParamValue('x', node, tensorMap, context) as Tensor)];\n }\n case 'Softplus': {\n return [tfOps.softplus(\n getParamValue('x', node, tensorMap, context) as Tensor)];\n }\n case 'Sqrt': {\n return [tfOps.sqrt(\n getParamValue('x', node, tensorMap, context) as Tensor)];\n }\n case 'Square': {\n return [tfOps.square(\n getParamValue('x', node, tensorMap, context)\n as Tensor)];\n }\n case 'Tanh': {\n return [tfOps.tanh(\n getParamValue('x', node, tensorMap, context) as Tensor)];\n }\n case 'Tan':\n return [tfOps.tan(\n getParamValue('x', node, tensorMap, context) as Tensor)];\n case 'ClipByValue':\n return [tfOps.clipByValue(\n getParamValue('x', node, tensorMap, context) as Tensor,\n getParamValue('clipValueMin', node, tensorMap, context) as number,\n getParamValue('clipValueMax', node, tensorMap, context) as\n number)];\n case 'Relu6':\n return [tfOps.relu6(\n getParamValue('x', node, tensorMap, context) as Tensor)];\n case 'Rsqrt':\n return [tfOps.rsqrt(\n getTensor(node.inputNames[0], tensorMap, context))];\n case 'Prod':\n return [tfOps.prod(\n getParamValue('x', node, tensorMap, context) as Tensor,\n getParamValue('axes', node, tensorMap, context) as number[])];\n case 'LeakyRelu':\n return [tfOps.leakyRelu(\n getParamValue('x', node, tensorMap, context) as Tensor,\n getParamValue('alpha', node, tensorMap, context) as number)];\n case 'Prelu':\n return [tfOps.prelu(\n getParamValue('x', node, tensorMap, context) as Tensor,\n getParamValue('alpha', node, tensorMap, context) as Tensor)];\n default:\n throw TypeError(`Node type ${node.op} is not implemented`);\n }\n};\n\nexport const CATEGORY = 'basic_math';\n","\n/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n *

http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ===\n */\n/**\n * This differs from util.assertShapesMatch in that it allows values of\n * negative one, an undefined size of a dimensinon, in a shape to match\n * anything.\n */\n\nimport {Tensor, util} from '@tensorflow/tfjs-core';\n\n/**\n * Used by TensorList and TensorArray to verify if elementShape matches, support\n * negative value as the dim shape.\n * @param shapeA\n * @param shapeB\n * @param errorMessagePrefix\n */\nexport function assertShapesMatchAllowUndefinedSize(\n shapeA: number|number[], shapeB: number|number[],\n errorMessagePrefix = ''): void {\n // constant shape means unknown rank\n if (typeof shapeA === 'number' || typeof shapeB === 'number') {\n return;\n }\n util.assert(\n shapeA.length === shapeB.length,\n () => errorMessagePrefix + ` Shapes ${shapeA} and ${shapeB} must match`);\n for (let i = 0; i < shapeA.length; i++) {\n const dim0 = shapeA[i];\n const dim1 = shapeB[i];\n util.assert(\n dim0 < 0 || dim1 < 0 || dim0 === dim1,\n () =>\n errorMessagePrefix + ` Shapes ${shapeA} and ${shapeB} must match`);\n }\n}\n\nexport function fullDefinedShape(elementShape: number|number[]): boolean {\n if (typeof elementShape === 'number' || elementShape.some(dim => dim < 0)) {\n return false;\n }\n return true;\n}\n/**\n * Generate the output element shape from the list elementShape, list tensors\n * and input param.\n * @param listElementShape\n * @param tensors\n * @param elementShape\n */\nexport function inferElementShape(\n listElementShape: number|number[], tensors: Tensor[],\n elementShape: number|number[]): number[] {\n let partialShape = mergeElementShape(listElementShape, elementShape);\n const notfullDefinedShape = !fullDefinedShape(partialShape);\n if (notfullDefinedShape && tensors.length === 0) {\n throw new Error(\n `Tried to calculate elements of an empty list` +\n ` with non-fully-defined elementShape: ${partialShape}`);\n }\n if (notfullDefinedShape) {\n tensors.forEach(tensor => {\n partialShape = mergeElementShape(tensor.shape, partialShape);\n });\n }\n if (!fullDefinedShape(partialShape)) {\n throw new Error(`Non-fully-defined elementShape: ${partialShape}`);\n }\n return partialShape as number[];\n}\n\nexport function mergeElementShape(\n elementShapeA: number|number[], elementShapeB: number|number[]): number|\n number[] {\n if (typeof elementShapeA === 'number') {\n return elementShapeB;\n }\n if (typeof elementShapeB === 'number') {\n return elementShapeA;\n }\n\n if (elementShapeA.length !== elementShapeB.length) {\n throw new Error(`Incompatible ranks during merge: ${elementShapeA} vs. ${\n elementShapeB}`);\n }\n\n const result: number[] = [];\n for (let i = 0; i < elementShapeA.length; ++i) {\n const dim0 = elementShapeA[i];\n const dim1 = elementShapeB[i];\n if (dim0 >= 0 && dim1 >= 0 && dim0 !== dim1) {\n throw new Error(`Incompatible shape during merge: ${elementShapeA} vs. ${\n elementShapeB}`);\n }\n result[i] = dim0 >= 0 ? dim0 : dim1;\n }\n return result;\n}\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ===\n */\n\nimport {concat, DataType, keep, reshape, scalar, slice, stack, Tensor, tensor, tidy, unstack} from '@tensorflow/tfjs-core';\n\nimport {assertShapesMatchAllowUndefinedSize} from './tensor_utils';\n\nexport interface TensorWithState {\n tensor?: Tensor;\n written?: boolean;\n read?: boolean;\n cleared?: boolean;\n}\n\n/**\n * The TensorArray object keeps an array of Tensors. It\n * allows reading from the array and writing to the array.\n */\nexport class TensorArray {\n private tensors: TensorWithState[] = [];\n private closed_ =

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false;\n  readonly idTensor: Tensor;\n  constructor(\n      readonly name: string, readonly dtype: DataType, private
maxSize: number,\n      private elementShape: number[], readonly identicalElementShapes: boolean,\n      readonly
dynamicSize: boolean,
 readonly clearAfterRead: boolean) {\n    this.idTensor = scalar(0);\n    keep(this.idTensor);\n  }\n\n  get id() {\n
return this.idTensor.id;\n  }\n\n  get closed() {\n    return this.closed_;\n  }\n\n  /**\n   * Dispose the tensors and
idTensor and mark the TensoryArray as closed.\n   */\n  clearAndClose(keepIds?: Set<number>) {\n
this.tensors.forEach(tensor => {\n      if (keepIds == null || !keepIds.has(tensor.tensor.id)) {\n
tensor.tensor.dispose();\n      }\n    });\n    this.tensors = [];\n    this.closed_ = true;\n    this.idTensor.dispose();\n
}\n\n  size(): number {\n    return this.tensors.length;\n  }\n\n  /**\n   * Read the value at location index in the
TensorArray.\n   * @param index Number the index to read from.\n   */\n  read(index: number): Tensor {\n    if
(this.closed_) {\n      throw new Error(`TensorArray ${this.name} has already been closed.`);\n    }\n\n    if (index <
0 || index >= this.size()) {\n      throw new Error(`Tried to read from index
 ${index}, but array size is: ${\n          this.size()}`);\n    }\n\n    const tensorWithState = this.tensors[index];\n    if
(tensorWithState.cleared) {\n      throw new Error(\n          `TensorArray ${this.name}: Could not read index ${\n
      index} twice because it was cleared after a previous read ` +\n          `(perhaps try setting clear_after_read =
false?).`);\n    }\n\n    if (this.clearAfterRead) {\n      tensorWithState.cleared = true;\n    }\n\n    tensorWithState.read
= true;\n    return tensorWithState.tensor;\n  }\n\n  /**\n   * Helper method to read multiple tensors from the
specified indices.\n   */\n  readMany(indices: number[]): Tensor[] {\n    return indices.map(index =>
this.read(index));\n  }\n\n  /**\n   * Write value into the index of the TensorArray.\n   * @param index number the
index to write to.\n   * @param tensor\n   */\n  write(index: number, tensor: Tensor) {\n    if (this.closed_) {\n
throw new Error(`TensorArray ${this.name} has already
 been closed.`);\n    }\n\n    if (index < 0 || !this.dynamicSize && index >= this.maxSize) {\n      throw new
Error(`Tried to write to index ${\n          index}, but array is not resizeable and size is: ${this.maxSize}`);\n    }\n\n
const t = this.tensors[index] || {};\n\n    if (tensor.dtype !== this.dtype) {\n      throw new Error(`TensorArray ${\n
  this.name}: Could not write to TensorArray index ${index},\n          because the value dtype is ${\n
tensor.dtype}, but TensorArray dtype is ${this.dtype}.`);\n    }\n\n    // Set the shape for the first time write to
unknow shape tensor array\n    if (this.size() === 0 &&\n        (this.elementShape == null || this.elementShape.length
=== 0)) {\n      this.elementShape = tensor.shape;\n    }\n\n    assertShapesMatchAllowUndefinedSize(\n
this.elementShape, tensor.shape,\n        `TensorArray ${this.name}: Could not write to TensorArray index ${\n
 index}.`);\n\n    if (t.read) {\n      throw new Error(\n
        `TensorArray ${this.name}: Could not write to TensorArray index ${\n          index}, because it has already
been read.`);\n    }\n\n    if (t.written) {\n      throw new Error(\n          `TensorArray ${this.name}: Could not write
to TensorArray index ${\n          index}, because it has already been written.`);\n    }\n\n    t.tensor = tensor;\n
keep(tensor);\n    t.written = true;\n\n    this.tensors[index] = t;\n  }\n\n  /**\n   * Helper method to write multiple
tensors to the specified indices.\n   */\n  writeMany(indices: number[], tensors: Tensor[]) {\n    if (indices.length !==
tensors.length) {\n      throw new Error(\n          `TensorArray ${this.name}: could not write multiple tensors,` +\n
    `because the index size: ${\n          indices.length} is not the same as tensors size: ${\n
tensors.length}.`);\n    }\n\n    indices.forEach((i, index) => this.write(i, tensors[index]));\n  }\n\n  /**\n   * Return
selected values in the
 TensorArray as a packed Tensor. All of\n   * selected values must have been written and their shapes must all
match.\n   * @param [indices] number[] Optional. Taking values in [0, max_value). If the\n   *    TensorArray is not
dynamic, max_value=size(). If not specified returns\n   *    all tensors in the original order.\n   * @param [dtype]\n
*/\n  gather(indices?: number[], dtype?: DataType): Tensor {\n    if (!!dtype && dtype !== this.dtype) {\n      throw
new Error(`TensorArray dtype is ${\n          this.dtype} but gather requested dtype ${dtype}`);\n    }\n\n    if
(!indices) {\n      indices = [];\n      for (let i = 0; i < this.size(); i++) {\n        indices.push(i);\n      }\n    } else {\n
indices = indices.slice(0, this.size());\n    }\n\n    if (indices.length === 0) {\n      return tensor([],
[0].concat(this.elementShape));\n    }\n\n    // Read all the PersistentTensors into a vector to keep track of\n    // their
memory.\n    const tensors = this.readMany(indices);\n\n
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    assertShapesMatchAllowUndefinedSize(\n        this.elementShape, tensors[0].shape, 'TensorArray shape
mismatch: ');\n\n    return stack(tensors, 0);\n  }\n\n  /**\n   * Return the values in the TensorArray as a concatenated
Tensor.\n   */\n  concat(dtype?: DataType): Tensor {\n    if (!!dtype && dtype !== this.dtype) {\n      throw new
Error(`TensorArray dtype is ${\n          this.dtype} but concat requested dtype ${dtype}`);\n    }\n\n    if (this.size()
=== 0) {\n      return tensor([], [0].concat(this.elementShape));\n    }\n\n    const indices = [];\n    for (let i = 0; i <
this.size(); i++) {\n      indices.push(i);\n    }\n    // Collect all the tensors from the tensors array.\n    const tensors =
this.readMany(indices);\n\n    assertShapesMatchAllowUndefinedSize(\n        this.elementShape, tensors[0].shape,\n
      `TensorArray shape mismatch: tensor array shape (${\n          this.elementShape}) vs first tensor shape
(${tensors[0].shape})`);\n\n    return concat(tensors,
 0);\n  }\n\n  /**\n   * Scatter the values of a Tensor in specific indices of a TensorArray.\n   * @param indices
nummber[] values in [0, max_value). If the\n   *    TensorArray is not dynamic, max_value=size().\n   * @param
tensor Tensor input tensor.\n   */\n  scatter(indices: number[], tensor: Tensor) {\n    if (tensor.dtype !== this.dtype)
{\n      throw new Error(`TensorArray dtype is ${\n          this.dtype} but tensor has dtype ${tensor.dtype}`);\n
}\n\n    if (indices.length !== tensor.shape[0]) {\n      throw new Error(`Expected len(indices) == tensor.shape[0], but
saw: ${\n          indices.length} vs. ${tensor.shape[0]}`);\n    }\n\n    const maxIndex = Math.max(...indices);\n\n    if
(!this.dynamicSize && maxIndex >= this.maxSize) {\n      throw new Error(\n          `Max index must be < array
size (${maxIndex}  vs. ${this.maxSize})`);\n    }\n\n    this.writeMany(indices, unstack(tensor, 0));\n  }\n\n  /**\n
* Split the values of a Tensor into the TensorArray.\n
   * @param length number[] with the lengths to use when splitting value along\n   *    its first dimension.\n   *
@param tensor Tensor, the tensor to split.\n   */\n  split(length: number[], tensor: Tensor) {\n    if (tensor.dtype !==
this.dtype) {\n      throw new Error(`TensorArray dtype is ${\n          this.dtype} but tensor has dtype
${tensor.dtype}`);\n    }\n    let totalLength = 0;\n    const cumulativeLengths = length.map(len => {\n
totalLength += len;\n      return totalLength;\n    });\n\n    if (totalLength !== tensor.shape[0]) {\n      throw new
Error(`Expected sum of lengths to be equal to\n          tensor.shape[0], but sum of lengths is\n        ${totalLength},
and tensor's shape is: ${tensor.shape}`);\n    }\n\n    if (!this.dynamicSize && length.length !== this.maxSize) {\n
throw new Error(\n          `TensorArray's size is not equal to the size of lengths (${\n              this.maxSize} vs.
${length.length}), ` +\n          'and the TensorArray is
 not marked as dynamically resizeable');\n    }\n\n    const elementPerRow = totalLength === 0 ? 0 : tensor.size /
totalLength;\n    const tensors: Tensor[] = [];\n    tidy(() => {\n      tensor = reshape(tensor, [1, totalLength,
elementPerRow]);\n      for (let i = 0; i < length.length; ++i) {\n        const previousLength = (i === 0) ? 0 :
cumulativeLengths[i - 1];\n        const indices = [0, previousLength, 0];\n        const sizes = [1, length[i],
elementPerRow];\n        tensors[i] = reshape(slice(tensor, indices, sizes), this.elementShape);\n      }\n      return
tensors;\n    });\n    const indices = [];\n    for (let i = 0; i < length.length; i++) {\n      indices[i] = i;\n    }\n
this.writeMany(indices, tensors);\n  }\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights
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language governing permissions and\n * limitations under the License.\n *
==========================================================================\n
*/\n\nimport {concat, DataType, keep, reshape, scalar, slice, stack, Tensor, tensor, tidy, unstack} from
'@tensorflow/tfjs-core';\n\nimport {assertShapesMatchAllowUndefinedSize, inferElementShape,
mergeElementShape} from './tensor_utils';\n\n/**\n * TensorList stores a container of `tf.Tensor` objects, which are
accessible\n * via tensors field.\n *\n * In order to get a copy of the underlying list, use the copy method:\n * ```\n *
TensorList b = a.copy();\n *    b.tensors().pushBack(t);  // This does not modify a.tensors().\n
 * ```\n *\n * Note that this is not a deep copy: the memory locations of the underlying\n * tensors will still point to
the same locations of the corresponding tensors\n * in the original.\n */\n\nexport class TensorList {\n  readonly
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idTensor: Tensor;\n  maxNumElements: number;\n\n  get id() {\n    return this.idTensor.id;\n  }\n  /**\n   *\n   * @param tensors list of tensors\n   * @param elementShape shape of each tensor, this can be a single number (any\n * shape is allowed) or partial shape (dim = -1).\n   * @param elementDtype data type of each tensor\n   * @param maxNumElements The maximum allowed size of `tensors`. Defaults to -1\n   *   meaning that the size of `tensors` is unbounded.\n   */\n  constructor(\n      readonly tensors: Tensor[], readonly elementShape: number|number[],\n readonly elementDtype: DataType, maxNumElements = -1) {\n    if (tensors != null) {\n      tensors.forEach(tensor => {\n        if (elementDtype !== tensor.dtype) {\n          throw new Error(`Invalid
 data types; op elements ${\n              elementDtype}, but list elements ${tensor.dtype}`);\n        }\n
assertShapesMatchAllowUndefinedSize(\n            elementShape, tensor.shape, 'TensorList shape mismatch: ');\n\n
    keep(tensor);\n      });\n    }\n    this.idTensor = scalar(0);\n    this.maxNumElements = maxNumElements;\n
keep(this.idTensor);\n  }\n\n  /**\n   * Get a new TensorList containing a copy of the underlying tensor container.\n
*/\n  copy(): TensorList {\n    return new TensorList(\n        [...this.tensors], this.elementShape,
this.elementDtype);\n  }\n\n  /**\n   * Dispose the tensors and idTensor and clear the tensor list.\n   */\n
clearAndClose(keepIds?: Set<number>) {\n    this.tensors.forEach(tensor => {\n      if (keepIds == null ||
!keepIds.has(tensor.id)) {\n        tensor.dispose();\n      }\n    });\n    this.tensors.length = 0;\n
this.idTensor.dispose();\n  }\n  /**\n   * The size of the tensors in the tensor list.\n   */\n
  size() {\n    return this.tensors.length;\n  }\n\n  /**\n   * Return a tensor that stacks a list of rank-R tf.Tensors into
one rank-(R+1)\n   * tf.Tensor.\n   * @param elementShape shape of each tensor\n   * @param elementDtype data
type of each tensor\n   * @param numElements the number of elements to stack\n   */\n  stack(elementShape:
number[], elementDtype: DataType, numElements = -1):\n      Tensor {\n    if (elementDtype !== this.elementDtype)
{\n      throw new Error(`Invalid data types; op elements ${\n          elementDtype}, but list elements
${this.elementDtype}`);\n    }\n    if (numElements !== -1 && this.tensors.length !== numElements) {\n      throw
new Error(`Operation expected a list with ${\n          numElements} elements but got a list with ${\n
this.tensors.length} elements.`);\n    }\n    assertShapesMatchAllowUndefinedSize(\n        elementShape,
this.elementShape, 'TensorList shape mismatch: ');\n    const outputElementShape =\n
inferElementShape(this.elementShape,
 this.tensors, elementShape);\n    return tidy(() => {\n      const reshapedTensors =\n          this.tensors.map(tensor =>
reshape(tensor, outputElementShape));\n      return stack(reshapedTensors, 0);\n    });\n  }\n\n  /**\n   * Pop a tensor
from the end of the list.\n   * @param elementShape shape of the tensor\n   * @param elementDtype data type of the
tensor\n   */\n  popBack(elementShape: number[], elementDtype: DataType): Tensor {\n    if (elementDtype !==
this.elementDtype) {\n      throw new Error(`Invalid data types; op elements ${\n          elementDtype}, but list
elements ${this.elementDtype}`);\n    }\n\n    if (this.size() === 0) {\n      throw new Error('Trying to pop from an
empty list.');\n    }\n    const outputElementShape =\n        inferElementShape(this.elementShape, this.tensors,
elementShape);\n    const tensor = this.tensors.pop();\n\n    assertShapesMatchAllowUndefinedSize(\n
tensor.shape, elementShape, 'TensorList shape mismatch:
 ');\n\n    return reshape(tensor, outputElementShape);\n  }\n\n  /**\n   * Push a tensor to the end of the list.\n   *
@param tensor Tensor to be pushed.\n   */\n  pushBack(tensor: Tensor) {\n    if (tensor.dtype !==
this.elementDtype) {\n      throw new Error(`Invalid data types; op elements ${\n          tensor.dtype}, but list
elements ${this.elementDtype}`);\n    }\n\n    assertShapesMatchAllowUndefinedSize(\n        tensor.shape,
this.elementShape, 'TensorList shape mismatch: ');\n\n    if (this.maxNumElements === this.size()) {\n      throw
new Error(`Trying to push element into a full list.`);\n    }\n    keep(tensor);\n    this.tensors.push(tensor);\n  }\n\n
/**\n   * Update the size of the list.\n   * @param size the new size of the list.\n   */\n  resize(size: number) {\n    if
(size < 0) {\n      throw new Error(\n          `TensorListResize expects size to be non-negative. Got: ${size}`);\n
}\n\n    if (this.maxNumElements !== -1 && size > this.maxNumElements) {\n
  throw new Error(`TensorListResize input size ${\n          size} is greater maxNumElement
${this.maxNumElements}.`);\n    }\n    this.tensors.length = size;\n  }\n\n  /**\n   * Retrieve the element at the
provided index\n   * @param elementShape shape of the tensor\n   * @param elementDtype dtype of the tensor\n   *
@param elementIndex index of the tensor\n   */\n  getItem(elementIndex: number, elementShape: number[],
```

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elementDtype: DataType):\n      Tensor {\n    if (elementDtype !== this.elementDtype) {\n      throw new
Error(`Invalid data types; op elements ${\n          elementDtype}, but list elements ${this.elementDtype}`);\n    }\n
if (elementIndex < 0 || elementIndex > this.tensors.length) {\n      throw new Error(`Trying to access element ${\n
  elementIndex} in a list with ${this.tensors.length} elements.`);\n    }\n\n    if (this.tensors[elementIndex] == null)
{\n      throw new Error(`element at index ${elementIndex} is null.`);\n    }\n\n
assertShapesMatchAllowUndefinedSize(\n
      this.tensors[elementIndex].shape, elementShape,\n        'TensorList shape mismatch: ');\n    const
outputElementShape =\n        inferElementShape(this.elementShape, this.tensors, elementShape);\n    return
reshape(this.tensors[elementIndex], outputElementShape);\n  }\n\n  /**\n   * Set the tensor at the index\n   *
@param elementIndex index of the tensor\n   * @param tensor the tensor to be inserted into the list\n   */\n
setItem(elementIndex: number, tensor: Tensor) {\n    if (tensor.dtype !== this.elementDtype) {\n      throw new
Error(`Invalid data types; op elements ${\n          tensor.dtype}, but list elements ${this.elementDtype}`);\n    }\n\n
if (elementIndex < 0 ||\n        this.maxNumElements !== -1 && elementIndex >= this.maxNumElements) {\n
throw new Error(`Trying to set element ${\n          elementIndex} in a list with max ${this.maxNumElements}
elements.`);\n    }\n\n    assertShapesMatchAllowUndefinedSize(\n        this.elementShape,
 tensor.shape, 'TensorList shape mismatch: ');\n    keep(tensor);\n    this.tensors[elementIndex] = tensor;\n  }\n\n
/**\n   * Return selected values in the TensorList as a stacked Tensor. All of\n   * selected values must have been
written and their shapes must all match.\n   * @param indices indices of tensors to gather\n   * @param
elementDtype output tensor dtype\n   * @param elementShape output tensor element shape\n   */\n  gather(indices:
number[], elementDtype: DataType, elementShape: number[]):\n      Tensor {\n    if (elementDtype !==
this.elementDtype) {\n      throw new Error(`Invalid data types; op elements ${\n          elementDtype}, but list
elements ${this.elementDtype}`);\n    }\n\n    assertShapesMatchAllowUndefinedSize(\n        this.elementShape,
elementShape, 'TensorList shape mismatch: ');\n\n    // When indices is greater than the size of the list, indices
beyond the\n    // size of the list are ignored.\n    indices = indices.slice(0, this.size());\n    const
 outputElementShape =\n        inferElementShape(this.elementShape, this.tensors, elementShape);\n    if
(indices.length === 0) {\n      return tensor([], [0].concat(outputElementShape));\n    }\n\n    return tidy(() => {\n
const tensors =\n          indices.map(i => reshape(this.tensors[i], outputElementShape));\n      return stack(tensors,
0);\n    });\n  }\n\n  /**\n   * Return the values in the TensorList as a concatenated Tensor.\n   * @param
elementDtype output tensor dtype\n   * @param elementShape output tensor element shape\n   */\n
concat(elementDtype: DataType, elementShape: number[]): Tensor {\n    if (!!elementDtype && elementDtype !==
this.elementDtype) {\n      throw new Error(`TensorList dtype is ${\n          this.elementDtype} but concat requested
dtype ${elementDtype}`);\n    }\n\n    assertShapesMatchAllowUndefinedSize(\n        this.elementShape,
elementShape, 'TensorList shape mismatch: ');\n    const outputElementShape =\n
inferElementShape(this.elementShape,
 this.tensors, elementShape);\n\n    if (this.size() === 0) {\n      return tensor([], [0].concat(outputElementShape));\n
}\n    return tidy(() => {\n      const tensors = this.tensors.map(t => reshape(t, outputElementShape));\n      return
concat(tensors, 0);\n    });\n  }\n}\n\n/**\n * Creates a TensorList which, when stacked, has the value of tensor.\n *
@param tensor from tensor\n * @param elementShape output tensor element shape\n */\nexport function
fromTensor(\n    tensor: Tensor, elementShape: number[], elementDtype: DataType) {\n  const dtype =
tensor.dtype;\n  if (tensor.shape.length < 1) {\n    throw new Error(\n        `Tensor must be at least a vector, but saw
shape: ${tensor.shape}`);\n  }\n  if (tensor.dtype !== elementDtype) {\n    throw new Error(`Invalid data types; op
elements ${\n        tensor.dtype}, but list elements ${elementDtype}`);\n  }\n  const tensorElementShape =
tensor.shape.slice(1);\n  assertShapesMatchAllowUndefinedSize(\n      tensorElementShape,
 elementShape, 'TensorList shape mismatch: ');\n  const tensorList: Tensor[] = unstack(tensor);\n  return new
TensorList(tensorList, elementShape, dtype);\n}\n\n/**\n * Return a TensorList of the given size with empty
elements.\n * @param elementShape the shape of the future elements of the list\n * @param elementDtype the
desired type of elements in the list\n * @param numElements the number of elements to reserve\n */\nexport
function reserve(\n    elementShape: number[], elementDtype: DataType, numElements: number) {\n  return new
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TensorList([], elementShape, elementDtype, numElements);\n}\n\n/**\n * Put tensors at specific indices of a stacked tensor into a TensorList.\n * @param indices list of indices on how to scatter the tensor.\n * @param tensor input tensor.\n * @param elementShape the shape of the future elements of the list\n * @param numElements the number of elements to scatter\n */\nexport function scatter(\n tensor: Tensor, indices: number[], elementShape: number[],\n numElements?: number): TensorList {\n if (indices.length !== tensor.shape[0]) {\n throw new Error(`Expected len(indices) == tensor.shape[0], but saw: ${\n indices.length} vs. ${tensor.shape[0]}`);\n }\n\n const maxIndex = Math.max(...indices);\n\n if (numElements != null && numElements !== -1 && maxIndex >= numElements) {\n throw new Error(\n `Max index must be < array size (${maxIndex} vs. ${numElements})`);\n }\n\n const list = new TensorList([], elementShape, tensor.dtype, numElements);\n const tensors = unstack(tensor, 0);\n indices.forEach((value, index) => {\n list.setItem(value, tensors[index]);\n });\n return list;\n}\n\n/**\n * Split the values of a Tensor into a TensorList.\n * @param length the lengths to use when splitting value along\n * its first dimension.\n * @param tensor the tensor to split.\n * @param elementShape the shape of the future elements of the list\n */\nexport function split(\n tensor: Tensor, length: number[],\n elementShape: number[]) {\n let totalLength = 0;\n const cumulativeLengths = length.map(len => {\n totalLength += len;\n return totalLength;\n });\n\n if (totalLength !== tensor.shape[0]) {\n throw new Error(`Expected sum of lengths to be equal to\n tensor.shape[0], but sum of lengths is\n ${totalLength}, and tensor's shape is: ${tensor.shape}`);\n }\n\n const shapeWithoutFirstDim = tensor.shape.slice(1);\n const outputElementShape =\n mergeElementShape(shapeWithoutFirstDim, elementShape);\n const elementPerRow = totalLength === 0 ? 0 : tensor.size / totalLength;\n const tensors: Tensor[] = tidy(() => {\n const tensors = [];\n tensor = reshape(tensor, [1, totalLength, elementPerRow]);\n for (let i = 0; i < length.length; ++i) {\n const previousLength = (i === 0) ? 0 : cumulativeLengths[i - 1];\n const indices = [0, previousLength, 0];\n const sizes = [1, length[i], elementPerRow];\n tensors[i] = reshape(\n slice(tensor, indices, sizes), outputElementShape as number[]);\n }\n tensor.dispose();\n return tensors;\n });\n\n const list = new TensorList([], elementShape, tensor.dtype, length.length);\n\n for (let i = 0; i < tensors.length; i++) {\n list.setItem(i, tensors[i]);\n }\n return list;\n}\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {DataType, scalar, Tensor} from '@tensorflow/tfjs-core';\n\nimport {NamedTensorsMap} from '../../data/types';\nimport {ExecutionContext} from '../../executor/execution_context';\nimport {TensorArray} from '../../executor/tensor_array';\nimport {fromTensor, reserve, scatter, split} from '../../executor/tensor_list';\nimport {InternalOpAsyncExecutor, Node} from '../types';\n\nimport {cloneTensor, getParamValue, getTensor} from './utils';\n\nexport const executeOp: InternalOpAsyncExecutor = async(\n node: Node, tensorMap: NamedTensorsMap,\n context: ExecutionContext): Promise<Tensor[]> => {\n switch (node.op) {\n case 'If':\n case 'StatelessIf': {\n const thenFunc =\n getParamValue('thenBranch', node, tensorMap, context) as string;\n const elseFunc =\n getParamValue('elseBranch', node, tensorMap, context) as string;\n const cond = getParamValue('cond', node, tensorMap, context) as Tensor;\n const args = getParamValue('args', node, tensorMap, context) as Tensor[];\n const condValue = await cond.data();\n if (condValue[0]) {\n return context.functionMap[thenFunc].executeFunctionAsync(\n args, context.tensorArrayMap, context.tensorListMap);\n } else {\n return context.functionMap[elseFunc].executeFunctionAsync(\n args, context.tensorArrayMap, context.tensorListMap);\n }\n }\n case 'While':\n case 'StatelessWhile': {\n const bodyFunc =\n getParamValue('body', node, tensorMap, context) as string;\n const condFunc =\n getParamValue('cond',

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node, tensorMap, context) as string;\n      const args = getParamValue('args', node, tensorMap, context) as
Tensor[];\n\n      // Calculate the condition of the loop\n      const condResult =\n          (await
context.functionMap[condFunc].executeFunctionAsync(\n              args, context.tensorArrayMap,
context.tensorListMap));\n      const argIds =
 args.map(tensor => tensor.id);\n      let condValue = await condResult[0].data();\n      // Dispose the intermediate
tensors for condition function\n      condResult.forEach(tensor => {\n        if (!tensor.kept &&
argIds.indexOf(tensor.id) === -1) {\n          tensor.dispose();\n        }\n      });\n\n      let result: Tensor[] = args;\n\n
 while (condValue[0]) {\n        // Record the previous result for intermediate tensor tracking\n        const origResult =
result;\n        // Execution the body of the loop\n        result = await
context.functionMap[bodyFunc].executeFunctionAsync(\n            result, context.tensorArrayMap,
context.tensorListMap);\n        const resultIds = result.map(tensor => tensor.id);\n\n        // Dispose the intermediate
tensor for body function that is not global\n        // kept, not input/output of the body function\n
origResult.forEach(tensor => {\n          if (!tensor.kept && argIds.indexOf(tensor.id) === -1 &&\n
resultIds.indexOf(tensor.id)
 === -1) {\n            tensor.dispose();\n          }\n        });\n\n        // Recalcuate the condition of the loop using the
latest results.\n        const condResult =\n            (await context.functionMap[condFunc].executeFunctionAsync(\n
          result, context.tensorArrayMap, context.tensorListMap));\n        condValue = await condResult[0].data();\n
 // Dispose the intermediate tensors for condition function\n        condResult.forEach(tensor => {\n          if
(!tensor.kept && argIds.indexOf(tensor.id) === -1 &&\n              resultIds.indexOf(tensor.id) === -1) {\n
tensor.dispose();\n          }\n        });\n      }\n      return result;\n    }\n    case 'LoopCond': {\n      const pred =
getParamValue('pred', node, tensorMap, context) as Tensor;\n      return [cloneTensor(pred)];\n    }\n    case 'Switch':
{\n      const pred = getParamValue('pred', node, tensorMap, context) as Tensor;\n      let data =
getParamValue('data', node,
 tensorMap, context) as Tensor;\n      if (!data.kept) {\n        data = cloneTensor(data);\n      }\n      // Outputs nodes
:0 => false, :1 => true\n      return (await pred.data())[0] ? [undefined, data] : [data, undefined];\n    }\n    case
'Merge': {\n      const inputName = node.inputNames.find(\n          name => getTensor(name, tensorMap, context)
!== undefined);\n      if (inputName) {\n        const data = getTensor(inputName, tensorMap, context);\n        return
[cloneTensor(data)];\n      }\n      return undefined;\n    }\n    case 'Enter': {\n      const frameId =\n
getParamValue('frameName', node, tensorMap, context) as string;\n      const data = getParamValue('tensor', node,
tensorMap, context) as Tensor;\n      context.enterFrame(frameId);\n      return [cloneTensor(data)];\n    }\n    case
'Exit': {\n      const data = getParamValue('tensor', node, tensorMap, context) as Tensor;\n      context.exitFrame();\n
    return [cloneTensor(data)];\n    }\n    case 'NextIteration':
 {\n      const data = getParamValue('tensor', node, tensorMap, context) as Tensor;\n      context.nextIteration();\n
return [cloneTensor(data)];\n    }\n    case 'TensorArrayV3': {\n      const size = getParamValue('size', node,
tensorMap, context) as number;\n      const dtype =\n          getParamValue('dtype', node, tensorMap, context) as
DataType;\n      const elementShape =\n          getParamValue('elementShape', node, tensorMap, context) as
number[];\n      const dynamicSize =\n          getParamValue('dynamicSize', node, tensorMap, context) as boolean;\n
    const clearAfterRead =\n          getParamValue('clearAfterRead', node, tensorMap, context) as boolean;\n      const
identicalElementShapes =\n          getParamValue('identicalElementShapes', node, tensorMap, context) as\n
boolean;\n      const name = getParamValue('name', node, tensorMap, context) as string;\n      const tensorArray =
new TensorArray(\n          name, dtype, size, elementShape,
 identicalElementShapes, dynamicSize,\n          clearAfterRead);\n      context.addTensorArray(tensorArray);\n
return [tensorArray.idTensor, scalar(1.0)];\n    }\n    case 'TensorArrayWriteV3': {\n      const id =\n
getParamValue('tensorArrayId', node, tensorMap, context) as Tensor;\n      const index = getParamValue('index',
node, tensorMap, context) as number;\n      const writeTensor =\n          getParamValue('tensor', node, tensorMap,
context) as Tensor;\n      const writeTensorArray = context.getTensorArray(id.id);\n
writeTensorArray.write(index, writeTensor);\n      return [writeTensorArray.idTensor];\n    }\n    case
'TensorArrayReadV3': {\n      const readId =\n          getParamValue('tensorArrayId', node, tensorMap, context) as
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Tensor;\n      const readIndex =\n          getParamValue('index', node, tensorMap, context) as number;\n      const
readTensorArray = context.getTensorArray(readId.id);\n      return [readTensorArray.read(readIndex)];\n    }\n
  case 'TensorArrayGatherV3': {\n      const gatherId =\n          getParamValue('tensorArrayId', node, tensorMap,
context) as Tensor;\n      const gatherIndices =\n          getParamValue('indices', node, tensorMap, context) as
number[];\n      const gatherDtype =\n          getParamValue('dtype', node, tensorMap, context) as DataType;\n
const gatherTensorArray = context.getTensorArray(gatherId.id);\n      return
[gatherTensorArray.gather(gatherIndices, gatherDtype)];\n    }\n    case 'TensorArrayScatterV3': {\n      const
scatterId =\n          getParamValue('tensorArrayId', node, tensorMap, context) as Tensor;\n      const scatterIndices
=\n          getParamValue('indices', node, tensorMap, context) as number[];\n      const scatterTensor =\n
getParamValue('tensor', node, tensorMap, context) as Tensor;\n      const scatterTensorArray =
context.getTensorArray(scatterId.id);\n      scatterTensorArray.scatter(scatterIndices, scatterTensor);\n      return
[scatterTensorArray.idTensor];\n
  }\n    case 'TensorArrayConcatV3': {\n      const concatId =\n          getParamValue('tensorArrayId', node,
tensorMap, context) as Tensor;\n      const concatTensorArray = context.getTensorArray(concatId.id);\n      const
concatDtype =\n          getParamValue('dtype', node, tensorMap, context) as DataType;\n      return
[concatTensorArray.concat(concatDtype)];\n    }\n    case 'TensorArraySplitV3': {\n      const splitId =\n
getParamValue('tensorArrayId', node, tensorMap, context) as Tensor;\n      const splitTensor =\n
getParamValue('tensor', node, tensorMap, context) as Tensor;\n      const lengths =\n          getParamValue('lengths',
node, tensorMap, context) as number[];\n      const splitTensorArray = context.getTensorArray(splitId.id);\n
splitTensorArray.split(lengths, splitTensor);\n      return [splitTensorArray.idTensor];\n    }\n    case
'TensorArraySizeV3': {\n      const sizeId =\n          getParamValue('tensorArrayId', node,
 tensorMap, context) as Tensor;\n      const sizeTensorArray = context.getTensorArray(sizeId.id);\n      return
[scalar(sizeTensorArray.size(), 'int32')];\n    }\n    case 'TensorArrayCloseV3': {\n      const closeId =\n
getParamValue('tensorArrayId', node, tensorMap, context) as Tensor;\n      const closeTensorArray =
context.getTensorArray(closeId.id);\n      closeTensorArray.clearAndClose();\n      return
[closeTensorArray.idTensor];\n    }\n    case 'TensorListSetItem': {\n      const idTensor =\n
getParamValue('tensorListId', node, tensorMap, context) as Tensor;\n      const index = getParamValue('index', node,
tensorMap, context) as number;\n      const writeTensor =\n          getParamValue('tensor', node, tensorMap, context)
as Tensor;\n      const tensorList = context.getTensorList(idTensor.id);\n      tensorList.setItem(index,
writeTensor);\n      return [tensorList.idTensor];\n    }\n    case 'TensorListGetItem': {\n      const idTensor =\n
getParamValue('tensorListId',
 node, tensorMap, context) as Tensor;\n      const readIndex =\n          getParamValue('index', node, tensorMap,
context) as number;\n      const elementShape =\n          getParamValue('elementShape', node, tensorMap, context)
as number[];\n\n      const elementDType =\n          getParamValue('elementDType', node, tensorMap, context) as
DataType;\n      const tensorList = context.getTensorList(idTensor.id);\n      return [tensorList.getItem(readIndex,
elementShape, elementDType)];\n    }\n    case 'TensorListScatterV2':\n    case 'TensorListScatter': {\n      const
scatterIndices =\n          getParamValue('indices', node, tensorMap, context) as number[];\n      const scatterTensor
=\n          getParamValue('tensor', node, tensorMap, context) as Tensor;\n      const elementShape =\n
getParamValue('elementShape', node, tensorMap, context) as number[];\n      const numElements =\n
getParamValue('numElements', node, tensorMap, context) as number;\n
      const tensorList =\n          scatter(scatterTensor, scatterIndices, elementShape, numElements);\n
context.addTensorList(tensorList);\n      return [tensorList.idTensor];\n    }\n    case 'TensorListReserve':\n    case
'EmptyTensorList': {\n      const elementShape =\n          getParamValue('elementShape', node, tensorMap, context)
as number[];\n      const elementDtype =\n          getParamValue('elementDType', node, tensorMap, context) as
DataType;\n      let numElementsParam;\n\n      if (node.op === 'TensorListReserve') {\n        numElementsParam =
'numElements';\n      } else {\n        numElementsParam = 'maxNumElements';\n      }\n\n      const numElements =\n
        getParamValue(numElementsParam, node, tensorMap, context) as number;\n\n      const tensorList =
reserve(elementShape, elementDtype, numElements);\n      context.addTensorList(tensorList);\n      return
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[tensorList.idTensor];\n }\n case 'TensorListGather': {\n const gatherId =\n getParamValue('tensorListId', node, tensorMap, context) as Tensor;\n const gatherIndices =\n getParamValue('indices', node, tensorMap, context) as number[];\n const elementShape =\n getParamValue('elementShape', node, tensorMap, context) as number[];\n const elementDtype =\n getParamValue('elementDType', node, tensorMap, context) as DataType;\n const tensorList = context.getTensorList(gatherId.id);\n return [tensorList.gather(gatherIndices, elementDtype, elementShape)];\n }\n case 'TensorListStack': {\n const idTensor =\n getParamValue('tensorListId', node, tensorMap, context) as Tensor;\n const elementShape =\n getParamValue('elementShape', node, tensorMap, context) as number[];\n const elementDtype =\n getParamValue('elementDType', node, tensorMap, context) as DataType;\n const numElements =\n getParamValue('numElements', node, tensorMap, context) as number;\n const
tensorList = context.getTensorList(idTensor.id);\n return [tensorList.stack(elementShape, elementDtype, numElements)];\n }\n case 'TensorListFromTensor': {\n const tensor =\n getParamValue('tensor', node, tensorMap, context) as Tensor;\n const elementShape =\n getParamValue('elementShape', node, tensorMap, context) as number[];\n const elementDtype =\n getParamValue('elementDType', node, tensorMap, context) as DataType;\n const tensorList = fromTensor(tensor, elementShape, elementDtype);\n context.addTensorList(tensorList);\n return [tensorList.idTensor];\n }\n case 'TensorListConcat': {\n const concatId =\n getParamValue('tensorListId', node, tensorMap, context) as Tensor;\n const tensorList = context.getTensorList(concatId.id);\n const concatDtype =\n getParamValue('dtype', node, tensorMap, context) as DataType;\n const elementShape =\n getParamValue('elementShape',
node, tensorMap, context) as number[];\n return [tensorList.concat(concatDtype, elementShape)];\n }\n case 'TensorListPushBack': {\n const idTensor =\n getParamValue('tensorListId', node, tensorMap, context) as Tensor;\n const writeTensor =\n getParamValue('tensor', node, tensorMap, context) as Tensor;\n const tensorList = context.getTensorList(idTensor.id);\n tensorList.pushBack(writeTensor);\n return [tensorList.idTensor];\n }\n case 'TensorListPopBack': {\n const idTensor =\n getParamValue('tensorListId', node, tensorMap, context) as Tensor;\n const elementShape =\n getParamValue('elementShape', node, tensorMap, context) as number[];\n const elementDType =\n getParamValue('elementDType', node, tensorMap, context) as DataType;\n const tensorList = context.getTensorList(idTensor.id);\n return [tensorList.popBack(elementShape, elementDType)];\n }\n case 'TensorListSplit':
{\n const splitTensor =\n getParamValue('tensor', node, tensorMap, context) as Tensor;\n const elementShape =\n getParamValue('elementShape', node, tensorMap, context) as number[];\n const lengths =\n getParamValue('lengths', node, tensorMap, context) as number[];\n\n const tensorList = split(splitTensor, lengths, elementShape);\n context.addTensorList(tensorList);\n return [tensorList.idTensor];\n }\n default:\n throw TypeError(`Node type ${node.op} is not implemented`);\n }\n};\n\nexport const CATEGORY = 'control';\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under
the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n */\n\nimport {Rank, Tensor, Tensor3D, Tensor4D, Tensor5D} from '@tensorflow/tfjs-core';\n// tslint:disable-next-line: no-imports-from-dist\nimport * as tfOps from '@tensorflow/tfjs-core/dist/ops/ops_for_converter';\n\nimport {NamedTensorsMap} from '../../data/types';\nimport {ExecutionContext} from '../../executor/execution_context';\nimport {InternalOpExecutor, Node} from '../types';\n\nimport {getPadding,

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getParamValue} from './utils';\n\nfunction fusedConvAndDepthWiseParams(\n    node: Node, tensorMap:
NamedTensorsMap, context: ExecutionContext) {\n  const [extraOp, activationFunc] =\n
(getParamValue('fusedOps', node, tensorMap, context) as string[]);\n\n  const isBiasAdd
 = extraOp === 'biasadd';\n  const isPrelu = activationFunc === 'prelu';\n  const isBatchNorm = extraOp ===
'fusedbatchnorm';\n\n  const numArgs =\n      (getParamValue('numArgs', node, tensorMap, context) as number);\n
if (isBiasAdd) {\n    if (isPrelu && numArgs !== 2) {\n      throw new Error(\n          'FusedConv2d and
DepthwiseConv2d with BiasAdd and Prelu ' +\n          'must have two extra arguments: bias and alpha.');\n    }\n    if
(!isPrelu && numArgs !== 1) {\n      throw new Error(\n          'FusedConv2d and DepthwiseConv2d with BiasAdd
must have ' +\n          'one extra argument: bias.');\n    }\n  }\n  if (isBatchNorm) {\n    throw new Error(\n
'FusedConv2d and DepthwiseConv2d with FusedBatchNorm is not supported.');\n  }\n  const stride =
getParamValue('strides', node, tensorMap, context) as number[];\n  const pad = getPadding(node, tensorMap,
context);\n  const dataFormat =\n      (getParamValue('dataFormat', node, tensorMap, context) as string)\n
      .toUpperCase();\n  const dilations =\n      getParamValue('dilations', node, tensorMap, context) as number[];\n
const [biasArg, preluArg] =\n      getParamValue('args', node, tensorMap, context) as Tensor[];\n  const
leakyreluAlpha =\n      getParamValue('leakyreluAlpha', node, tensorMap, context) as number;\n\n  return {\n
stride,\n    pad,\n    dataFormat,\n    dilations,\n    biasArg,\n    preluArg,\n    activationFunc,\n    leakyreluAlpha\n
};\n}\n\nexport const executeOp: InternalOpExecutor =\n    (node: Node, tensorMap: NamedTensorsMap,\n
context: ExecutionContext): Tensor[] => {\n      switch (node.op) {\n        case 'Conv1D': {\n          const stride =\n
        getParamValue('stride', node, tensorMap, context) as number;\n          const pad = getParamValue('pad', node,
tensorMap, context);\n          const dataFormat =\n              (getParamValue('dataFormat', node, tensorMap, context)
as string)\n                  .toUpperCase();\n          const dilation
 =\n              getParamValue('dilation', node, tensorMap, context) as number;\n          return [tfOps.conv1d(\n
getParamValue('x', node, tensorMap, context) as Tensor3D,\n              getParamValue('filter', node, tensorMap,
context) as Tensor3D,\n              stride, pad as 'valid' | 'same', dataFormat as 'NWC' | 'NCW',\n              dilation)];\n
  }\n        case 'Conv2D': {\n          const stride =\n              getParamValue('strides', node, tensorMap, context) as
number[];\n          const pad = getPadding(node, tensorMap, context);\n          const dataFormat =\n
(getParamValue('dataFormat', node, tensorMap, context) as string)\n                  .toUpperCase();\n          const
dilations =\n              getParamValue('dilations', node, tensorMap, context) as number[];\n          return
[tfOps.conv2d(\n              getParamValue('x', node, tensorMap, context) as Tensor3D |\n                  Tensor4D,\n
    getParamValue('filter',
 node, tensorMap, context) as Tensor4D,\n              [stride[1], stride[2]], pad as 'valid' | 'same',\n              dataFormat
as 'NHWC' | 'NCHW', [dilations[1], dilations[2]])];\n        }\n        case '_FusedConv2D': {\n          const {\n
stride,\n            pad,\n            dataFormat,\n            dilations,\n            biasArg,\n            preluArg,\n
activationFunc,\n            leakyreluAlpha\n          } = fusedConvAndDepthWiseParams(node, tensorMap,
context);\n\n          return [tfOps.fused.conv2d({\n            x: getParamValue('x', node, tensorMap, context) as
Tensor3D |\n                Tensor4D,\n            filter: getParamValue('filter', node, tensorMap, context) as\n
Tensor4D,\n            strides: [stride[1], stride[2]],\n            pad: pad as 'valid' | 'same',\n            dataFormat:
dataFormat as 'NHWC' | 'NCHW',\n            dilations: [dilations[1], dilations[2]],\n            bias: biasArg,\n
activation:
 activationFunc as tfOps.fused.Activation,\n            preluActivationWeights: preluArg,\n            leakyreluAlpha\n
  })];\n        }\n\n        case 'FusedDepthwiseConv2dNative': {\n          const {\n            stride,\n            pad,\n
dataFormat,\n            dilations,\n            biasArg,\n            preluArg,\n            activationFunc,\n
leakyreluAlpha,\n          } = fusedConvAndDepthWiseParams(node, tensorMap, context);\n\n          return
[tfOps.fused.depthwiseConv2d({\n            x: getParamValue('x', node, tensorMap, context) as Tensor3D |\n
Tensor4D,\n            filter: getParamValue('filter', node, tensorMap, context) as\n                Tensor4D,\n
strides: [stride[1], stride[2]],\n            pad: pad as 'valid' | 'same',\n            dataFormat: dataFormat as 'NHWC' |
'NCHW',\n            dilations: [dilations[1], dilations[2]],\n            bias: biasArg,\n            activation: activationFunc
```

```
as tfOps.fused.Activation,\n            preluActivationWeights: preluArg,\n            leakyreluAlpha\n          })];\n
}\n        case 'Conv2DBackpropInput':\n        case 'Conv2dTranspose': {\n          const shape = getParamValue(\n
              'outputShape', node, tensorMap,\n                          context) as [number, number, number] |\n
[number, number, number, number];\n          const stride =\n              getParamValue('strides', node, tensorMap,
context) as number[];\n          const pad = getPadding(node, tensorMap, context);\n          return
[tfOps.conv2dTranspose(\n              getParamValue('x', node, tensorMap, context) as Tensor3D |\n
Tensor4D,\n              getParamValue('filter', node, tensorMap, context) as Tensor4D,\n              shape, [stride[1],
stride[2]], pad as 'valid' | 'same')];\n        }\n        case 'DepthwiseConv2dNative':\n        case 'DepthwiseConv2d': {\n
      const stride =\n
          getParamValue('strides', node, tensorMap, context) as number[];\n          const pad = getPadding(node,
tensorMap, context);\n          const dilations =\n              getParamValue('dilations', node, tensorMap, context) as
number[];\n          const dataFormat =\n              (getParamValue('dataFormat', node, tensorMap, context) as string)\n
              .toUpperCase();\n\n          return [tfOps.depthwiseConv2d(\n              getParamValue('input', node,
tensorMap, context) as Tensor3D |\n                  Tensor4D,\n              getParamValue('filter', node, tensorMap,
context) as Tensor4D,\n              [stride[1], stride[2]], pad as 'valid' | 'same',\n              dataFormat as 'NHWC' |
'NCHW', [dilations[1], dilations[2]])];\n        }\n        case 'Conv3D': {\n          const stride =\n
getParamValue('strides', node, tensorMap, context) as number[];\n          const pad = getParamValue('pad', node,
tensorMap, context);\n          const dataFormat
          =\n              (getParamValue('dataFormat', node, tensorMap, context) as string)\n                  .toUpperCase();\n
const dilations =\n              getParamValue('dilations', node, tensorMap, context) as number[];\n          return
[tfOps.conv3d(\n              getParamValue('x', node, tensorMap, context) as Tensor4D |\n
Tensor<Rank.R5>,\n              getParamValue('filter', node, tensorMap, context) as\n                  Tensor<Rank.R5>,\n
              [stride[1], stride[2], stride[3]], pad as 'valid' | 'same',\n              dataFormat as 'NDHWC' | 'NCDHW',\n
          [dilations[1], dilations[2], dilations[3]])];\n        }\n        case 'AvgPool': {\n          const stride =\n
getParamValue('strides', node, tensorMap, context) as number[];\n          const pad = getParamValue('pad', node,
tensorMap, context);\n          const kernelSize =\n              getParamValue('kernelSize', node, tensorMap, context) as
number[];\n\n          return
          [tfOps.avgPool(\n              getParamValue('x', node, tensorMap, context) as Tensor3D |\n                  Tensor4D,\n
      [kernelSize[1], kernelSize[2]], [stride[1], stride[2]],\n              pad as 'valid' | 'same')];\n        }\n        case
'MaxPool': {\n          const stride =\n              getParamValue('strides', node, tensorMap, context) as number[];\n
const pad = getParamValue('pad', node, tensorMap, context);\n          const kernelSize =\n
getParamValue('kernelSize', node, tensorMap, context) as number[];\n\n          return [tfOps.maxPool(\n
getParamValue('x', node, tensorMap, context) as Tensor3D |\n                  Tensor4D,\n              [kernelSize[1],
kernelSize[2]], [stride[1], stride[2]],\n              pad as 'valid' | 'same')];\n        }\n        case 'MaxPoolWithArgmax':
{\n          const stride =\n              getParamValue('strides', node, tensorMap, context) as number[];\n          const pad
= getParamValue('pad',
          node, tensorMap, context);\n          const kernelSize =\n              getParamValue('kernelSize', node, tensorMap,
context) as number[];\n          const includeBatchInIndex =\n              getParamValue('includeBatchInIndex', node,
tensorMap, context) as\n              boolean;\n          const {result, indexes} = tfOps.maxPoolWithArgmax(\n
getParamValue('x', node, tensorMap, context) as Tensor4D,\n              [kernelSize[1], kernelSize[2]], [stride[1],
stride[2]],\n              pad as 'valid' | 'same', includeBatchInIndex);\n          return [result, indexes];\n        }\n        case
'AvgPool3D': {\n          const stride =\n              getParamValue('strides', node, tensorMap, context) as number[];\n
    const pad = getParamValue('pad', node, tensorMap, context);\n          const kernelSize =\n
getParamValue('kernelSize', node, tensorMap, context) as number[];\n\n          return [tfOps.avgPool3d(\n
getParamValue('x',
          node, tensorMap, context) as Tensor5D,\n              [kernelSize[1], kernelSize[2], kernelSize[3]],\n
[stride[1], stride[2], stride[3]], pad as 'valid' | 'same')];\n        }\n\n        case 'MaxPool3D': {\n          const stride =\n
          getParamValue('strides', node, tensorMap, context) as number[];\n          const pad = getParamValue('pad',
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node, tensorMap, context);\n const kernelSize =\n getParamValue('kernelSize', node, tensorMap, context) as number[];\n\n return [tfOps.maxPool3d(\n getParamValue('x', node, tensorMap, context) as Tensor5D,\n [kernelSize[1], kernelSize[2], kernelSize[3]],\n [stride[1], stride[2], stride[3]], pad as 'valid' | 'same')];\n }\n\n case 'Dilation2D': {\n const strides =\n getParamValue('strides', node, tensorMap, context) as number[];\n const pad = getParamValue('pad', node, tensorMap, context);\n const dilations
=\n getParamValue('dilations', node, tensorMap, context) as number[];\n\n // strides: [1, stride_height, stride_width, 1].\n const strideHeight = strides[1];\n const strideWidth = strides[2];\n\n // dilations: [1, dilation_height, dilation_width, 1].\n const dilationHeight = dilations[1];\n const dilationWidth = dilations[2];\n\n return [tfOps.dilation2d(\n getParamValue('x', node, tensorMap, context) as Tensor3D |\n Tensor4D,\n getParamValue('filter', node, tensorMap, context) as Tensor3D,\n [strideHeight, strideWidth], pad as 'valid' | 'same',\n [dilationHeight, dilationWidth], 'NHWC' /* dataFormat */)];\n }\n\n default:\n throw TypeError(`Node type ${node.op} is not implemented`);\n }\n };\n\nexport const CATEGORY = 'convolution';\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n
* Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n
*/\n\nimport {DataType, Tensor, Tensor1D} from '@tensorflow/tfjs-core';\n// tslint:disable-next-line: no-imports-from-dist\nimport * as tfOps from '@tensorflow/tfjs-core/dist/ops/ops_for_converter';\n\nimport {NamedTensorsMap} from '../../data/types';\nimport {ExecutionContext} from '../../executor/execution_context';\nimport {InternalOpExecutor, Node}
from '../types';\n\nimport {getParamValue} from './utils';\n\nexport const executeOp: InternalOpExecutor =\n (node: Node, tensorMap: NamedTensorsMap,\n context: ExecutionContext): Tensor[] => {\n switch (node.op) {\n case 'Fill': {\n const shape =\n getParamValue('shape', node, tensorMap, context) as number[];\n const dtype =\n getParamValue('dtype', node, tensorMap, context) as DataType;\n const value =\n getParamValue('value', node, tensorMap, context) as number;\n return [tfOps.fill(shape, value, dtype)];\n }\n case 'LinSpace': {\n const start =\n getParamValue('start', node, tensorMap, context) as number;\n const stop =\n getParamValue('stop', node, tensorMap, context) as number;\n const num = getParamValue('num', node, tensorMap, context) as number;\n return [tfOps.linspace(start, stop, num)];\n }\n
case 'Multinomial': {\n const logits =\n getParamValue('logits', node, tensorMap, context) as Tensor1D;\n const numSamples =\n getParamValue('numSamples', node, tensorMap, context) as number;\n const seed =\n getParamValue('seed', node, tensorMap, context) as number;\n return [tfOps.multinomial(logits, numSamples, seed)];\n }\n case 'OneHot': {\n const indices =\n getParamValue('indices', node, tensorMap, context) as Tensor1D;\n const depth =\n getParamValue('depth', node, tensorMap, context) as number;\n const onValue =\n getParamValue('onValue', node, tensorMap, context) as number;\n const offValue =\n getParamValue('offValue', node, tensorMap, context) as number;\n return [tfOps.oneHot(indices, depth, onValue, offValue)];\n }\n case 'Ones': {\n return [tfOps.ones(\n getParamValue('shape', node, tensorMap, context) as number[],\n getParamValue('dtype', node, tensorMap, context) as DataType)];\n }\n case 'OnesLike': {\n return [tfOps.onesLike(\n getParamValue('x', node, tensorMap, context) as Tensor)];\n }\n case 'RandomUniform': {\n return [tfOps.randomUniform(\n // tslint:disable-next-line:no-any\n getParamValue('shape', node,

tensorMap, context) as any,\n getParamValue('minval', node, tensorMap, context) as number,\n getParamValue('maxval', node, tensorMap, context) as number,\n getParamValue('dtype', node, tensorMap, context) as DataType)];\n }\n case 'Range': {\n const start =\n getParamValue('start', node, tensorMap, context) as number;\n const stop =\n getParamValue('stop', node, tensorMap, context) as number;\n const step =\n getParamValue('step', node, tensorMap, context) as number;\n return [tfOps.range(\n start, stop, step,\n getParamValue('dtype', node, tensorMap, context) as 'float32' |\n 'int32')];\n }\n case 'TruncatedNormal': {\n const shape =\n getParamValue('shape', node, tensorMap, context) as number[];\n const mean =\n getParamValue('mean', node, tensorMap, context) as number;\n const stdDev =\n getParamValue('stdDev', node, tensorMap, context) as number;\n const seed =\n getParamValue('seed', node, tensorMap, context) as number;\n return [tfOps.truncatedNormal(\n shape, mean, stdDev,\n getParamValue('dtype', node, tensorMap, context) as 'float32' |\n 'int32',\n seed)];\n }\n case 'Zeros': {\n return [tfOps.zeros(\n getParamValue('shape', node, tensorMap, context) as number[],\n getParamValue('dtype', node, tensorMap, context) as DataType)];\n }\n case 'ZerosLike': {\n return [tfOps.zerosLike(\n getParamValue('x', node, tensorMap, context) as Tensor)];\n }\n default:\n throw TypeError(`Node type ${node.op} is not implemented`);\n }\n};\n\nexport const CATEGORY = 'creation';\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing\n permissions and\n * limitations under the License.\n *\n ==\n */\n\nimport {Tensor, Tensor1D, Tensor2D} from '@tensorflow/tfjs-core';\n// tslint:disable-next-line: no-imports-from-dist\nimport * as tfOps from '@tensorflow/tfjs-core/dist/ops/ops_for_converter';\n\nimport {NamedTensorsMap} from '../../data/types';\nimport {ExecutionContext} from '../../executor/execution_context';\nimport {InternalOpAsyncExecutor, Node} from '../types';\n\nimport {getParamValue} from './utils';\n\nfunction nmsParams(\n node: Node, tensorMap: NamedTensorsMap, context: ExecutionContext) {\n const boxes = getParamValue('boxes', node, tensorMap, context) as Tensor;\n const scores = getParamValue('scores', node, tensorMap, context) as Tensor;\n const maxOutputSize =\n getParamValue('maxOutputSize', node, tensorMap, context) as number;\n const iouThreshold =\n getParamValue('iouThreshold', node, tensorMap, context)\n as number;\n const scoreThreshold =\n getParamValue('scoreThreshold', node, tensorMap, context) as number;\n const softNmsSigma =\n getParamValue('softNmsSigma', node, tensorMap, context) as number;\n\n return {\n boxes,\n scores,\n maxOutputSize,\n iouThreshold,\n scoreThreshold,\n softNmsSigma\n };\n}\n\nexport const executeOp: InternalOpAsyncExecutor = async(\n node: Node, tensorMap: NamedTensorsMap,\n context: ExecutionContext): Promise<Tensor[]> => {\n switch (node.op) {\n case 'NonMaxSuppressionV5': {\n const {\n boxes,\n scores,\n maxOutputSize,\n iouThreshold,\n scoreThreshold,\n softNmsSigma\n } = nmsParams(node, tensorMap, context);\n\n const result = await tfOps.image.nonMaxSuppressionWithScoreAsync(\n boxes as Tensor2D, scores as Tensor1D, maxOutputSize,\n iouThreshold,\n scoreThreshold, softNmsSigma);\n\n return [result.selectedIndices,\n result.selectedScores];\n }\n case 'NonMaxSuppressionV4': {\n const {boxes, scores, maxOutputSize, iouThreshold, scoreThreshold} =\n nmsParams(node, tensorMap, context);\n\n const padToMaxOutputSize =\n getParamValue('padToMaxOutputSize', node, tensorMap, context) as\n boolean;\n\n const result = await tfOps.image.nonMaxSuppressionPaddedAsync(\n boxes as Tensor2D, scores as Tensor1D, maxOutputSize,

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iouThreshold,\n scoreThreshold, padToMaxOutputSize);\n\n return [result.selectedIndices,
result.validOutputs];\n }\n case 'NonMaxSuppressionV3':\n case 'NonMaxSuppressionV2': {\n const
{boxes, scores, maxOutputSize, iouThreshold, scoreThreshold} =\n nmsParams(node, tensorMap,
context);\n\n return [await tfOps.image.nonMaxSuppressionAsync(\n boxes as Tensor2D, scores as
Tensor1D, maxOutputSize, iouThreshold,\n scoreThreshold)];\n }\n case 'Where': {\n const condition =
tfOps.cast(\n
    (getParamValue('condition', node, tensorMap, context) as Tensor),\n 'bool');\n const result = [await
tfOps.whereAsync(condition)];\n condition.dispose();\n return result;\n }\n case 'ListDiff': {\n return
tfOps.setdiff1dAsync(\n getParamValue('x', node, tensorMap, context) as Tensor,\n getParamValue('y',
node, tensorMap, context) as Tensor);\n }\n default:\n throw TypeError(`Node type ${node.op} is not
implemented`);\n }\n};\n\nexport const CATEGORY = 'dynamic';\n","/**\n * @license\n * Copyright 2018 Google
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 WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for
the specific language governing permissions and\n * limitations under the License.\n *
==========================================================================\n
*/\n\nimport {Tensor} from '@tensorflow/tfjs-core';\n// tslint:disable-next-line: no-imports-from-dist\nimport * as
tfOps from '@tensorflow/tfjs-core/dist/ops/ops_for_converter';\n\nimport {NamedTensorsMap} from
'../../data/types';\nimport {ExecutionContext} from '../../executor/execution_context';\nimport {InternalOpExecutor,
Node} from '../types';\n\nimport {getParamValue} from './utils';\n\nexport const executeOp: InternalOpExecutor =\n
 (node: Node, tensorMap: NamedTensorsMap, context: ExecutionContext):\n Tensor[] => {\n switch
(node.op) {\n case 'TopKV2': {\n const x = getParamValue('x', node, tensorMap, context) as
Tensor;\n const k = getParamValue('k', node, tensorMap,
 context) as number;\n const sorted =\n getParamValue('sorted', node, tensorMap, context) as
boolean;\n const result = tfOps.topk(x, k, sorted);\n return [result.values, result.indices];\n }\n
    case 'Unique': {\n const x = getParamValue('x', node, tensorMap, context) as Tensor;\n const
result = tfOps.unique(x);\n return [result.values, result.indices];\n }\n case 'UniqueV2': {\n
  const x = getParamValue('x', node, tensorMap, context) as Tensor;\n const axis =\n
getParamValue('axis', node, tensorMap, context) as number;\n const result = tfOps.unique(x, axis);\n
return [result.values, result.indices];\n }\n default:\n throw TypeError(`Node type ${node.op}
is not implemented`);\n }\n };\n\nexport const CATEGORY = 'evaluation';\n","/**\n
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WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for
the specific language governing permissions and\n * limitations under the License.\n *
==========================================================================\n
*/\n\nimport {Tensor} from '@tensorflow/tfjs-core';\n// tslint:disable-next-line: no-imports-from-dist\nimport * as
tfOps from '@tensorflow/tfjs-core/dist/ops/ops_for_converter';\n\nimport {NamedTensorsMap} from
'../../data/types';\nimport {ExecutionContext} from '../../executor/execution_context';\nimport
 {InternalOpExecutor, Node} from '../types';\n\nimport {cloneTensor, getParamValue, getTensor} from
'./utils';\n\nexport const executeOp: InternalOpExecutor =\n (node: Node, tensorMap: NamedTensorsMap,\n
context: ExecutionContext): Tensor[] => {\n switch (node.op) {\n case 'Const': {\n return
tensorMap[node.name];\n }\n case 'PlaceholderWithDefault':\n const def =\n
getParamValue('default', node, tensorMap, context) as Tensor;\n return [getTensor(node.name, tensorMap,
```

context) || def];\n case 'Placeholder':\n return [getTensor(node.name, tensorMap, context)];\n case 'Identity':\n case 'StopGradient':\n case 'FakeQuantWithMinMaxVars': { // This op is currently ignored.\n const data = getParamValue('x', node, tensorMap, context) as Tensor;\n return [cloneTensor(data)];\n }\n case 'IdentityN':\n return (getParamValue('x',\n node, tensorMap, context) as Tensor[])\n .map((t: Tensor) => cloneTensor(t));\n case 'Snapshot':\n const snapshot =\n (getParamValue('x', node, tensorMap, context) as Tensor);\n return [cloneTensor(snapshot)];\n case 'Shape':\n return [tfOps.tensor1d(\n (getParamValue('x', node, tensorMap, context) as Tensor).shape,\n 'int32')];\n case 'ShapeN':\n return (getParamValue('x', node, tensorMap, context) as Tensor[])\n .map((t: Tensor) => tfOps.tensor1d(t.shape));\n case 'Size':\n return [tfOps.scalar(\n (getParamValue('x', node, tensorMap, context) as Tensor).size,\n 'int32')];\n case 'Rank':\n return [tfOps.scalar(\n (getParamValue('x', node, tensorMap, context) as Tensor).rank,\n 'int32')];\n case 'NoOp':\n return [tfOps.scalar(1)];\n case 'Print':\n const input = getParamValue('x', node, tensorMap, context) as Tensor;\n const data =\n getParamValue('data', node, tensorMap, context) as Tensor[];\n const message =\n getParamValue('message', node, tensorMap, context) as string;\n const summarize =\n getParamValue('summarize', node, tensorMap, context) as number;\n console.warn(\n 'The graph has a tf.print() operation,' +\n 'usually used for debugging, which slows down performance.');\n console.log(message);\n for (let i = 0; i < data.length; i++) {\n console.log(Array.prototype.slice.call(data[i].dataSync())\n .slice(0, summarize));\n }\n return [input];\n\n default:\n throw TypeError(`Node type ${node.op} is not implemented`);\n }\n };\n\nexport const CATEGORY = 'graph';\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\nimport {DataType, keep, scalar, stack, Tensor, tidy, unstack, util} from '@tensorflow/tfjs-core';\n\n/**\n * Hashtable contains a set of tensors, which can be accessed by key.\n */\nexport class HashTable {\n readonly handle: Tensor;\n\n // tslint:disable-next-line: no-any\n private tensorMap: Map<any, Tensor>;\n\n get id() {\n return this.handle.id;\n }\n\n /**\n * Constructor of HashTable. Creates a hash table.\n *\n * @param keyDType `dtype` of the table keys.\n * @param valueDType `dtype` of the table values.\n */\n constructor(readonly keyDType: DataType, readonly valueDType: DataType) {\n this.handle = scalar(0);\n // tslint:disable-next-line: no-any\n this.tensorMap = new Map<any, Tensor>();\n\n keep(this.handle);\n }\n\n /**\n * Dispose the tensors and handle and clear the hashtable.\n */\n clearAndClose() {\n this.tensorMap.forEach(value => value.dispose());\n this.tensorMap.clear();\n this.handle.dispose();\n }\n\n /**\n * The number of items in the hash table.\n */\n size(): number {\n return this.tensorMap.size;\n }\n\n /**\n * Replaces the contents of the table with the specified keys and values.\n * @param keys Keys to store in the hashtable.\n * @param values Values to store in the hashtable.\n */\n async import(keys: Tensor, values: Tensor): Promise<Tensor> {\n this.checkKeyAndValueTensor(keys, values);\n\n // We only store the primitive values of the keys, this allows lookup\n // to be O(1).\n const $keys = await keys.data();\n\n // Clear the hashTable before inserting new values.\n this.tensorMap.forEach(value => value.dispose());\n this.tensorMap.clear();\n\n return tidy(() => {\n const $values = unstack(values);\n\n const keysLength = $keys.length;\n const valuesLength = $values.length;\n\n util.assert(\n keysLength === valuesLength,\n () => `The number of elements doesn't match, keys has ` +\n `${keysLength} elements, the values has ${valuesLength} ` +\n `elements.`);\n\n for (let i = 0; i < keysLength; i++) {\n const key = $keys[i];\n const value = $values[i];\n\n keep(value);\n this.tensorMap.set(key, value);\n }\n

```
return this.handle;\n    });\n  }\n\n  /**\n   * Looks up
 keys in a hash table, outputs the corresponding values.\n   *\n   * Performs batch lookups, for every element in the
key tensor, `find`\n   * stacks the corresponding value into the return tensor.\n   *\n   * If an element is not present in
the table, the given `defaultValue` is\n   * used.\n   *\n   * @param keys Keys to look up. Must have the same type
as the keys of the\n   *     table.\n   * @param defaultValue The scalar `defaultValue` is the value output for keys\n
*     not present in the table. It must also be of the same type as the\n   *     table values.\n   */\n  async find(keys:
Tensor, defaultValue: Tensor): Promise<Tensor> {\n    this.checkKeyAndValueTensor(keys, defaultValue);\n\n
const $keys = await keys.data();\n\n    return tidy(() => {\n      const result: Tensor[] = [];\n\n      for (let i = 0; i <
$keys.length; i++) {\n        const key = $keys[i];\n\n        const value = this.findWithDefault(key, defaultValue);\n
  result.push(value);\n      }\n\n
  return stack(result);\n    });\n  }\n\n  // tslint:disable-next-line: no-any\n  private findWithDefault(key: any,
defaultValue: Tensor): Tensor {\n    const result = this.tensorMap.get(key);\n\n    return result != null ? result :
defaultValue;\n  }\n\n  private checkKeyAndValueTensor(key: Tensor, value: Tensor) {\n    if (key.dtype !==
this.keyDType) {\n      throw new Error(\n          `Expect key dtype ${this.keyDType}, but got ` +\n
`${key.dtype}`);\n    }\n\n    if (value.dtype !== this.valueDType) {\n      throw new Error(\n          `Expect value
dtype ${this.valueDType}, but got ` +\n          `${value.dtype}`);\n    }\n  }\n}\n","/**\n * @license\n * Copyright
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WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for
the specific language governing permissions and\n * limitations under the License.\n *
==========================================================================\n
*/\n\nimport {DataType, Tensor} from '@tensorflow/tfjs-core';\n\nimport {NamedTensorsMap} from
'../../data/types';\nimport {ExecutionContext} from '../../executor/execution_context';\nimport {HashTable} from
'../../executor/hash_table';\nimport {ResourceManager} from '../../executor/resource_manager';\nimport
{InternalOpAsyncExecutor, Node} from '../types';\n\nimport {getParamValue} from './utils';\n\nexport const
executeOp: InternalOpAsyncExecutor = async(\n    node: Node, tensorMap: NamedTensorsMap, context:
ExecutionContext,\n    resourceManager: ResourceManager): Promise<Tensor[]> => {\n  switch (node.op) {\n
 case 'HashTable':\n    case 'HashTableV2': {\n      const keyDType =\n          getParamValue('keyDType', node,
tensorMap, context) as DataType;\n      const valueDType =\n          getParamValue('valueDType', node, tensorMap,
context) as DataType;\n\n      const hashTable = new HashTable(keyDType, valueDType);\n
resourceManager.addHashTable(node.name, hashTable);\n      return [hashTable.handle];\n    }\n    case
'LookupTableImport':\n    case 'LookupTableImportV2': {\n      const handle = getParamValue(\n
'tableHandle', node, tensorMap, context,\n                                resourceManager) as Tensor;\n      const keys =
getParamValue('keys', node, tensorMap, context) as Tensor;\n      const values =\n          getParamValue('values',
node, tensorMap, context) as Tensor;\n\n      const hashTable = resourceManager.getHashTableById(handle.id);\n\n
   return [await hashTable.import(keys, values)];\n    }\n    case 'LookupTableFind':\n    case 'LookupTableFindV2':
 {\n      const handle = getParamValue(\n                                'tableHandle', node, tensorMap, context,\n
resourceManager) as Tensor;\n      const keys = getParamValue('keys', node, tensorMap, context) as Tensor;\n
const defaultValue =\n          getParamValue('defaultValue', node, tensorMap, context) as Tensor;\n\n      const
hashTable = resourceManager.getHashTableById(handle.id);\n      return [await hashTable.find(keys,
defaultValue)];\n    }\n    default:\n      throw TypeError(`Node type ${node.op} is not implemented`);\n
}\n};\n\nexport const CATEGORY = 'hash_table';\n","/**\n * @license\n * Copyright 2018 Google LLC. All
Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this
file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n *
http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing,
software\n
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 * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========================================================================\n
*/\n\nimport {Tensor, Tensor1D, Tensor2D, Tensor3D, Tensor4D} from '@tensorflow/tfjs-core';\n// tslint:disable-next-line: no-imports-from-dist\nimport * as tfOps from '@tensorflow/tfjs-core/dist/ops/ops_for_converter';\n\nimport {NamedTensorsMap} from '../../data/types';\nimport {ExecutionContext} from '../../executor/execution_context';\nimport {InternalOpExecutor, Node} from '../types';\n\nimport {getParamValue} from './utils';\n\nexport const executeOp: InternalOpExecutor =\n    (node: Node, tensorMap: NamedTensorsMap,\n     context: ExecutionContext): Tensor[] => {\n      switch (node.op) {\n case 'ResizeBilinear': {\n          const images
 =\n              getParamValue('images', node, tensorMap, context) as Tensor;\n          const size =\n getParamValue('size', node, tensorMap, context) as number[];\n          const alignCorners =\n getParamValue('alignCorners', node, tensorMap, context) as\n              boolean;\n          const halfPixelCenters =\n              getParamValue('halfPixelCenters', node, tensorMap, context) as\n              boolean;\n          return [tfOps.image.resizeBilinear(\n              images as Tensor3D | Tensor4D, [size[0], size[1]], alignCorners,\n halfPixelCenters)];\n        }\n        case 'ResizeNearestNeighbor': {\n          const images =\n getParamValue('images', node, tensorMap, context) as Tensor;\n          const size =\n              getParamValue('size', node, tensorMap, context) as number[];\n          const alignCorners =\n              getParamValue('alignCorners', node, tensorMap, context) as\n              boolean;\n
    const halfPixelCenters =\n              getParamValue('halfPixelCenters', node, tensorMap, context) as\n boolean;\n          return [tfOps.image.resizeNearestNeighbor(\n              images as Tensor3D | Tensor4D, [size[0], size[1]], alignCorners,\n              halfPixelCenters)];\n        }\n        case 'CropAndResize': {\n          const image =\n            getParamValue('image', node, tensorMap, context) as Tensor;\n          const boxes =\n getParamValue('boxes', node, tensorMap, context) as Tensor;\n          const boxInd =\n getParamValue('boxInd', node, tensorMap, context) as Tensor;\n          const cropSize =\n getParamValue('cropSize', node, tensorMap, context) as number[];\n          const method =\n getParamValue('method', node, tensorMap, context) as string;\n          const extrapolationValue =\n getParamValue('extrapolationValue', node, tensorMap, context) as\n              number;\n          return [tfOps.image.cropAndResize(\n              image as Tensor4D, boxes as Tensor2D, boxInd as Tensor1D,\n              cropSize as [number, number], method as 'bilinear' | 'nearest',\n              extrapolationValue)];\n        }\n default:\n          throw TypeError(`Node type ${node.op} is not implemented`);\n      }\n    };\n\nexport const CATEGORY = 'image';\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations
 under the License.\n *
==========================================================================\n
*/\n\nimport {Tensor} from '@tensorflow/tfjs-core';\n// tslint:disable-next-line: no-imports-from-dist\nimport * as tfOps from '@tensorflow/tfjs-core/dist/ops/ops_for_converter';\n\nimport {NamedTensorsMap} from '../../data/types';\nimport {ExecutionContext} from '../../executor/execution_context';\nimport {InternalOpExecutor, Node} from '../types';\n\nimport {getParamValue} from './utils';\n\nexport const executeOp: InternalOpExecutor =\n  (node: Node, tensorMap: NamedTensorsMap,\n     context: ExecutionContext): Tensor[] => {\n      switch (node.op) {\n        case 'Equal': {\n          return [tfOps.equal(\n              getParamValue('a', node, tensorMap, context) as Tensor,\n              getParamValue('b', node, tensorMap, context) as Tensor)];\n        }\n        case 'NotEqual': {\n          return [tfOps.notEqual(\n              getParamValue('a', node, tensorMap, context)
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as Tensor,\n getParamValue('b', node, tensorMap, context) as Tensor)];\n }\n case 'Greater': {\n return [tfOps.greater(\n getParamValue('a', node, tensorMap, context) as Tensor,\n getParamValue('b', node, tensorMap, context) as Tensor)];\n }\n case 'GreaterEqual': {\n return [tfOps.greaterEqual(\n getParamValue('a', node, tensorMap, context) as Tensor,\n getParamValue('b', node, tensorMap, context) as Tensor)];\n }\n case 'Less': {\n return [tfOps.less(\n getParamValue('a', node, tensorMap, context) as Tensor,\n getParamValue('b', node, tensorMap, context) as Tensor)];\n }\n case 'LessEqual': {\n return [tfOps.lessEqual(\n getParamValue('a', node, tensorMap, context) as Tensor,\n getParamValue('b', node, tensorMap, context) as Tensor)];\n }\n case 'LogicalAnd':
{\n return [tfOps.logicalAnd(\n getParamValue('a', node, tensorMap, context) as Tensor,\n getParamValue('b', node, tensorMap, context) as Tensor)];\n }\n case 'LogicalNot': {\n return [tfOps.logicalNot(\n getParamValue('a', node, tensorMap, context) as Tensor)];\n }\n case 'LogicalOr': {\n return [tfOps.logicalOr(\n getParamValue('a', node, tensorMap, context) as Tensor,\n getParamValue('b', node, tensorMap, context) as Tensor)];\n }\n case 'Select':\n case 'SelectV2': {\n return [tfOps.where(\n getParamValue('condition', node, tensorMap, context) as Tensor,\n getParamValue('a', node, tensorMap, context) as Tensor,\n getParamValue('b', node, tensorMap, context) as Tensor)];\n }\n default:\n throw TypeError(`Node type ${node.op} is not implemented`);\n }\n};\n\nexport const
CATEGORY = 'logical';\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n
*/\n\nimport {Tensor, Tensor2D} from '@tensorflow/tfjs-core';\n// tslint:disable-next-line: no-imports-from-dist\nimport * as tfOps from '@tensorflow/tfjs-core/dist/ops/ops_for_converter';\n\nimport {NamedTensorsMap} from '../../data/types';\nimport
{ExecutionContext} from '../../executor/execution_context';\nimport {InternalOpExecutor, Node} from '../types';\n\nimport {getParamValue} from './utils';\n\nexport const executeOp: InternalOpExecutor =\n (node: Node, tensorMap: NamedTensorsMap,\n context: ExecutionContext): Tensor[] => {\n switch (node.op) {\n case 'BatchMatMul':\n case 'BatchMatMulV2':\n case 'MatMul':\n return [tfOps.matMul(\n getParamValue('a', node, tensorMap, context) as Tensor2D,\n getParamValue('b', node, tensorMap, context) as Tensor2D,\n getParamValue('transposeA', node, tensorMap, context) as boolean,\n getParamValue('transposeB', node, tensorMap, context) as\n boolean)];\n\n case 'Transpose':\n return [tfOps.transpose(\n getParamValue('x', node, tensorMap, context) as Tensor,\n getParamValue('perm', node, tensorMap, context) as number[])];\n\n case '_FusedMatMul':\n const [extraOp, activationFunc] =\n (getParamValue('fusedOps', node, tensorMap, context) as string[]);\n\n const isBiasAdd = extraOp === 'biasadd';\n const isPrelu = activationFunc === 'prelu';\n\n const numArgs =\n (getParamValue('numArgs', node, tensorMap, context) as number);\n const leakyreluAlpha =\n getParamValue('leakyreluAlpha', node, tensorMap, context) as\n number;\n\n if (isBiasAdd) {\n if (isPrelu && numArgs !== 2) {\n throw new Error(\n 'Fused MatMul with BiasAdd and Prelu must have two ' +\n 'extra arguments: bias and alpha.');\n }\n if (!isPrelu && numArgs !== 1) {\n throw new Error(\n 'Fused MatMul with BiasAdd must have one extra argument: bias.');\n }\n }\n const [biasArg, preluArg] =\n getParamValue('args',

node, tensorMap, context) as Tensor[];\n return [tfOps.fused.matMul({\n a: getParamValue('a', node, tensorMap, context) as Tensor2D,\n b: getParamValue('b', node, tensorMap, context) as Tensor2D,\n transposeA: getParamValue('transposeA', node, tensorMap, context) as\n boolean,\n transposeB: getParamValue('transposeB', node, tensorMap, context) as\n boolean,\n bias: biasArg,\n activation: activationFunc as tfOps.fused.Activation,\n preluActivationWeights: preluArg,\n leakyreluAlpha\n })];\n\n default:\n throw TypeError(`Node type ${node.op} is not implemented`);\n }\n };\n\nexport const CATEGORY = 'matrices';\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n
* You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n*/\n\nimport {Scalar, Tensor, Tensor3D, Tensor4D} from '@tensorflow/tfjs-core';\n// tslint:disable-next-line: no-imports-from-dist\nimport * as tfOps from '@tensorflow/tfjs-core/dist/ops/ops_for_converter';\n\nimport {NamedTensorsMap} from '../../data/types';\nimport {ExecutionContext} from '../../executor/execution_context';\nimport {InternalOpExecutor, Node} from '../types';\n\nimport {getParamValue} from './utils';\n\nexport const executeOp: InternalOpExecutor =\n (node: Node, tensorMap: NamedTensorsMap,\n context: ExecutionContext): Tensor[] => {\n switch (node.op) {\n case 'FusedBatchNorm':\n case 'FusedBatchNormV2': {\n return [tfOps.batchNorm(\n getParamValue('x', node, tensorMap, context) as Tensor,\n getParamValue('mean', node, tensorMap, context) as Tensor,\n getParamValue('variance', node, tensorMap, context) as Tensor,\n getParamValue('offset', node, tensorMap, context) as Tensor,\n getParamValue('scale', node, tensorMap, context) as Tensor,\n getParamValue('epsilon', node, tensorMap, context) as number)];\n }\n case 'FusedBatchNormV3': {\n return [tfOps.batchNorm(\n getParamValue('x', node, tensorMap, context) as Tensor,\n getParamValue('mean', node, tensorMap, context) as Tensor,\n getParamValue('variance', node, tensorMap, context) as Tensor,\n getParamValue('offset',
node, tensorMap, context) as Tensor,\n getParamValue('scale', node, tensorMap, context) as Tensor,\n getParamValue('epsilon', node, tensorMap, context) as number)];\n }\n case 'LRN': {\n return [tfOps.localResponseNormalization(\n getParamValue('x', node, tensorMap, context) as Tensor3D |\n Tensor4D,\n getParamValue('radius', node, tensorMap, context) as number,\n getParamValue('bias', node, tensorMap, context) as number,\n getParamValue('alpha', node, tensorMap, context) as number,\n getParamValue('beta', node, tensorMap, context) as number)];\n }\n case 'Softmax': {\n return [tfOps.softmax(\n getParamValue('x', node, tensorMap, context) as Tensor)];\n }\n case 'LogSoftmax': {\n return [tfOps.logSoftmax(\n getParamValue('x', node, tensorMap, context) as Tensor)];\n }\n case
'SparseToDense': {\n return [tfOps.sparseToDense(\n getParamValue('sparseIndices', node, tensorMap, context) as\n Tensor,\n getParamValue('outputShape', node, tensorMap, context) as Tensor,\n getParamValue('sparseValues', node, tensorMap, context) as\n number[],\n getParamValue('defaultValue', node, tensorMap, context) as\n Scalar)];\n }\n default:\n throw TypeError(`Node type ${node.op} is not implemented`);\n }\n };\n\nexport const CATEGORY = 'normalization';\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n *
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permissions and\n * limitations under the License.\n *
==========================================================================\n
*/\n\nimport {Tensor, Tensor1D, Tensor2D} from '@tensorflow/tfjs-core';\n// tslint:disable-next-line: no-imports-
from-dist\nimport * as tfOps from '@tensorflow/tfjs-core/dist/ops/ops_for_converter';\n\nimport
{NamedTensorsMap} from '../../data/types';\nimport {ExecutionContext} from
'../../executor/execution_context';\nimport {InternalOpExecutor, Node} from '../types';\n\nimport {getParamValue}
from './utils';\n\nexport const executeOp: InternalOpExecutor =\n    (node: Node, tensorMap: NamedTensorsMap,\n
  context: ExecutionContext): Tensor[] => {\n      switch (node.op) {\n        case 'Max': {\n          const axis =\n
  getParamValue('axis',
 node, tensorMap, context) as number[];\n          const keepDims =\n              getParamValue('keepDims', node,
tensorMap, context) as boolean;\n          return [tfOps.max(\n              getParamValue('x', node, tensorMap, context)
as Tensor, axis,\n              keepDims)];\n        }\n        case 'Mean': {\n          const axis =\n
getParamValue('axis', node, tensorMap, context) as number[];\n          const keepDims =\n
getParamValue('keepDims', node, tensorMap, context) as boolean;\n          return [tfOps.mean(\n
getParamValue('x', node, tensorMap, context) as Tensor, axis,\n              keepDims)];\n        }\n        case 'Min': {\n
    const axis =\n              getParamValue('axis', node, tensorMap, context) as number[];\n          const keepDims =\n
        getParamValue('keepDims', node, tensorMap, context) as boolean;\n          return [tfOps.min(\n
getParamValue('x', node, tensorMap, context) as Tensor,
 axis,\n              keepDims)];\n        }\n        case 'Sum': {\n          const axis =\n              getParamValue('axis', node,
tensorMap, context) as number[];\n          const keepDims =\n              getParamValue('keepDims', node, tensorMap,
context) as boolean;\n          return [tfOps.sum(\n              getParamValue('x', node, tensorMap, context) as Tensor,
axis,\n              keepDims)];\n        }\n        case 'All': {\n          const axis =\n              getParamValue('axis', node,
tensorMap, context) as number[];\n          const keepDims =\n              getParamValue('keepDims', node, tensorMap,
context) as boolean;\n          return [tfOps.all(\n              getParamValue('x', node, tensorMap, context) as Tensor,
axis,\n              keepDims)];\n        }\n        case 'Any': {\n          const axis =\n              getParamValue('axis', node,
tensorMap, context) as number[];\n          const keepDims =\n              getParamValue('keepDims', node, tensorMap,
 context) as boolean;\n          return [tfOps.any(\n              getParamValue('x', node, tensorMap, context) as Tensor,
axis,\n              keepDims)];\n        }\n        case 'ArgMax': {\n          const axis =\n              getParamValue('axis',
node, tensorMap, context) as number;\n          return [tfOps.argMax(\n              getParamValue('x', node, tensorMap,
context) as Tensor, axis)];\n        }\n        case 'ArgMin': {\n          const axis =\n              getParamValue('axis', node,
tensorMap, context) as number;\n          return [tfOps.argMin(\n              getParamValue('x', node, tensorMap,
context) as Tensor, axis)];\n        }\n        case 'Prod': {\n          const axis =\n              getParamValue('axis', node,
tensorMap, context) as number[];\n          const keepDims =\n              getParamValue('keepDims', node, tensorMap,
context) as boolean;\n          return [tfOps.prod(\n              getParamValue('x', node, tensorMap, context) as Tensor,
axis,\n
              keepDims)];\n        }\n        case 'Cumsum': {\n          const axis =\n              getParamValue('axis', node,
tensorMap, context) as number;\n          const exclusive =\n              getParamValue('exclusive', node, tensorMap,
context) as boolean;\n          const reverse =\n              getParamValue('reverse', node, tensorMap, context) as
boolean;\n          return [tfOps.cumsum(\n              getParamValue('x', node, tensorMap, context) as Tensor, axis,\n
          exclusive, reverse)];\n        }\n        case 'Bincount':\n          const x = getParamValue('x', node, tensorMap,
context) as Tensor1D;\n          const weights =\n              getParamValue('weights', node, tensorMap, context) as
Tensor1D;\n          const size =\n              getParamValue('size', node, tensorMap, context) as number;\n\n
return [tfOps.bincount(x, weights, size)];\n        case 'DenseBincount': {\n          const x = getParamValue('x', node,
tensorMap, context)
 as Tensor1D |\n              Tensor2D;\n          const weights =\n              getParamValue('weights', node, tensorMap,
context) as Tensor1D |\n              Tensor2D;\n          const size =\n              getParamValue('size', node, tensorMap,
context) as number;\n\n          const binaryOutput =\n              getParamValue('binaryOutput', node, tensorMap,
context) as\n              boolean;\n\n          return [tfOps.denseBincount(x, weights, size, binaryOutput)];\n        }\n
```

default:\n throw TypeError(`Node type ${node.op} is not implemented`);\n }\n };\n\nexport const CATEGORY = 'reduction';\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ===\n */\n\nimport {Scalar, Tensor, Tensor1D, tidy, util} from '@tensorflow/tfjs-core';\n// tslint:disable-next-line: no-imports-from-dist\nimport * as tfOps from '@tensorflow/tfjs-core/dist/ops/ops_for_converter';\n\nimport {NamedTensorsMap} from '../../data/types';\nimport {ExecutionContext} from '../../executor/execution_context';\nimport {InternalOpExecutor, Node} from '../types';\n\nimport {getParamValue} from './utils';\n\nexport const executeOp: InternalOpExecutor =\n (node: Node, tensorMap: NamedTensorsMap,\n context: ExecutionContext): Tensor[] => {\n switch (node.op) {\n case 'ConcatV2':\n case 'Concat': {\n const n = getParamValue('n', node, tensorMap, context) as number;\n const axis =\n getParamValue('axis', node, tensorMap, context) as number;\n let inputs =\n getParamValue('tensors', node, tensorMap, context) as Tensor[];\n inputs = inputs.slice(0, n);\n return [tfOps.concat(inputs, axis)];\n }\n case 'Gather': {\n const input = getParamValue('x', node, tensorMap, context) as Tensor;\n const indices =\n getParamValue('indices', node, tensorMap, context) as Tensor1D;\n return [tfOps.gather(input, tfOps.cast(indices, 'int32'), 0)];\n }\n case 'GatherV2': {\n const axis =\n getParamValue('axis', node, tensorMap, context) as number;\n const batchDims =\n getParamValue('batchDims', node, tensorMap, context) as number;\n const input = getParamValue('x', node, tensorMap, context) as Tensor;\n\n const indices =\n getParamValue('indices', node, tensorMap, context) as Tensor1D;\n return [tfOps.gather(\n input, tfOps.cast(indices, 'int32'), axis, batchDims)];\n }\n case 'Reverse': {\n const dims =\n getParamValue('dims', node, tensorMap, context) as boolean[];\n const axis = [];\n for (let i = 0; i < dims.length; i++) {\n if (dims[i]) {\n axis.push(i);\n }\n }\n const input = getParamValue('x', node, tensorMap, context) as Tensor;\n return [tfOps.reverse(input, axis)];\n }\n case 'ReverseV2': {\n const axis =\n getParamValue('axis', node, tensorMap, context) as number[];\n const input = getParamValue('x', node, tensorMap, context) as Tensor;\n return [tfOps.reverse(input, axis)];\n }\n case 'Slice': {\n // tslint:disable-next-line:no-any\n const begin = getParamValue('begin', node, tensorMap, context) as any;\n // tslint:disable-next-line:no-any\n const size = getParamValue('size', node, tensorMap, context) as any;\n return [tfOps.slice(\n getParamValue('x', node, tensorMap, context) as Tensor, begin,\n size)];\n }\n case 'StridedSlice': {\n const begin =\n getParamValue('begin', node, tensorMap, context) as number[];\n const end =\n getParamValue('end', node, tensorMap, context) as number[];\n const strides =\n getParamValue('strides', node, tensorMap, context) as number[];\n const beginMask =\n getParamValue('beginMask', node, tensorMap, context) as number;\n const endMask =\n getParamValue('endMask', node, tensorMap, context) as number;\n const ellipsisMask =\n getParamValue('ellipsisMask', node, tensorMap, context) as number;\n const newAxisMask =\n getParamValue('newAxisMask', node, tensorMap, context) as number;\n const shrinkAxisMask =\n getParamValue('shrinkAxisMask', node, tensorMap, context) as\n number;\n const tensor = getParamValue('x', node, tensorMap, context) as Tensor;\n\n return [tfOps.stridedSlice(\n tensor, begin, end, strides, beginMask, endMask, ellipsisMask,\n newAxisMask, shrinkAxisMask)];\n }\n case 'Pack': {\n return tidy(() => {\n const axis =\n getParamValue('axis', node, tensorMap, context) as number;\n const tensors =\n getParamValue('tensors', node, tensorMap, context) as Tensor[];\n // Reshape the tensors to the first tensor's

shape if they don't\n // match.\n const shape = tensors[0].shape;\n const squeezedShape = tfOps.squeeze(tensors[0]).shape;\n const
mapped = tensors.map(tensor => {\n const sameShape = util.arraysEqual(tensor.shape, shape);\n if (!sameShape &&\n !util.arraysEqual(\n tfOps.squeeze(tensor).shape, squeezedShape)) {\n throw new Error('the input tensors shape does not match');\n }\n return sameShape ? tensor : tfOps.reshape(tensor, shape);\n });\n return [tfOps.stack(mapped, axis)];\n });\n }\n case 'Unpack': {\n const axis =\n getParamValue('axis', node, tensorMap, context) as number;\n const tensor =\n getParamValue('tensor', node, tensorMap, context) as Tensor;\n return tfOps.unstack(tensor, axis);\n }\n case 'Tile': {\n const reps =\n getParamValue('reps', node, tensorMap, context) as number[];\n return [tfOps.tile(\n getParamValue('x', node, tensorMap, context)
as Tensor, reps)];\n }\n case 'Split':\n case 'SplitV': {\n const axis =\n getParamValue('axis', node, tensorMap, context) as number;\n const numOrSizeSplits =\n getParamValue('numOrSizeSplits', node, tensorMap, context) as\n number |\n number[];\n const tensor = getParamValue('x', node, tensorMap, context) as Tensor;\n\n return tfOps.split(tensor, numOrSizeSplits, axis);\n }\n case 'ScatterNd': {\n const indices =\n getParamValue('indices', node, tensorMap, context) as Tensor;\n const values =\n getParamValue('values', node, tensorMap, context) as Tensor;\n const shape =\n getParamValue('shape', node, tensorMap, context) as number[];\n return [tfOps.scatterND(indices, values, shape)];\n }\n case 'GatherNd': {\n const x = getParamValue('x', node, tensorMap, context)
as Tensor;\n const indices =\n getParamValue('indices', node, tensorMap, context) as Tensor;\n return [tfOps.gatherND(x, indices)];\n }\n case 'SparseToDense': {\n const indices =\n getParamValue('sparseIndices', node, tensorMap, context) as\n Tensor;\n const shape =\n getParamValue('outputShape', node, tensorMap, context) as\n number[];\n const sparseValues =\n getParamValue('sparseValues', node, tensorMap, context) as Tensor;\n const defaultValue =\n getParamValue('defaultValue', node, tensorMap, context) as Scalar;\n return [tfOps.sparseToDense(\n indices, sparseValues, shape,\n sparseValues.dtype === defaultValue.dtype ?\n defaultValue :\n tfOps.cast(defaultValue, sparseValues.dtype))];\n }\n default:\n throw TypeError(`Node type ${node.op} is not implemented`);\n }\n };\n\nexport const CATEGORY = 'slice_join';\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n */\n\nimport {Tensor} from '@tensorflow/tfjs-core';\n// tslint:disable-next-line: no-imports-from-dist\nimport * as tfOps from '@tensorflow/tfjs-core/dist/ops/ops_for_converter';\n\nimport
{NamedTensorsMap} from '../../data/types';\nimport {ExecutionContext} from '../../executor/execution_context';\nimport {InternalOpExecutor, Node} from '../types';\n\nimport {getParamValue} from './utils';\n\nexport const executeOp: InternalOpExecutor =\n (node: Node, tensorMap: NamedTensorsMap, context: ExecutionContext):\n Tensor[] => {\n switch (node.op) {\n case 'FFT': {\n return [tfOps.fft(\n getParamValue('x', node, tensorMap, context) as Tensor)];\n }\n case 'IFFT': {\n return [tfOps.ifft(\n getParamValue('x', node, tensorMap, context) as Tensor)];\n }\n case 'RFFT': {\n return [tfOps.rfft(\n getParamValue('x', node, tensorMap, context) as Tensor)];\n }\n case 'IRFFT': {\n return [tfOps.irfft(\n getParamValue('x', node, tensorMap, context) as Tensor)];\n }\n default:\n throw TypeError(`Node type ${node.op} is not implemented`);\n }\n };\n\nexport const CATEGORY = 'spectral';\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights

Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==========\n */\n\nimport {Tensor, Tensor4D} from '@tensorflow/tfjs-core';\n// tslint:disable-next-line: no-imports-from-dist\nimport
* as tfOps from '@tensorflow/tfjs-core/dist/ops/ops_for_converter';\n\nimport {NamedTensorsMap} from '../../data/types';\nimport {ExecutionContext} from '../../executor/execution_context';\nimport {InternalOpExecutor, Node} from '../types';\n\nimport {getParamValue} from './utils';\n\nexport const executeOp: InternalOpExecutor =\n (node: Node, tensorMap: NamedTensorsMap,\n context: ExecutionContext): Tensor[] => {\n switch (node.op) {\n case 'Cast': {\n return [tfOps.cast(\n getParamValue('x', node, tensorMap, context) as Tensor,\n getParamValue('dtype', node, tensorMap, context) as 'int32' |\n 'float32' | 'bool')];\n }\n case 'ExpandDims': {\n const axis =\n getParamValue('axis', node, tensorMap, context) as number;\n return [tfOps.expandDims(\n getParamValue('x', node, tensorMap, context) as Tensor, axis)];\n }\n case 'Squeeze': {\n const axis =\n getParamValue('axis', node, tensorMap, context) as number[];\n return [tfOps.squeeze(\n getParamValue('x', node, tensorMap, context) as Tensor, axis)];\n }\n\n case 'Reshape': {\n return [tfOps.reshape(\n getParamValue('x', node, tensorMap, context) as Tensor,\n getParamValue('shape', node, tensorMap, context) as number[])];\n }\n case 'MirrorPad': {\n return [tfOps.mirrorPad(\n getParamValue('x', node, tensorMap, context) as Tensor,\n getParamValue('padding', node, tensorMap, context) as\n Array<[number, number]>,\n getParamValue('mode', node, tensorMap, context) as 'reflect' |\n 'symmetric')];\n }\n case 'PadV2':\n case 'Pad': {\n return [tfOps.pad(\n getParamValue('x', node, tensorMap, context) as Tensor,\n getParamValue('padding',
node, tensorMap, context) as\n Array<[number, number]>,\n getParamValue('constantValue', node, tensorMap, context) as\n number)];\n }\n case 'SpaceToBatchND': {\n const blockShape =\n getParamValue('blockShape', node, tensorMap, context) as number[];\n const paddings =\n getParamValue('paddings', node, tensorMap, context) as number[][];\n return [tfOps.spaceToBatchND(\n getParamValue('x', node, tensorMap, context) as Tensor,\n blockShape, paddings)];\n }\n case 'BatchToSpaceND': {\n const blockShape =\n getParamValue('blockShape', node, tensorMap, context) as number[];\n const crops =\n getParamValue('crops', node, tensorMap, context) as number[][];\n return [tfOps.batchToSpaceND(\n getParamValue('x', node, tensorMap, context) as Tensor,\n blockShape,
crops)];\n }\n case 'DepthToSpace': {\n const blockSize =\n getParamValue('blockSize', node, tensorMap, context) as number;\n const dataFormat =\n (getParamValue('dataFormat', node, tensorMap, context) as\n string).toUpperCase() as 'NHWC' |\n 'NCHW';\n return [tfOps.depthToSpace(\n getParamValue('x', node, tensorMap, context) as Tensor4D,\n blockSize, dataFormat)];\n }\n case 'BroadcastTo': {\n return [tfOps.broadcastTo(\n getParamValue('x', node, tensorMap, context) as Tensor,\n getParamValue('shape', node, tensorMap, context) as number[])];\n }\n default:\n throw TypeError(`Node type ${node.op} is not implemented`);\n }\n };\n\nexport const CATEGORY = 'transformation';\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version
2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n *

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WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========================================================================\n */\n\nimport * as tfc from '@tensorflow/tfjs-core';\n\nimport {NamedTensorsMap} from '../data/types';\nimport {ExecutionContext} from '../executor/execution_context';\nimport {ResourceManager} from '../executor/resource_manager';\n\nimport {NodeValueImpl} from './custom_op/node_value_impl';\nimport {getRegisteredOp} from './custom_op/register';\nimport * as arithmetic from './executors/arithmetic_executor';\nimport * as basicMath from './executors/basic_math_executor';\nimport * as control from './executors/control_executor';\nimport * as convolution from './executors/convolution_executor';\nimport * as creation from './executors/creation_executor';\nimport * as dynamic from './executors/dynamic_executor';\nimport * as evaluation from './executors/evaluation_executor';\nimport * as graph from './executors/graph_executor';\nimport * as hashTable from './executors/hash_table_executor';\nimport * as image from './executors/image_executor';\nimport * as logical from './executors/logical_executor';\nimport * as matrices from './executors/matrices_executor';\nimport * as normalization from './executors/normalization_executor';\nimport * as reduction from './executors/reduction_executor';\nimport * as sliceJoin from './executors/slice_join_executor';\nimport * as spectral from './executors/spectral_executor';\nimport * as transformation from './executors/transformation_executor';\nimport {Node} from './types';\n\n/**\n * Executes the op defined by the node object.\n * @param node\n * @param tensorMap contains tensors for executed nodes and weights\n * @param context contains tensors and information for running the current node.\n * @param resourceManager Optional. Contains global resources of the model.\n */\nexport function executeOp(\n    node: Node, tensorMap: NamedTensorsMap, context: ExecutionContext,\n    resourceManager?: ResourceManager): tfc.Tensor[]|Promise<tfc.Tensor[]> {\n  const value =\n      ((node: Node, tensorMap: NamedTensorsMap, context: ExecutionContext) => {\n        switch (node.category) {\n          case 'arithmetic':\n            return tfc.tidy(\n                () => arithmetic.executeOp(node, tensorMap, context));\n          case 'basic_math':\n            return tfc.tidy(\n                () => basicMath.executeOp(node, tensorMap, context));\n          case 'control':\n            return control.executeOp(node, tensorMap, context);\n          case 'convolution':\n            return tfc.tidy(\n                () => convolution.executeOp(node, tensorMap, context));\n          case 'creation':\n            return tfc.tidy(() => creation.executeOp(node, tensorMap, context));\n          case 'dynamic':\n            return dynamic.executeOp(node, tensorMap, context);\n          case 'evaluation':\n            return tfc.tidy(\n                () => evaluation.executeOp(node, tensorMap, context));\n          case 'image':\n            return tfc.tidy(() => image.executeOp(node, tensorMap, context));\n          case 'graph':\n            return tfc.tidy(() => graph.executeOp(node, tensorMap, context));\n          case 'logical':\n            return tfc.tidy(() => logical.executeOp(node, tensorMap, context));\n          case 'matrices':\n            return tfc.tidy(() => matrices.executeOp(node, tensorMap, context));\n          case 'normalization':\n            return tfc.tidy(\n                () => normalization.executeOp(node,\n                    tensorMap, context));\n          case 'reduction':\n            return tfc.tidy(\n                () => reduction.executeOp(node, tensorMap, context));\n          case 'slice_join':\n            return tfc.tidy(\n                () => sliceJoin.executeOp(node, tensorMap, context));\n          case 'spectral':\n            return tfc.tidy(() => spectral.executeOp(node, tensorMap, context));\n          case 'transformation':\n            return tfc.tidy(\n                () => transformation.executeOp(node, tensorMap, context));\n          case 'hash_table':\n            return hashTable.executeOp(\n                node, tensorMap, context, resourceManager);\n          case 'custom':\n            const opMapper = getRegisteredOp(node.op);\n            if (opMapper && opMapper.customExecutor) {\n              return opMapper.customExecutor(\n                  new NodeValueImpl(node, tensorMap, context));\n            } else {\n              throw TypeError(`Custom op ${node.op} is not registered.`);\n            }\n          default:\n            throw TypeError(\n                `Unknown op '${node.op}'. File an issue at ` +\n                `https://github.com/tensorflow/tfjs/issues so we can add it` +\n                `, or register a custom execution with tf.registerOp()`);\n        }\n      })(node, tensorMap, context);\n  if (tfc.util.isPromise(value)) {\n    return (value as Promise<tfc.Tensor>).then((data) => [].concat(data));\n  }\n  return
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[].concat(value);\n}\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==\n */\nimport {Tensor} from '@tensorflow/tfjs-core';\n\nimport {NamedTensorsMap, TensorArrayMap, TensorListMap} from '../data/types';\n\nimport {TensorArray} from './tensor_array';\nimport {TensorList} from './tensor_list';\nimport {FunctionExecutor} from './types';\n\nexport interface ExecutionContextInfo {\n id: number; // the unique id of the context info\n frameName: string; // The frame name of the loop, this comes from\n // the TensorFlow NodeDef.\n iterationId: number; // The iteration id of the loop\n}\n\n/**\n * ExecutionContext captures the runtime environment of the node. It keeps\n * track of the current frame and iteration for the control flow ops.\n *\n * For example, typical Dynamic RNN model may contain loops, for which\n * TensorFlow will generate graphs with Enter/Exit nodes to control the\n * current execution frame, and NextIteration Nodes for iteration id increment.\n * For model with branch logic, TensorFLow will generate Switch/Merge ops.\n */\nexport class ExecutionContext {\n private rootContext = {id: 0, frameName: '', iterationId: 0};\n private contexts: ExecutionContextInfo[] = [this.rootContext];\n private lastId = 0;\n private _currentContextIds: string[];\n\n constructor(\n readonly weightMap: NamedTensorsMap = {},\n readonly tensorArrayMap: TensorArrayMap = {},\n readonly tensorListMap: TensorListMap = {},\n readonly functionMap: {[key: string]: FunctionExecutor} = {}) {\n this.generateCurrentContextIds();\n }\n\n private newFrame(id: number, frameName: string) {\n return {id, frameName, iterationId: 0};\n }\n\n /**\n * Set the current context\n * @param contexts: ExecutionContextInfo[] the current path of execution\n * frames\n */\n set currentContext(contexts: ExecutionContextInfo[]) {\n if (this.contexts !== contexts) {\n this.contexts = contexts;\n this.generateCurrentContextIds();\n }\n }\n\n get currentContext(): ExecutionContextInfo[] {\n return this.contexts;\n }\n\n /**\n * Returns the current context in string format.\n */\n get currentContextId(): string {\n return this._currentContextIds[0];\n }\n\n /**\n * Returns the current context and all parent contexts in string format.\n * This allow access to the nodes in the current and parent frames.\n */\n get currentContextIds(): string[] {\n return this._currentContextIds;\n }\n\n private generateCurrentContextIds() {\n const names = [];\n for (let i = 0; i < this.contexts.length - 1; i++) {\n const contexts = this.contexts.slice(0, this.contexts.length - i);\n names.push(this.contextIdforContexts(contexts));\n }\n names.push('');\n this._currentContextIds = names;\n }\n\n private contextIdforContexts(contexts: ExecutionContextInfo[]) {\n return contexts ?\n contexts\n .map(\n context => (context.id === 0 && context.iterationId === 0) ?\n '' :\n `${context.frameName}-${context.iterationId}`)\n .join('/') :\n '';\n }\n\n /**\n * Enter a new frame, a new context is pushed on the current context list.\n * @param frameId new frame id\n */\n enterFrame(frameId: string) {\n if (this.contexts) {\n this.lastId++;\n this.contexts = this.contexts.slice();\n this.contexts.push(this.newFrame(this.lastId, frameId));\n this._currentContextIds.unshift(this.contextIdforContexts(this.contexts));\n }\n }\n\n /**\n * Exit the current frame, the last context is removed from the current\n * context list.\n */\n exitFrame() {\n if (this.contexts && this.contexts.length > 1) {\n this.contexts = this.contexts.slice();\n this.contexts.splice(-1);\n this.currentContextIds.shift();\n } else {\n throw new Error('Cannot exit frame, the context is empty');\n }\n }\n\n /**\n * Enter the next iteration of a loop, the iteration id of last context is\n * increased.\n */\n nextIteration() {\n if (this.contexts && this.contexts.length > 0) {\n this.contexts = this.contexts.slice();\n this.lastId++;\n const context =\n Object.assign({}, this.contexts[this.contexts.length - 1]);\n context.iterationId += 1;\n context.id = this.lastId;\n this.contexts.splice(-1, 1, context);\n this._currentContextIds.splice(\n 0, 1, this.contextIdforContexts(this.contexts));\n } else {\n throw new

Error('Cannot increase frame iteration, the context is empty');\n }\n }\n\n getWeight(name: string): Tensor[] {\n return this.weightMap[name];\n }\n\n addTensorArray(tensorArray: TensorArray) {\n this.tensorArrayMap[tensorArray.id] = tensorArray;\n }\n\n getTensorArray(id: number): TensorArray {\n return this.tensorArrayMap[id];\n }\n\n addTensorList(tensorList: TensorList) {\n this.tensorListMap[tensorList.id] = tensorList;\n }\n\n getTensorList(id: number): TensorList {\n return this.tensorListMap[id];\n }\n\n dispose(keepIds: Set<number>) {\n for (const key in this.tensorArrayMap) {\n this.tensorArrayMap[key].clearAndClose(keepIds);\n }\n\n for (const key in this.tensorListMap) {\n this.tensorListMap[key].clearAndClose(keepIds);\n }\n }\n}\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ===\n */\n\nimport {NamedTensorMap} from '@tensorflow/tfjs-core';\n\nimport {NamedTensorsMap} from '../data/types';\nimport {parseNodeName} from '../operations/executors/utils';\nimport {Graph, Node} from '../operations/types';\n\nexport interface ExecutionInfo {\n inputs: NamedTensorMap;\n outputs: Node[];\n usedNodes: Set<string>;\n missingInputs: string[];\n dynamicNode: Node;\n syncInputs: string[];\n}\n\n/**\n * Given graph inputs and desired outputs, find the minimal set of nodes\n * to execute in order to compute the outputs. In addition return other useful\n * info such:\n * - Missing inputs needed to compute the output.\n * - Whether the subgraph contains dynamic ops (control flow, dynamic shape).\n * - Alternative inputs in order to avoid async (dynamic op) execution.\n */\nexport function getExecutionSubgraph(\n inputs: NamedTensorMap, outputs: Node[], weightMap: NamedTensorsMap,\n initNodes?: Node[]): ExecutionInfo {\n const usedNodes = new Set<string>();\n const missingInputs: string[] = [];\n let dynamicNode: Node = null;\n let syncInputs: string[] = null;\n\n // Start with the outputs, going backwards and find all the nodes that are\n // needed to compute those outputs.\n const seen = new Set<string>();\n const inputNodeNames =\n Object.keys(inputs).map(name => parseNodeName(name)[0]);\n\n let initNodeNames: string[] = [];\n if (initNodes != null) {\n initNodeNames = initNodes.map(node => parseNodeName(node.name)[0]);\n }\n\n const frontier = [...outputs];\n while (frontier.length > 0) {\n const node = frontier.pop();\n if (isControlFlow(node) || isDynamicShape(node) || isHashTable(node)) {\n if (dynamicNode == null) {\n dynamicNode = node;\n syncInputs = dynamicNode.children.map(child => child.name)\n .filter(name => usedNodes.has(name));\n }\n }\n usedNodes.add(node.name);\n\n // Weights are dead end since we already have their values.\n if (weightMap[node.name] != null) {\n continue;\n }\n // This node is a dead end since it's one of the user-provided inputs.\n if (inputNodeNames.indexOf(node.name) !== -1) {\n continue;\n }\n // This node is a dead end since it doesn't have any inputs.\n if (initNodeNames.indexOf(node.name) !== -1) {\n continue;\n }\n if (node.inputs.length === 0) {\n missingInputs.push(node.name);\n continue;\n }\n node.inputs.forEach(input => {\n // Don't add to the frontier if it is already there.\n if (seen.has(input.name)) {\n return;\n }\n seen.add(input.name);\n frontier.push(input);\n });\n }\n return {inputs, outputs, usedNodes, missingInputs, dynamicNode, syncInputs};\n}\n\n/**\n * Given the execution info, return a list of nodes in topological order that\n * need to be executed to compute the output.\n */\nexport function getNodesInTopologicalOrder(\n graph: Graph, weightMap: NamedTensorsMap,\n executionInfo: ExecutionInfo): Node[] {\n const {usedNodes, inputs} = executionInfo;\n const frontier: Node[] = [];\n const inputNodes = Object.keys(inputs)\n .map(name => parseNodeName(name)[0])\n .map(name => graph.nodes[name]);\n const initNodes = graph.initNodes;\n\n inputNodes.forEach(input => {\n if (usedNodes.has(input.name)) {\n frontier.push(input);\n }\n });\n graph.weights.forEach(weight => {\n if (usedNodes.has(weight.name)) {\n frontier.push(weight);\n }\n });\n if (initNodes != null) {\n

initNodes.forEach(node => {\n if (usedNodes.has(node.name)) {\n frontier.push(node);\n }\n });\n }\n const seen = new Set<string>();\n const orderedNodes:
Node[] = [];\n while (frontier.length > 0) {\n const node = frontier.pop();\n seen.add(node.name);\n if (!weightMap[node.name]) {\n orderedNodes.push(node);\n }\n node.children.forEach(child => {\n if (!seen.has(child.name) && usedNodes.has(child.name) &&\n child.inputs.every(input => seen.has(input.name))) {\n frontier.push(child);\n }\n });\n }\n return orderedNodes;\n}\n\nconst CONTROL_FLOW_OPS = [\n 'Switch', 'Merge', 'Enter', 'Exit', 'NextIteration', 'StatelessIf',\n 'StatelessWhile', 'if', 'While'\n];\nconst DYNAMIC_SHAPE_OPS = [\n 'NonMaxSuppressionV2', 'NonMaxSuppressionV3', 'NonMaxSuppressionV5', 'Where'\n];\nconst HASH_TABLE_OPS = [\n 'HashTable', 'HashTableV2', 'LookupTableImport', 'LookupTableImportV2',\n 'LookupTableFind', 'LookupTableFindV2'\n];\n\nexport function isControlFlow(node: Node) {\n return CONTROL_FLOW_OPS.indexOf(node.op) >= 0;\n}\n\nexport function isDynamicShape(node: Node) {\n return DYNAMIC_SHAPE_OPS.indexOf(node.op) >= 0;\n}\n\nexport function isHashTable(node: Node) {\n return HASH_TABLE_OPS.indexOf(node.op) >= 0;\n}\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n*/\n\nimport {DataType, NamedTensorMap, Tensor, tidy, util} from '@tensorflow/tfjs-core';\n\nimport {ISignatureDef} from '../data/compiled_api';\nimport {NamedTensorsMap, TensorArrayMap, TensorInfo, TensorListMap} from '../data/types';\nimport {getNodeNameAndIndex, getParamValue, getTensor, getTensorsForCurrentContenxt, parseNodeName} from '../operations/executors/utils';\nimport {executeOp} from '../operations/operation_executor';\nimport {Graph, Node} from '../operations/types';\n\nimport {ExecutionContext, ExecutionContextInfo} from './execution_context';\nimport {getExecutionSubgraph, getNodesInTopologicalOrder, isControlFlow} from './model_analysis';\nimport {ResourceManager} from './resource_manager';\nimport {FunctionExecutor} from './types';\n\ninterface NodeWithContexts {\n contexts: ExecutionContextInfo[];\n node: Node;\n}\n\nexport class GraphExecutor implements FunctionExecutor {\n private compiledMap: Map<string, Node[]> = new Map();\n private _weightMap: NamedTensorsMap = {};\n private _weightIds: number[];\n private _signature: ISignatureDef;\n private _inputs: Node[];\n private _outputs: Node[];\n private _initNodes:
Node[]; // Internal init nodes to start initialization.\n private SEPERATOR = ',';\n private _functions: {[key: string]: Graph} = {};\n private _functionExecutorMap: {[key: string]: FunctionExecutor} = {};\n private _resourceManager: ResourceManager;\n\n get weightIds(): number[] {\n return this.parent ? this.parent.weightIds : this._weightIds;\n }\n\n get functionExecutorMap(): {[key: string]: FunctionExecutor} {\n return this.parent ? this.parent.functionExecutorMap :\n this._functionExecutorMap;\n }\n\n get weightMap(): NamedTensorsMap {\n return this.parent ? this.parent.weightMap : this._weightMap;\n }\n\n set weightMap(weightMap: NamedTensorsMap) {\n const weightIds = Object.keys(weightMap).map(\n key => weightMap[key].map(tensor => tensor.id));\n this._weightIds = [].concat(...weightIds);\n this._weightMap = weightMap;\n }\n\n /**\n * Set `ResourceManager` shared by executors of a model.\n * @param resourceManager:
`ResourceManager` of the `GraphModel`.\n */\n set resourceManager(resourceManager: ResourceManager) {\n this._resourceManager = resourceManager;\n }\n\n get inputs(): TensorInfo[] {\n return this._inputs.map(node => {\n return {\n name: node.name,\n shape: node.attrParams['shape'] ?\n node.attrParams['shape'].value as number[] :\n undefined,\n dtype: node.attrParams['dtype'] ?\n node.attrParams['dtype'].value as DataType :\n undefined\n };\n });\n }\n\n get outputs(): TensorInfo[] {\n return this._outputs.map(node => {\n return {\n name: node.name,\n shape:

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node.attrParams['shape'] ?\n            node.attrParams['shape'].value as number[] :\n            undefined,\n        dtype:
node.attrParams['dtype'] ?\n            node.attrParams['dtype'].value as DataType :\n            undefined\n      };\n    });\n
}\n\n  get inputNodes(): string[] {\n    return this._inputs.map(node
 => node.signatureKey || node.name);\n  }\n\n  get outputNodes(): string[] {\n    return this._outputs.map((node) =>
{\n      const name = node.signatureKey || node.name;\n      return node.defaultOutput ?
(`${name}:${node.defaultOutput}`) : name;\n    });\n  }\n\n  get functions(): {[key: string]: ISignatureDef} {\n
return Object.keys(this._functions).reduce((map, key) => {\n      map[key] = this._functions[key].signature;\n
return map;\n    }, {} as {[key: string]: ISignatureDef});\n  }\n\n  /**\n   *\n   * @param graph Graph the model or
function graph to be executed.\n   * @param parent When building function exector you need to set the parent\n   *
executor. Since the weights and function executor maps are set at parant\n   * level, that function executor can
access the function maps and weight maps\n   * through the parent.\n   */\n  constructor(private graph: Graph,
private parent?: GraphExecutor) {\n    this._outputs = graph.outputs;\n    this._inputs = graph.inputs;\n
    this._initNodes = graph.initNodes;\n    this._signature = graph.signature;\n    this._functions = graph.functions;\n
// create sub-graph executors\n    if (graph.functions != null) {\n      Object.keys(graph.functions).forEach(name =>
{\n        this._functionExecutorMap[name] =\n            new GraphExecutor(graph.functions[name], this);\n      });\n
}\n  }\n\n  private getCompilationKey(inputs: Node[], outputs: Node[]): string {\n    const sortedInputs =
inputs.map(node => node.name).sort();\n    const sortedOutputs = outputs.map(node => node.name).sort();\n
return sortedInputs.join(this.SEPERATOR) + '--' +\n        sortedOutputs.join(this.SEPERATOR);\n  }\n\n  /**\n   *
Compiles the inference graph and returns the minimal set of nodes that are\n   * required for execution, in the correct
execution order.\n   */\n  private compile(inputs: NamedTensorMap, outputs: Node[]): Node[] {\n    const
executionInfo =\n        getExecutionSubgraph(inputs, outputs, this.weightMap,
 this._initNodes);\n    const {missingInputs, dynamicNode, syncInputs} = executionInfo;\n    if (dynamicNode !=
null) {\n      throw new Error(\n          `This execution contains the node '${dynamicNode.name}', which has ` +\n
  `the dynamic op '${dynamicNode.op}'. Please use ` +\n          `model.executeAsync() instead. Alternatively, to
avoid the ` +\n          `dynamic ops, specify the inputs [${syncInputs}]`);\n    }\n\n    if (missingInputs.length > 0) {\n
    const outNames = outputs.map(n => n.name);\n      const inNames = Object.keys(inputs);\n      throw new Error(\n
        `Cannot compute the outputs [${outNames}] from the provided inputs ` +\n          `[${inNames}]. Missing the
following inputs: [${missingInputs}]`);\n    }\n\n    return getNodesInTopologicalOrder(\n        this.graph,
this.weightMap, executionInfo);\n  }\n\n  /**\n   * Executes the inference for given input tensors.\n   * @param
inputs Tensor map for the model inputs, keyed by the input
 node\n   * names.\n   * @param outputs Optional. output node name from the Tensorflow model, if\n   * no outputs
are specified, the default outputs of the model would be used.\n   * You can inspect intermediate nodes of the model
by adding them to the\n   * outputs array.\n   */\n  execute(inputs: NamedTensorMap, outputs?: string[]): Tensor[]
{\n    inputs = this.mapInputs(inputs);\n    const names = Object.keys(inputs).sort();\n    this.checkInputs(inputs);\n
this.checkInputShapeAndType(inputs);\n    outputs = this.mapOutputs(outputs);\n    this.checkOutputs(outputs);\n
const inputNodes =\n        names.map(name => this.graph.nodes[parseNodeName(name)[0]]);\n    const
outputNodeNames = outputs.map(name => parseNodeName(name)[0]);\n    let outputNodes =
outputNodeNames.map(name => this.graph.nodes[name]);\n\n    // If no outputs are specified, then use the default
outputs of the model.\n    if (outputNodes.length === 0) {\n      outputNodes = this._outputs;\n    }\n\n    const
compilationKey
 = this.getCompilationKey(inputNodes, outputNodes);\n\n    // Do nothing if the compiled graph cache contains the
input.\n    let orderedNodes = this.compiledMap.get(compilationKey);\n    if (orderedNodes == null) {\n
orderedNodes = this.compile(inputs, outputNodes);\n      this.compiledMap.set(compilationKey, orderedNodes);\n
}\n\n    const tensorArrayMap: TensorArrayMap = {};\n    const tensorListMap: TensorListMap = {};\n\n    return
tidy(() => {\n      const context = new ExecutionContext(\n          this.weightMap, tensorArrayMap, tensorListMap,\n
        this.functionExecutorMap);\n      const tensorsMap: NamedTensorsMap = {...this.weightMap};\n\n
Object.keys(inputs).forEach(name => {\n        const [nodeName, index] = parseNodeName(name);\n        const
tensors: Tensor[] = [];\n        tensors[index] = inputs[name];\n        tensorsMap[nodeName] = tensors;\n      });\n\n
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const tensorsToKeep = this.getFrozenTensorIds(tensorsMap);\n      const intermediateTensorConsumerCount:
 {[key: number]: number} = {};\n      for (let i = 0; i < orderedNodes.length; i++) {\n        const node =
orderedNodes[i];\n        if (!tensorsMap[node.name]) {\n          const tensors =\n              executeOp(node,
tensorsMap, context, this._resourceManager) as\n              Tensor[];\n          if (util.isPromise(tensors)) {\n
throw new Error(\n              `The execution of the op '${node.op}' returned a promise. ` +\n              `Please use
model.executeAsync() instead.`);\n          }\n          tensorsMap[node.name] = tensors;\n
this.checkTensorForDisposal(\n              node.name, node, tensorsMap, context, tensorsToKeep,\n
outputNodeNames, intermediateTensorConsumerCount);\n        }\n      }\n      // dispose the context for the root
executor\n      if (this.parent == null) {\n        context.dispose(tensorsToKeep);\n      }\n      return outputs.map(name
=> getTensor(name, tensorsMap, context));\n    });\n
  }\n\n  private getFrozenTensorIds(tensorMap: NamedTensorsMap): Set<number> {\n    const ids =
[].concat.apply(\n        [],\n        Object.keys(tensorMap)\n            .map(key => tensorMap[key])\n
.map(tensors => tensors.map(tensor => tensor.id)));\n    return new Set(ids);\n  }\n  private
checkTensorForDisposal(\n      nodeName: string, node: Node, tensorMap: NamedTensorsMap,\n      context:
ExecutionContext, tensorsToKeep: Set<number>,\n      outputNames: string[],\n
intermediateTensorConsumerCount: {[key: string]: number}) {\n    // Skip output nodes and any control flow nodes,
since its dependency is\n    // tricky to track correctly.\n    if (node.category === 'control' ||
outputNames.indexOf(nodeName) !== -1) {\n      return;\n    }\n\n    tensorMap[nodeName].forEach(tensor => {\n
 if (tensor != null) {\n        intermediateTensorConsumerCount[tensor.id] =\n
(intermediateTensorConsumerCount[tensor.id] || 0) +\n            node.children.length;\n
    }\n    });\n    node.inputs.forEach(input => {\n      // Skip any control flow nodes, since its dependency is tricky
to track\n      // correctly.\n      if (input.category !== 'control') {\n        const tensors =\n
getTensorsForCurrentContenxt(input.name, tensorMap, context);\n        if (tensors != null) {\n
tensors.forEach(tensor => {\n            if (tensor && !tensorsToKeep.has(tensor.id)) {\n              const count =
intermediateTensorConsumerCount[tensor.id];\n              if (count === 1) {\n                tensor.dispose();\n
delete intermediateTensorConsumerCount[tensor.id];\n              } else if (count != null) {\n                // only
intermediate nodes has count set, inputs and weights are\n                // not.\n
intermediateTensorConsumerCount[tensor.id]--;\n              }\n            }\n          });\n        }\n      }\n    });\n  }\n\n
/**\n   * Executes the inference for given input tensors in
 Async fashion.\n   * @param inputs Tensor map for the model inputs, keyed by the input node\n   * names.\n   *
@param outputs output node name from the Tensorflow model, if no outputs\n   * are specified, the default outputs
of the model would be used. You can\n   * inspect intermediate nodes of the model by adding them to the outputs\n
* array.\n   */\n  async executeAsync(inputs: NamedTensorMap, outputs?: string[]):\n      Promise<Tensor[]> {\n
return this._executeAsync(inputs, outputs);\n  }\n\n  /**\n   * Executes the inference for given input tensors in
Async fashion.\n   * @param inputs Tensor map for the model inputs, keyed by the input node\n   * names.\n   *
@param outputs Optional. output node name from the Tensorflow model,\n   * if no outputs are specified, the
default outputs of the model would be\n   * used. You can inspect intermediate nodes of the model by adding them
to the\n   * outputs array.\n   * @param isFunctionExecution Optional. Flag for executing a function.\n
   * @param tensorArrayMap Optional, global TensorArray map by id. Used for\n   * function execution.\n   *
@param tensorArrayMap Optinal global TensorList map by id. Used for\n   * function execution.\n   */\n  private
async _executeAsync(\n      inputs: NamedTensorMap, outputs?: string[], isFunctionExecution = false,\n
tensorArrayMap: TensorArrayMap = {},\n      tensorListMap: TensorListMap = {}): Promise<Tensor[]> {\n    if
(!isFunctionExecution) {\n      inputs = this.mapInputs(inputs);\n      this.checkInputs(inputs);\n
this.checkInputShapeAndType(inputs);\n      outputs = this.mapOutputs(outputs);\n      this.checkOutputs(outputs);\n
  }\n\n    const context = new ExecutionContext(\n        this.weightMap, tensorArrayMap, tensorListMap,\n
this.functionExecutorMap);\n\n    // Graph with control flow op requires runtime evaluation of the execution\n    //
order, while without control flow the execution order is pre-determined\n    // in the compile method.\n
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    const tensorMap = await this.executeWithControlFlow(\n        inputs, context, outputs, isFunctionExecution);\n
const results = outputs.map(name => getTensor(name, tensorMap, context));\n\n    // dispose all the intermediate
tensors\n    const outputIds = results.map(t => t.id);\n    const inputIds = Object.keys(inputs).map(name =>
inputs[name].id);\n    const keepIds =\n        new Set<number>([...outputIds, ...inputIds, ...this.weightIds]);\n
Object.keys(tensorMap).forEach(key => {\n      const tensorArray = tensorMap[key];\n
tensorArray.forEach(tensor => {\n        if (tensor && !tensor.isDisposed && !keepIds.has(tensor.id)) {\n
tensor.dispose();\n        }\n      });\n    });\n    // dispose the context for the root executor\n    if (this.parent == null)
{\n      context.dispose(keepIds);\n    }\n\n    return results;\n  }\n\n  async executeFunctionAsync(\n      inputs:
Tensor[], tensorArrayMap: TensorArrayMap,\n      tensorListMap: TensorListMap): Promise<Tensor[]>
 {\n    const mappedInputs = inputs.reduce((map, tensor, index) => {\n      map[this.inputs[index].name] = tensor;\n
  return map;\n    }, {} as NamedTensorMap);\n\n    return this._executeAsync(\n        mappedInputs,
this.outputNodes, true, tensorArrayMap, tensorListMap);\n  }\n  /**\n   * When there are control flow nodes in the
graph, the graph execution use\n   * ExecutionContext to keep track of the frames and loop iterators.\n   * @param
inputs placeholder tensors for the graph.\n   * @param context the execution context object for current execution.\n
* @param outputNames Optional. output node name from the Tensorflow model,\n   * if no outputs are specified,
the default outputs of the model would be\n   * used. You can inspect intermediate nodes of the model by adding
them to the\n   * outputs array.\n   * @param isFunctionExecution Flag for executing a function.\n   */\n  private
async executeWithControlFlow(\n      inputs: NamedTensorMap, context: ExecutionContext,
 outputNames?: string[],\n      isFunctionExecution?: boolean): Promise<NamedTensorsMap> {\n    const names =
Object.keys(inputs);\n    const inputNodes =\n        names.map(name =>
this.graph.nodes[parseNodeName(name)[0]]);\n    const outputNodeNames = outputNames.map(name =>
parseNodeName(name)[0]);\n    let outputNodes = outputNodeNames.map(name => this.graph.nodes[name]);\n\n
// If no outputs are specified, then use the default outputs of the model.\n    if (outputNodes.length === 0) {\n
outputNodes = this._outputs;\n    }\n\n    const {usedNodes, missingInputs, dynamicNode, syncInputs} =\n
getExecutionSubgraph(\n            inputs, outputNodes, this.weightMap, this._initNodes);\n\n    // First nodes to
execute include inputNodes, weights, and initNodes.\n    const stack: NodeWithContexts[] = [\n      ...inputNodes,
...this.graph.weights, ...(this._initNodes || [])\n    ].map(node => {\n      return {node, contexts:
context.currentContext};\n    });\n    const tensorsMap:
 NamedTensorsMap = {...this.weightMap};\n    Object.keys(inputs).forEach(name => {\n      const [nodeName,
index] = parseNodeName(name);\n      const tensors: Tensor[] = [];\n      tensors[index] = inputs[name];\n
tensorsMap[nodeName] = tensors;\n    });\n    const intermediateTensorConsumerCount: {[key: number]: number} =
{};\n    const tensorsToKeep = this.getFrozenTensorIds(tensorsMap);\n    const added: {[key: string]: boolean} =
{};\n    while (stack.length > 0) {\n      const promises = this.processStack(\n          inputNodes, stack, context,
tensorsMap, added, tensorsToKeep,\n          outputNodeNames, intermediateTensorConsumerCount, usedNodes);\n
  await Promise.all(promises);\n    }\n    if (dynamicNode == null && !isFunctionExecution) {\n      console.warn(\n
      `This model execution did not contain any nodes with control flow ` +\n          `or dynamic output shapes. You
can use model.execute() instead.`);\n    }\n    const missingOutputs =\n        outputNodes\n
          .filter(\n              node => !isControlFlow(node) &&\n                  !getTensor(node.name, tensorsMap,
context))\n          .map(node => node.name);\n    if (missingOutputs.length > 0) {\n      let alternativeMsg = '';\n
if (dynamicNode != null) {\n        alternativeMsg =\n            `Alternatively, to avoid the dynamic ops, use
model.execute() ` +\n            `and specify the inputs [${syncInputs}]`;\n      }\n      throw new Error(\n          `Cannot
compute the outputs [${missingOutputs}] from the provided ` +\n          `inputs [${names}]. Consider providing the
following inputs: ` +\n          `[${missingInputs}]. ${alternativeMsg}`);\n    }\n    return tensorsMap;\n  }\n\n  private
processStack(\n      inputNodes: Node[], stack: NodeWithContexts[], context: ExecutionContext,\n      tensorMap:
NamedTensorsMap, added: {[key: string]: boolean},\n      tensorsToKeep: Set<number>, outputNames: string[],\n
intermediateTensorConsumerCount:
 {[key: number]: number},\n      usedNodes: Set<string>) {\n    const promises: Array<Promise<Tensor[]>> = [];\n
while (stack.length > 0) {\n      const item = stack.pop();\n      context.currentContext = item.contexts;\n      let
```

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nodeName = '';\n      // The tensor of the Enter op with isConstant set should be set\n      // in the parent scope, so it will be available as constant for the\n      // whole loop.\n      if (item.node.op === 'Enter' &&\n getParamValue('isConstant', item.node, tensorMap, context)) {\n        [nodeName] = getNodeNameAndIndex(item.node.name, context);\n      }\n\n      // only process nodes that are not in the tensorMap yet, this include\n      // inputNodes and internal initNodes.\n      if (tensorMap[item.node.name] == null) {\n const tensors =\n            executeOp(item.node, tensorMap, context, this._resourceManager);\n        if (!nodeName) {\n          [nodeName] = getNodeNameAndIndex(item.node.name, context);\n        }\n        const currentContext = context.currentContext;\n        if (util.isPromise(tensors)) {\n          promises.push((tensors as Promise<Tensor[]>).then(t => {\n            tensorMap[nodeName] = t;\n            context.currentContext = currentContext;\n            this.checkTensorForDisposal(\n                nodeName, item.node, tensorMap, context, tensorsToKeep,\n                outputNames, intermediateTensorConsumerCount);\n            this.processChildNodes(\n                item.node, stack, context, tensorMap, added, usedNodes);\n            return t;\n          }));\n        } else {\n tensorMap[nodeName] = tensors as Tensor[];\n          this.checkTensorForDisposal(\n              nodeName, item.node, tensorMap, context, tensorsToKeep,\n              outputNames, intermediateTensorConsumerCount);\n          this.processChildNodes(\n              item.node, stack, context, tensorMap, added, usedNodes);\n        }\n      } else {\n        this.processChildNodes(\n            item.node,\n stack, context, tensorMap, added, usedNodes);\n      }\n    }\n    return promises;\n  }\n\n  private processChildNodes(\n      node: Node, stack: NodeWithContexts[], context: ExecutionContext,\n      tensorMap: NamedTensorsMap, added: {[key: string]: boolean},\n      usedNodes: Set<string>) {\n node.children.forEach((childNode) => {\n      const [nodeName, ] = getNodeNameAndIndex(childNode.name, context);\n      if (added[nodeName] || !usedNodes.has(childNode.name)) {\n        return;\n      }\n      // Merge op can be pushed if any of its inputs has value.\n      if (childNode.op === 'Merge') {\n        if (childNode.inputNames.some(name => {\n              return !!getTensor(name, tensorMap, context);\n            })) {\n          added[nodeName] = true;\n          stack.push({contexts: context.currentContext, node: childNode});\n        }\n      } else  // Otherwise all inputs must to have value.\n          if (childNode.inputNames.every(name => {\n return\n !!getTensor(name, tensorMap, context);\n            })) {\n        added[nodeName] = true;\n stack.push({contexts: context.currentContext, node: childNode});\n      }\n    });\n  }\n\n  /**\n   * Releases the memory used by the weight tensors.\n   */\n  dispose() {\n    Object.keys(this.weightMap)\n        .forEach(\n key => this.weightMap[key].forEach(tensor => tensor.dispose()));\n  }\n\n  private checkInputShapeAndType(inputs: NamedTensorMap) {\n    Object.keys(inputs).forEach(name => {\n      const input = inputs[name];\n      const [nodeName, ] = parseNodeName(name);\n      const node = this.graph.nodes[nodeName];\n      if (node.attrParams['shape'] && node.attrParams['shape'].value) {\n        const shape = node.attrParams['shape'].value as number[];\n        const match = shape.length === input.shape.length &&\n            input.shape.every(\n                (dim, index) => shape[index] === -1 || shape[index] === dim);\n util.assert(\n            match,\n            () => `The shape of dict['${node.name}'] provided in ` +\n                `model.execute(dict) must be [${shape}], but was ` +\n                `[${input.shape}]`);\n      }\n      if (node.attrParams['dtype'] && node.attrParams['dtype'].value) {\n        util.assert(\n            input.dtype === node.attrParams['dtype'].value as string,\n            () => `The dtype of dict['${node.name}'] provided in ` +\n                `model.execute(dict) must be ` +\n                `${node.attrParams['dtype'].value}, but was ${input.dtype}`);\n      }\n    });\n  }\n\n  private mapInputs(inputs: NamedTensorMap) {\n    const result: NamedTensorMap = {};\n    for (const inputName in inputs) {\n      if (this._signature != null && this._signature.inputs != null &&\n this._signature.inputs[inputName] != null) {\n        const tensor = this._signature.inputs[inputName];\n result[tensor.name] = inputs[inputName];\n      } else {\n        result[inputName] = inputs[inputName];\n      }\n    }\n    return result;\n  }\n\n  private checkInputs(inputs: NamedTensorMap) {\n    const notInGraph = Object.keys(inputs).filter(name => {\n      const [nodeName] = parseNodeName(name);\n      return this.graph.nodes[nodeName] == null;\n    });\n    if (notInGraph.length > 0) {\n      throw new Error(\n          `The
```

dict provided in model.execute(dict) has ` +\n `keys: [${notInGraph}] that are not part of graph`);\n }\n }\n\n private mapOutputs(outputs: string[]) {\n return outputs.map(name => {\n if (this._signature != null && this._signature.outputs != null &&\n this._signature.outputs[name] != null) {\n const tensor = this._signature.outputs[name];\n return tensor.name;\n }\n return name;\n }, {});\n }\n\n private checkOutputs(outputs: string[]): void {\n outputs.forEach(name => {\n const [normalizedName] = parseNodeName(name);\n if (!this.graph.nodes[normalizedName]) {\n throw new Error(`The output '${name}' is not found in the graph`);\n }\n });\n }\n}\n","/**\n * @license\n * Copyright 2020 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ===\n */\nimport {HashTableMap, NamedTensorMap} from '../data/types';\nimport {HashTable} from './hash_table';\n\n/**\n * Contains global resources of a model.\n */\nexport class ResourceManager {\n constructor(\n readonly hashTableNameToHandle: NamedTensorMap = {},\n readonly hashTableMap: HashTableMap = {}) {}\n\n /**\n * Register a `HashTable` in the resource manager.\n *\n * The `HashTable` can be retrieved by `resourceManager.getHashTableById`,\n * where id is the table handle tensor's id.\n *\n * @param name Op node name that creates the `HashTable`.\n * @param hashTable The `HashTable` to be added to resource manager.\n */\n addHashTable(name: string, hashTable: HashTable) {\n this.hashTableNameToHandle[name] = hashTable.handle;\n this.hashTableMap[hashTable.id] = hashTable;\n }\n\n /**\n * Get the table handle by node name.\n * @param name Op node name that creates the `HashTable`. This name is also\n * used in the inputs list of lookup and import `HashTable` ops.\n */\n getHashTableHandleByName(name: string) {\n return this.hashTableNameToHandle[name];\n }\n\n /**\n * Get the actual `HashTable` by its handle tensor's id.\n * @param id The id of the handle tensor.\n */\n getHashTableById(id: number): HashTable {\n return this.hashTableMap[id];\n }\n\n /**\n * Dispose `ResourceManager`, including its hashTables and tensors in them.\n */\n dispose() {\n for (const key in this.hashTableMap) {\n this.hashTableMap[key].clearAndClose();\n delete this.hashTableMap[key];\n }\n\n for (const name in this.hashTableNameToHandle) {\n this.hashTableNameToHandle[name].dispose();\n delete this.hashTableNameToHandle[name];\n }\n}\n","/**\n * @license\n * Copyright 2018 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ===\n */\n\nimport {InferenceModel, io, ModelPredictConfig, NamedTensorMap, Tensor} from '@tensorflow/tfjs-core';\n\nimport * as tensorflow from '../data/compiled_api';\nimport {NamedTensorsMap, TensorInfo} from '../data/types';\nimport {OperationMapper} from '../operations/operation_mapper';\n\nimport {GraphExecutor} from './graph_executor';\nimport {ResourceManager} from './resource_manager';\n\nexport const TFHUB_SEARCH_PARAM = '?tfjs-format=file';\nexport const DEFAULT_MODEL_NAME = 'model.json';\n/**\n * A `tf.GraphModel` is a directed, acyclic graph built from a\n * SavedModel GraphDef and allows inference execution.\n *\n * A `tf.GraphModel` can only be created by loading from a model converted from\n * a [TensorFlow

SavedModel](https://www.tensorflow.org/guide/saved_model) using\n * the command line converter tool and loaded via `tf.loadGraphModel`.\n *\n * @doc {heading: 'Models', subheading: 'Classes'}\n */\nexport class GraphModel implements InferenceModel {\n private executor: GraphExecutor;\n private version = 'n/a';\n private handler: io.IOHandler;\n private artifacts: io.ModelArtifacts;\n private initializer: GraphExecutor;\n private resourceManager: ResourceManager;\n private signature: tensorflow.ISignatureDef;\n\n // Returns the version information for the tensorflow model GraphDef.\n get modelVersion(): string {\n return this.version;\n }\n\n get inputNodes(): string[] {\n return this.executor.inputNodes;\n }\n\n get outputNodes(): string[] {\n return this.executor.outputNodes;\n }\n\n get inputs(): TensorInfo[] {\n return this.executor.inputs;\n }\n\n get outputs(): TensorInfo[] {\n return this.executor.outputs;\n }\n\n get weights(): NamedTensorsMap {\n return this.executor.weightMap;\n }\n\n get metadata(): {} {\n return this.artifacts.userDefinedMetadata;\n }\n\n get modelSignature(): {} {\n return this.signature;\n }\n\n /**\n * @param modelUrl url for the model, or an `io.IOHandler`.\n * @param weightManifestUrl url for the weight file generated by\n * scripts/convert.py script.\n * @param requestOption options for Request, which allows to send credentials\n * and custom headers.\n * @param onProgress Optional, progress callback function, fired periodically\n * before the load is completed.\n */\n constructor(\n private modelUrl: string|io.IOHandler,\n private loadOptions: io.LoadOptions = {}) {\n if (loadOptions == null) {\n this.loadOptions = {};\n }\n this.resourceManager = new ResourceManager();\n }\n\n private findIOHandler() {\n const path = this.modelUrl;\n if ((path as io.IOHandler).load != null) {\n // Path is an IO Handler.\n this.handler = path as io.IOHandler;\n } else if (this.loadOptions.requestInit != null) {\n this.handler = io.browserHTTPRequest(path as string, this.loadOptions);\n } else {\n const handlers = io.getLoadHandlers(path as string, this.loadOptions);\n if (handlers.length === 0) {\n // For backward compatibility: if no load handler can be found,\n // assume it is a relative http path.\n handlers.push(io.browserHTTPRequest(path as string, this.loadOptions));\n } else if (handlers.length > 1) {\n throw new Error(\n `Found more than one (${handlers.length}) load handlers for ` +\n `URL '${[path]}'`);\n }\n this.handler = handlers[0];\n }\n }\n\n /**\n * Loads the model and weight files, construct the in memory weight map and\n * compile the inference graph.\n */\n async load(): Promise<boolean> {\n this.findIOHandler();\n if (this.handler.load == null) {\n throw new Error(\n 'Cannot proceed with model loading because the IOHandler provided ' +\n 'does not have the `load` method implemented.');\n }\n const artifacts = await this.handler.load();\n\n return this.loadSync(artifacts);\n }\n\n /**\n * Synchronously construct the in memory weight map and\n * compile the inference graph. Also initialize hashtable if any.\n *\n * @doc {heading: 'Models', subheading: 'Classes', ignoreCI: true}\n */\n loadSync(artifacts: io.ModelArtifacts) {\n this.artifacts = artifacts;\n const graph = this.artifacts.modelTopology as tensorflow.IGraphDef;\n\n let signature;\n if (this.artifacts.userDefinedMetadata != null &&\n this.artifacts.userDefinedMetadata.signature != null) {\n signature = // tslint:disable-next-line:no-any\n (this.artifacts.userDefinedMetadata as any).signature as\n tensorflow.ISignatureDef;\n } else {\n signature = this.artifacts.signature;\n }\n this.signature = signature;\n\n this.version = `${graph.versions.producer}.${graph.versions.minConsumer}`;\n const weightMap = \n io.decodeWeights(this.artifacts.weightData, this.artifacts.weightSpecs);\n this.executor = new GraphExecutor(\n OperationMapper.Instance.transformGraph(graph, this.signature));\n this.executor.weightMap = this.convertTensorMapToTensorsMap(weightMap);\n // Attach a model-level resourceManager to each executor to share resources,\n // such as `HashTable`.\n this.executor.resourceManager = this.resourceManager;\n\n if (artifacts.modelInitializer != null &&\n (artifacts.modelInitializer as tensorflow.IGraphDef).node != null) {\n const initializer = \n OperationMapper.Instance.transformGraph(artifacts.modelInitializer);\n this.initializer = new GraphExecutor(initializer);\n this.initializer.weightMap = this.executor.weightMap;\n // Attach a model-level resourceManager to the initializer, the\n // hashTables created from when executing the initializer will be stored\n // in the resourceManager.\n this.initializer.resourceManager = this.resourceManager;\n this.initializer.executeAsync({}, []);\n }\n\n return true;\n }\n\n /**\n * Save the configuration and/or weights of the GraphModel.\n *\n * An `IOHandler` is an object that has a `save` method of

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the proper\n   * signature defined. The `save` method manages the storing or\n   * transmission of serialized data (\"artifacts\") that represent the\n   * model's topology and weights onto or via a specific medium, such as\n   * file downloads, local storage, IndexedDB in the web browser and HTTP\n   * requests to a server. TensorFlow.js provides `IOHandler`\n   * implementations for a number of frequently used saving mediums, such as\n   * `tf.io.browserDownloads` and `tf.io.browserLocalStorage`. See `tf.io`\n   * for more details.\n   *\n   * This method also allows you to refer to certain types of `IOHandler`s\n   * as URL-like
 string shortcuts, such as 'localstorage://' and\n   * 'indexeddb://'.\n   *\n   * Example 1: Save `model`'s topology and weights to browser [local\n   * storage](https://developer.mozilla.org/en-US/docs/Web/API/Window/localStorage);\n   * then load it back.\n   *\n   * ```js\n   * const modelUrl =\n   * 'https://storage.googleapis.com/tfjs-models/savedmodel/mobilenet_v2_1.0_224/model.json';\n   * const model = await tf.loadGraphModel(modelUrl);\n   * const zeros = tf.zeros([1, 224, 224, 3]);\n   * model.predict(zeros).print();\n   *\n   * const saveResults = await model.save('localstorage://my-model-1');\n   *\n   * const loadedModel = await tf.loadGraphModel('localstorage://my-model-1');\n   * console.log('Prediction from loaded model:');\n   * model.predict(zeros).print();\n   * ```\n   *\n   * @param handlerOrURL An instance of `IOHandler` or a URL-like,\n   * scheme-based string shortcut for `IOHandler`.\n   * @param config Options for saving the model.\n   * @returns A `Promise`
 of `SaveResult`, which summarizes the result of\n   * the saving, such as byte sizes of the saved artifacts for the model's\n   *   topology and weight values.\n   *\n   * @doc {heading: 'Models', subheading: 'Classes', ignoreCI: true}\n   */\n  async save(handlerOrURL: io.IOHandler|string, config?: io.SaveConfig):\n Promise<io.SaveResult> {\n    if (typeof handlerOrURL === 'string') {\n      const handlers =
 io.getSaveHandlers(handlerOrURL);\n      if (handlers.length === 0) {\n        throw new Error(\n            `Cannot find any save handlers for URL '${handlerOrURL}'`);\n      } else if (handlers.length > 1) {\n        throw new Error(\n    `Found more than one (${handlers.length}) save handlers for ` +\n            `URL '${handlerOrURL}'`);\n      }\n      handlerOrURL = handlers[0];\n    }\n    if (handlerOrURL.save == null) {\n      throw new Error(\n 'GraphModel.save() cannot proceed because the IOHandler ' +\n          'provided does not have the `save`
 attribute defined.');\n    }\n\n    return handlerOrURL.save(this.artifacts);\n  }\n\n  /**\n   * Execute the inference for the input tensors.\n   *\n   * @param input The input tensors, when there is single input for the model,\n   * inputs param should be a `tf.Tensor`. For models with mutliple inputs,\n   * inputs params should be in either `tf.Tensor`[] if the input order is\n   * fixed, or otherwise NamedTensorMap format.\n   *\n   * For model with multiple inputs, we recommend you use NamedTensorMap as the\n   * input type, if you use `tf.Tensor`[], the order of the array needs to\n   * follow the\n   * order of inputNodes array. @see {@link GraphModel.inputNodes}\n   *\n   * You can also feed any intermediate nodes using the NamedTensorMap as the\n   * input type. For example, given the graph\n   *    InputNode => Intermediate => OutputNode,\n   * you can execute the subgraph Intermediate => OutputNode by calling\n   *    model.execute('IntermediateNode' : tf.tensor(...));\n
   *\n   * This is useful for models that uses tf.dynamic_rnn, where the intermediate\n   * state needs to be fed manually.\n   *\n   * For batch inference execution, the tensors for each input need to be\n   * concatenated together. For example with mobilenet, the required input shape\n   * is [1, 244, 244, 3], which represents the [batch, height, width, channel].\n   * If we are provide a batched data of 100 images, the input tensor should be\n   * in the shape of [100, 244, 244, 3].\n   *\n   * @param config Prediction configuration for specifying the batch size and\n   * output node names. Currently the batch size option is ignored for graph\n   * model.\n   *\n   * @returns Inference result tensors. The output would be single `tf.Tensor`\n   * if model has single output node, otherwise Tensor[] or NamedTensorMap[]\n   * will be returned for model with multiple outputs.\n   *\n   * @doc {heading: 'Models', subheading: 'Classes'}\n   */\n  predict(inputs: Tensor|Tensor[]|NamedTensorMap,
 config?: ModelPredictConfig):\n      Tensor|Tensor[]|NamedTensorMap {\n    return this.execute(inputs, this.outputNodes);\n  }\n\n  private normalizeInputs(inputs: Tensor|Tensor[]|\n                          NamedTensorMap):
 NamedTensorMap {\n    if (!(inputs instanceof Tensor) && !Array.isArray(inputs)) {\n      // The input is already a NamedTensorMap.\n      return inputs;\n    }\n    inputs = Array.isArray(inputs) ? inputs : [inputs];\n    if (inputs.length !== this.inputNodes.length) {\n      throw new Error(\n          'Input tensor count mismatch,' +\n
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`the graph model has ${this.inputNodes.length} placeholders, ` +\n        `while there are ${inputs.length} input tensors.`);\n    }\n    return this.inputNodes.reduce((map, inputName, i) => {\n      map[inputName] = (inputs as Tensor[])[i];\n      return map;\n    }, {} as NamedTensorMap);\n  }\n\n  private normalizeOutputs(outputs: string|string[]): string[] {\n    outputs = outputs || this.outputNodes;\n    return !Array.isArray(outputs) ? [outputs] : outputs;\n  }\n\n  /**\n   * Executes inference for the model for given input tensors.\n   * @param inputs tensor, tensor array or tensor map of the inputs for the\n   * model, keyed by the input node names.\n   * @param outputs output node name from the Tensorflow model, if no\n   * outputs are specified, the default outputs of the model would be used.\n   * You can inspect intermediate nodes of the model by adding them to the\n   * outputs array.\n   *\n   * @returns A single tensor if provided with a single output or no outputs\n * are provided and there is only one default output, otherwise return a\n   * tensor array. The order of the tensor array is the same as the outputs\n   * if provided, otherwise the order of outputNodes attribute of the model.\n   *\n * @doc {heading: 'Models', subheading: 'Classes'}\n   */\n  execute(inputs: Tensor|Tensor[]|NamedTensorMap, outputs?: string|string[]):\n      Tensor|Tensor[] {\n    inputs = this.normalizeInputs(inputs);\n    outputs = this.normalizeOutputs(outputs);\n    const result = this.executor.execute(inputs, outputs);\n    return result.length > 1 ? result : result[0];\n  }\n  /**\n   * Executes inference for the model for given input tensors in async\n   * fashion, use this method when your model contains control flow ops.\n   * @param inputs tensor, tensor array or tensor map of the inputs for the\n   * model, keyed by the input node names.\n   * @param outputs output node name from the Tensorflow model, if no outputs\n   * are specified, the default outputs of the model would be used. You can\n   * inspect intermediate nodes of the model by adding them to the outputs\n   * array.\n   *\n   * @returns A Promise of single tensor if provided with a single output or\n   * no outputs are provided and there is only one default output, otherwise\n   * return a tensor map.\n   *\n   * @doc {heading: 'Models', subheading: 'Classes'}\n   */\n  async executeAsync(\n      inputs: Tensor|Tensor[]|NamedTensorMap,\n      outputs?: string|string[]): Promise<Tensor|Tensor[]> {\n    inputs = this.normalizeInputs(inputs);\n    outputs = this.normalizeOutputs(outputs);\n    const result = await this.executor.executeAsync(inputs, outputs);\n    return result.length > 1 ? result : result[0];\n  }\n\n  private convertTensorMapToTensorsMap(map: NamedTensorMap): NamedTensorsMap {\n    return Object.keys(map).reduce((newMap: NamedTensorsMap, key) => {\n      newMap[key] = [map[key]];\n      return newMap;\n    }, {});\n  }\n\n  /**\n   * Releases the memory used by the weight tensors and resourceManager.\n *\n   * @doc {heading: 'Models', subheading: 'Classes'}\n   */\n  dispose() {\n    this.executor.dispose();\n\n    if (this.initializer) {\n      this.initializer.dispose();\n    }\n\n    this.resourceManager.dispose();\n  }\n}\n\n/**\n * Load a graph model given a URL to the model definition.\n *\n * Example of loading MobileNetV2 from a URL and making a prediction with
 a\n * zeros input:\n *\n * ```js\n * const modelUrl =\n *    'https://storage.googleapis.com/tfjs-models/savedmodel/mobilenet_v2_1.0_224/model.json';\n * const model = await tf.loadGraphModel(modelUrl);\n * const zeros = tf.zeros([1, 224, 224, 3]);\n * model.predict(zeros).print();\n * ```\n *\n * Example of loading MobileNetV2 from a TF Hub URL and making a prediction with\n * a zeros input:\n *\n * ```js\n * const modelUrl =\n *    'https://tfhub.dev/google/imagenet/mobilenet_v2_140_224/classification/2';\n * const model = await tf.loadGraphModel(modelUrl, {fromTFHub: true});\n * const zeros = tf.zeros([1, 224, 224, 3]);\n * model.predict(zeros).print();\n * ```\n * @param modelUrl The url or an `io.IOHandler` that loads the model.\n * @param options Options for the HTTP request, which allows to send credentials\n *    and custom headers.\n *\n * @doc {heading: 'Models', subheading: 'Loading'}\n */\nexport async function loadGraphModel(\n    modelUrl: string|io.IOHandler,\n    options:
 io.LoadOptions = {}): Promise<GraphModel> {\n  if (modelUrl == null) {\n    throw new Error(\n        'modelUrl in loadGraphModel() cannot be null. Please provide a url ' +\n        'or an IOHandler that loads the model');\n  }\n  if (options == null) {\n    options = {};\n  }\n\n  if (options.fromTFHub) {\n    if ((modelUrl as io.IOHandler).load == null) {\n      if (!(modelUrl as string).endsWith('/')) {\n        modelUrl = (modelUrl as string) + '/';\n      }\n      modelUrl = `${modelUrl}${DEFAULT_MODEL_NAME}${TFHUB_SEARCH_PARAM}`;\n    }\n  }\n  const model = new GraphModel(modelUrl, options);\n  await model.load();\n  return
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model;\n}\n",null,null,null,null,null,null,null,null,null,null,null,null,null,null,null,null,null,null,null,"/**\n * dat-gui JavaScript Controller Library\n * http://code.google.com/p/dat-gui\n *\n * Copyright 2011 Data Arts Team, Google Creative Lab\n *\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except
in compliance with the License.\n * You may obtain a copy of the License at\n *\n *
http://www.apache.org/licenses/LICENSE-2.0\n */\n\nimport Color from './color/Color';\nimport math from './color/math';\nimport interpret from './color/interpret';\n\nimport Controller from './controllers/Controller';\nimport BooleanController from './controllers/BooleanController';\nimport OptionController from './controllers/OptionController';\nimport StringController from './controllers/StringController';\nimport NumberController from './controllers/NumberController';\nimport NumberControllerBox from './controllers/NumberControllerBox';\nimport NumberControllerSlider from './controllers/NumberControllerSlider';\nimport FunctionController from './controllers/FunctionController';\nimport ColorController from './controllers/ColorController';\n\nimport domImport from './dom/dom';\nimport GUIImport from './gui/GUI';\n\nexport const color = {\n Color: Color,\n math: math,\n interpret: interpret\n};\n\nexport const controllers = {\n Controller: Controller,\n BooleanController: BooleanController,\n OptionController: OptionController,\n StringController: StringController,\n NumberController: NumberController,\n NumberControllerBox: NumberControllerBox,\n NumberControllerSlider: NumberControllerSlider,\n FunctionController: FunctionController,\n ColorController: ColorController\n};\n\nexport const dom = { dom: domImport };\n\nexport const gui = { GUI: GUIImport };\n\nexport const GUI = GUIImport;\n\nexport default {\n color,\n controllers,\n dom,\n gui,\n GUI\n};\n","/**\n * dat-gui JavaScript Controller Library\n * http://code.google.com/p/dat-gui\n *\n * Copyright 2011 Data Arts Team, Google Creative Lab\n *\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n */\n\nexport default function(color,
forceCSSHex) {\n const colorFormat = color.__state.conversionName.toString();\n\n const r = Math.round(color.r);\n const g = Math.round(color.g);\n const b = Math.round(color.b);\n const a = color.a;\n const h = Math.round(color.h);\n const s = color.s.toFixed(1);\n const v = color.v.toFixed(1);\n\n if (forceCSSHex || (colorFormat === 'THREE_CHAR_HEX') || (colorFormat === 'SIX_CHAR_HEX')) {\n   let str = color.hex.toString(16);\n   while (str.length < 6) {\n   str = '0' + str;\n   }\n   return '#' + str;\n } else if (colorFormat === 'CSS_RGB') {\n   return 'rgb(' + r + ',' + g + ',' + b + ')';\n } else if (colorFormat === 'CSS_RGBA') {\n   return 'rgba(' + r + ',' + g + ',' + b + ',' + a + ')';\n } else if (colorFormat === 'HEX') {\n   return '0x' + color.hex.toString(16);\n } else if (colorFormat === 'RGB_ARRAY') {\n   return '[' + r + ',' + g + ',' + b + ']';\n } else if (colorFormat === 'RGBA_ARRAY') {\n   return '[' + r + ',' + g + ',' + b + ',' + a + ']';\n } else if (colorFormat === 'RGB_OBJ') {\n   return '{r:' + r + ',g:' + g + ',b:' + b + '}';\n } else if (colorFormat === 'RGBA_OBJ') {\n   return '{r:' + r + ',g:' + g + ',b:' + b + ',a:' + a + '}';\n } else if (colorFormat === 'HSV_OBJ') {\n   return '{h:' + h + ',s:' + s + ',v:' + v + '}';\n } else if (colorFormat === 'HSVA_OBJ') {\n   return '{h:' + h + ',s:' + s + ',v:' + v + ',a:' + a + '}';\n }\n\n return 'unknown format';\n}\n","/**\n * dat-gui JavaScript Controller Library\n * http://code.google.com/p/dat-gui\n *\n * Copyright 2011 Data Arts Team, Google Creative Lab\n *\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n *
http://www.apache.org/licenses/LICENSE-2.0\n */\n\nconst ARR_EACH = Array.prototype.forEach;\nconst ARR_SLICE = Array.prototype.slice;\n\n/**\n * Band-aid methods for things that should be a lot easier in
JavaScript.\n * Implementation and structure inspired by underscore.js\n *
http://documentcloud.github.com/underscore/\n */\n\nconst Common = {\n BREAK: {},\n\n extend: function(target) {\n   this.each(ARR_SLICE.call(arguments, 1), function(obj) {\n   const keys = this.isObject(obj) ? Object.keys(obj) : [];\n   keys.forEach(function(key) {\n   if (!this.isUndefined(obj[key])) {\n   target[key] = obj[key];\n   }\n   }.bind(this));\n   }, this);\n\n   return target;\n },\n\n defaults: function(target) {\n   this.each(ARR_SLICE.call(arguments, 1), function(obj) {\n   const keys = this.isObject(obj) ?

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Object.keys(obj) : [];\n      keys.forEach(function(key) {\n        if (this.isUndefined(target[key])) {\n          target[key] = obj[key];\n        }\n      }.bind(this));\n    }, this);\n\n    return target;\n  },\n\n  compose: function() {\n    const toCall = ARR_SLICE.call(arguments);\n    return function() {\n      let args = ARR_SLICE.call(arguments);\n      for (let i = toCall.length - 1; i >= 0; i--) {\n        args = [toCall[i].apply(this, args)];\n      }\n      return args[0];\n    };\n  },\n\n  each: function(obj, itr, scope) {\n    if (!obj) {\n      return;\n    }\n\n    if (ARR_EACH && obj.forEach && obj.forEach === ARR_EACH) {\n      obj.forEach(itr, scope);\n    } else if (obj.length === obj.length + 0) { // Is number but not NaN\n      let key;\n      let l;\n      for (key = 0, l = obj.length; key < l; key++) {\n        if (key in obj && itr.call(scope, obj[key], key) === this.BREAK) {\n          return;\n        }\n      }\n    } else {\n      for (const key in obj) {\n        if (itr.call(scope, obj[key], key) === this.BREAK) {\n          return;\n        }\n      }\n    }\n  },\n\n  defer: function(fnc) {\n    setTimeout(fnc, 0);\n  },\n\n  // if the function is called repeatedly, wait until threshold passes until we execute the function\n  debounce: function(func, threshold, callImmediately) {\n    let timeout;\n\n    return function() {\n      const obj = this;\n      const args = arguments;\n      function delayed() {\n        timeout = null;\n        if (!callImmediately) func.apply(obj, args);\n      }\n\n      const callNow = callImmediately || !timeout;\n\n      clearTimeout(timeout);\n      timeout = setTimeout(delayed, threshold);\n\n      if (callNow) {\n        func.apply(obj, args);\n      }\n    };\n  },\n\n  toArray: function(obj) {\n    if (obj.toArray) return obj.toArray();\n    return ARR_SLICE.call(obj);\n  },\n\n  isUndefined: function(obj) {\n    return obj === undefined;\n  },\n\n  isNull: function(obj) {\n    return obj === null;\n  },\n\n  isNaN: function(obj) {\n    return isNaN(obj);\n  },\n\n  isArray: Array.isArray || function(obj) {\n    return obj.constructor === Array;\n  },\n\n  isObject: function(obj) {\n    return obj === Object(obj);\n  },\n\n  isNumber: function(obj) {\n    return obj === obj + 0;\n  },\n\n  isString: function(obj) {\n    return obj === obj + '';\n  },\n\n  isBoolean: function(obj) {\n    return obj === false || obj === true;\n  },\n\n  isFunction: function(obj) {\n    return Object.prototype.toString.call(obj) === '[object Function]';\n  }\n\n};\n\nexport default Common;\n","/**\n * dat-gui JavaScript Controller Library\n * http://code.google.com/p/dat-gui\n *\n * Copyright 2011 Data Arts Team, Google Creative Lab\n *\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n */\n\nimport toString from './toString';\nimport common from '../utils/common';\n\nconst INTERPRETATIONS = [\n  // Strings\n  {\n    litmus: common.isString,\n    conversions: {\n      THREE_CHAR_HEX: {\n        read: function(original) {\n          const test = original.match(/^#([A-F0-9])([A-F0-9])([A-F0-9])$/i);\n          if (test === null) {\n            return false;\n          }\n\n          return {\n            space: 'HEX',\n            hex: parseInt(\n              '0x' +\n              test[1].toString() + test[1].toString() +\n              test[2].toString() + test[2].toString() +\n              test[3].toString() + test[3].toString(),\n              0)\n            };\n          },\n\n        write: toString\n      },\n\n      SIX_CHAR_HEX: {\n        read: function(original) {\n          const test = original.match(/^#([A-F0-9]{6})$/i);\n          if (test === null) {\n            return false;\n          }\n\n          return {\n            space: 'HEX',\n            hex: parseInt('0x' + test[1].toString(), 0)\n          };\n        },\n\n        write: toString\n      },\n\n      CSS_RGB: {\n        read: function(original) {\n          const test = original.match(/^rgb\\(\\s*(.+)\\s*,\\s*(.+)\\s*,\\s*(.+)\\s*\\)/);\n          if (test === null) {\n            return false;\n          }\n\n          return {\n            space: 'RGB',\n            r: parseFloat(test[1]),\n            g: parseFloat(test[2]),\n            b: parseFloat(test[3])\n          };\n        },\n\n        write: toString\n      },\n\n      CSS_RGBA: {\n        read: function(original) {\n          const test = original.match(/^rgba\\(\\s*(.+)\\s*,\\s*(.+)\\s*,\\s*(.+)\\s*,\\s*(.+)\\s*\\)/);\n          if (test === null) {\n            return false;\n          }\n\n          return {\n            space: 'RGB',\n            r: parseFloat(test[1]),\n            g: parseFloat(test[2]),\n            b: parseFloat(test[3]),\n            a: parseFloat(test[4])\n          };\n        },\n\n        write: toString\n      }\n    }\n  },\n\n  // Numbers\n  {\n    litmus: common.isNumber,\n\n    conversions: {\n\n      HEX: {\n        read: function(original) {\n          return {\n            space: 'HEX',\n            hex: original,\n            conversionName: 'HEX'\n          };\n        },\n\n        write: function(color) {\n          return color.hex;\n        }\n      }\n\n    }\n\n  },\n\n  // Arrays\n  {\n    litmus: common.isArray,\n    conversions: {\n      RGB_ARRAY: {\n        read: function(original) {\n          if (original.length !== 3) {\n            return false;\n          }\n\n          return {\n
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space: 'RGB',\n r: original[0],\n g: original[1],\n b: original[2]\n };\n },\n\n write: function(color) {\n return [color.r, color.g, color.b];\n }\n },\n\n RGBA_ARRAY: {\n read: function(original) {\n if (original.length !== 4) return false;\n return {\n space: 'RGB',\n r: original[0],\n g: original[1],\n b: original[2],\n a: original[3]\n };\n },\n\n write: function(color) {\n return [color.r, color.g, color.b, color.a];\n }\n }\n }\n },\n\n // Objects\n {\n litmus: common.isObject,\n conversions: {\n\n RGBA_OBJ:
{\n read: function(original) {\n if (common.isNumber(original.r) &&\n common.isNumber(original.g) &&\n common.isNumber(original.b) &&\n common.isNumber(original.a)) {\n return {\n space: 'RGB',\n r: original.r,\n g: original.g,\n b: original.b,\n a: original.a\n };\n }\n return false;\n },\n\n write: function(color) {\n return {\n r: color.r,\n g: color.g,\n b: color.b,\n a: color.a\n };\n }\n },\n\n RGB_OBJ: {\n read: function(original) {\n if (common.isNumber(original.r) &&\n common.isNumber(original.g) &&\n common.isNumber(original.b)) {\n return {\n space: 'RGB',\n r: original.r,\n g: original.g,\n b: original.b\n };\n
}\n return false;\n },\n\n write: function(color) {\n return {\n r: color.r,\n g: color.g,\n b: color.b\n };\n }\n },\n\n HSVA_OBJ: {\n read: function(original) {\n if (common.isNumber(original.h) &&\n common.isNumber(original.s) &&\n common.isNumber(original.v) &&\n common.isNumber(original.a)) {\n return {\n space: 'HSV',\n h: original.h,\n s: original.s,\n v: original.v,\n a: original.a\n };\n
}\n return false;\n },\n\n write: function(color) {\n return {\n h: color.h,\n s: color.s,\n v: color.v,\n a: color.a\n };\n }\n },\n\n HSV_OBJ: {\n read: function(original) {\n if (common.isNumber(original.h) &&\n common.isNumber(original.s)
&&\n common.isNumber(original.v)) {\n return {\n space: 'HSV',\n h: original.h,\n s: original.s,\n v: original.v\n };\n }\n return false;\n },\n\n write: function(color) {\n return {\n h: color.h,\n s: color.s,\n v: color.v\n };\n }\n
}\n }\n }\n];\n\nlet result;\nlet toReturn;\n\nconst interpret = function() {\n toReturn = false;\n\n const original = arguments.length > 1 ? common.toArray(arguments) : arguments[0];\n common.each(INTERPRETATIONS, function(family) {\n if (family.litmus(original)) {\n common.each(family.conversions, function(conversion, conversionName) {\n result = conversion.read(original);\n\n if (toReturn === false && result !== false) {\n toReturn = result;\n result.conversionName = conversionName;\n result.conversion = conversion;\n return common.BREAK;\n }\n });\n\n return common.BREAK;\n }\n });\n\n return toReturn;\n};\n\nexport default interpret;\n","/**\n * dat-gui JavaScript Controller Library\n * http://code.google.com/p/dat-gui\n *\n * Copyright 2011 Data Arts Team, Google Creative Lab\n *\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n */\n\nlet tmpComponent;\n\nconst ColorMath = {\n hsv_to_rgb: function(h, s, v) {\n const hi = Math.floor(h / 60) % 6;\n\n const f = h / 60 - Math.floor(h / 60);\n const p = v * (1.0 - s);\n const q = v * (1.0 - (f * s));\n const t = v * (1.0 - ((1.0 - f) * s));\n\n const c = [\n [v, t, p],\n [q, v, p],\n [p, v, t],\n [p, q, v],\n [t, p, v],\n [v, p, q]\n][hi];\n\n return {\n r: c[0] * 255,\n
g: c[1] * 255,\n b: c[2] * 255\n };\n },\n\n rgb_to_hsv: function(r, g, b) {\n const min = Math.min(r, g, b);\n const max = Math.max(r, g, b);\n const delta = max - min;\n let h;\n let s;\n\n if (max !== 0) {\n s = delta / max;\n } else {\n return {\n h: NaN,\n s: 0,\n v: 0\n };\n }\n\n if (r === max) {\n h = (g - b) / delta;\n } else if (g === max) {\n h = 2 + (b - r) / delta;\n } else {\n h = 4 + (r - g) / delta;\n }\n h /= 6;\n if (h < 0) {\n h += 1;\n }\n\n return {\n h: h * 360,\n s: s,\n v: max / 255\n };\n },\n\n rgb_to_hex: function(r, g, b) {\n let hex = this.hex_with_component(0, 2, r);\n hex = this.hex_with_component(hex, 1, g);\n hex = this.hex_with_component(hex, 0, b);\n return hex;\n },\n\n component_from_hex: function(hex, componentIndex) {\n return (hex >> (componentIndex * 8)) & 0xFF;\n

},\n\n hex_with_component:
 function(hex, componentIndex, value) {\n   return value << (tmpComponent = componentIndex * 8) | (hex &
~(0xFF << tmpComponent));\n }\n};\n\nexport default ColorMath;\n","/**\n * dat-gui JavaScript Controller
Library\n * http://code.google.com/p/dat-gui\n *\n * Copyright 2011 Data Arts Team, Google Creative Lab\n *\n *
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compliance with the License.\n * You may obtain a copy of the License at\n *\n *
http://www.apache.org/licenses/LICENSE-2.0\n */\n\nimport interpret from './interpret';\nimport math from
'./math';\nimport colorToString from './toString';\nimport common from '../utils/common';\n\nclass Color {\n
constructor() {\n   this.__state = interpret.apply(this, arguments);\n\n   if (this.__state === false) {\n   throw new
Error('Failed to interpret color arguments');\n   }\n\n   this.__state.a = this.__state.a || 1;\n }\n\n toString() {\n
return colorToString(this);\n
  }\n\n toHexString() {\n   return colorToString(this, true);\n }\n\n toOriginal() {\n   return
this.__state.conversion.write(this);\n }\n}\n\nfunction defineRGBComponent(target, component,
componentHexIndex) {\n Object.defineProperty(target, component, {\n   get: function() {\n   if
(this.__state.space === 'RGB') {\n   return this.__state[component];\n   }\n\n   Color.recalculateRGB(this,
component, componentHexIndex);\n\n   return this.__state[component];\n   },\n\n   set: function(v) {\n   if
(this.__state.space !== 'RGB') {\n   Color.recalculateRGB(this, component, componentHexIndex);\n
this.__state.space = 'RGB';\n   }\n\n   this.__state[component] = v;\n   }\n });\n}\n\nfunction
defineHSVComponent(target, component) {\n Object.defineProperty(target, component, {\n   get: function() {\n
if (this.__state.space === 'HSV') {\n   return this.__state[component];\n   }\n\n
Color.recalculateHSV(this);\n\n   return
 this.__state[component];\n   },\n\n   set: function(v) {\n   if (this.__state.space !== 'HSV') {\n
Color.recalculateHSV(this);\n   this.__state.space = 'HSV';\n   }\n\n   this.__state[component] = v;\n   }\n
});\n}\n\n\nColor.recalculateRGB = function(color, component, componentHexIndex) {\n if (color.__state.space
=== 'HEX') {\n   color.__state[component] = math.component_from_hex(color.__state.hex,
componentHexIndex);\n } else if (color.__state.space === 'HSV') {\n   common.extend(color.__state,
math.hsv_to_rgb(color.__state.h, color.__state.s, color.__state.v));\n } else {\n   throw new Error('Corrupted color
state');\n }\n};\n\nColor.recalculateHSV = function(color) {\n const result = math.rgb_to_hsv(color.r, color.g,
color.b);\n\n common.extend(color.__state,\n   {\n   s: result.s,\n   v: result.v\n   }\n);\n\n if
(!common.isNaN(result.h)) {\n   color.__state.h = result.h;\n } else if (common.isUndefined(color.__state.h)) {\n
color.__state.h
 = 0;\n }\n};\n\nColor.COMPONENTS = ['r', 'g', 'b', 'h', 's', 'v', 'hex', 'a'];\n\ndefineRGBComponent(Color.prototype,
'r', 2);\ndefineRGBComponent(Color.prototype, 'g', 1);\ndefineRGBComponent(Color.prototype, 'b',
0);\n\ndefineHSVComponent(Color.prototype, 'h');\ndefineHSVComponent(Color.prototype,
's');\ndefineHSVComponent(Color.prototype, 'v');\n\nObject.defineProperty(Color.prototype, 'a', {\n get: function()
{\n   return this.__state.a;\n },\n\n set: function(v) {\n   this.__state.a = v;\n
}\n});\n\nObject.defineProperty(Color.prototype, 'hex', {\n get: function() {\n   if (!this.__state.space !== 'HEX')
{\n   this.__state.hex = math.rgb_to_hex(this.r, this.g, this.b);\n   }\n\n   return this.__state.hex;\n },\n\n set:
function(v) {\n   this.__state.space = 'HEX';\n   this.__state.hex = v;\n }\n});\n\nexport default Color;\n","/**\n *
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use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n *
http://www.apache.org/licenses/LICENSE-2.0\n */\n\n/**\n * @class An \"abstract\" class that represents a given
property of an object.\n *\n * @param {Object} object The object to be manipulated\n * @param {string} property
The name of the property to be manipulated\n */\nclass Controller {\n constructor(object, property) {\n
this.initialValue = object[property];\n\n   /**\n   * Those who extend this class will put their DOM elements in
here.\n   * @type {DOMElement}\n   */\n   this.domElement = document.createElement('div');\n\n   /**\n   *
The object to manipulate\n   * @type {Object}\n   */\n   this.object = object;\n\n   /**\n   * The name of the

property to manipulate\n * @type {String}\n */\n this.property = property;\n\n /**\n * The function to be called on change.\n * @type {Function}\n * @ignore\n */\n this.__onChange = undefined;\n\n /**\n * The function to be called on finishing change.\n * @type {Function}\n * @ignore\n */\n this.__onFinishChange = undefined;\n }\n\n /**\n * Specify that a function fire every time someone changes the value with\n * this Controller.\n *\n * @param {Function} fnc This function will be called whenever the value\n * is modified via this Controller.\n * @returns {Controller} this\n */\n onChange(fnc) {\n this.__onChange = fnc;\n return this;\n }\n\n /**\n * Specify that a function fire every time someone \"finishes\" changing\n * the value wih this Controller. Useful for values that change\n * incrementally like numbers or strings.\n *\n * @param {Function} fnc This function will be called whenever\n * someone \"finishes\" changing the value via this Controller.\n * @returns {Controller} this\n */\n onFinishChange(fnc) {\n this.__onFinishChange = fnc;\n return this;\n }\n\n /**\n * Change the value of <code>object[property]</code>\n *\n * @param {Object} newValue The new value of <code>object[property]</code>\n */\n setValue(newValue) {\n this.object[this.property] = newValue;\n if (this.__onChange) {\n this.__onChange.call(this, newValue);\n }\n\n this.updateDisplay();\n return this;\n }\n\n /**\n * Gets the value of <code>object[property]</code>\n *\n * @returns {Object} The current value of <code>object[property]</code>\n */\n getValue() {\n return this.object[this.property];\n }\n\n /**\n * Refreshes the visual display of a Controller in order to keep sync\n * with the object's current value.\n * @returns {Controller} this\n */\n updateDisplay() {\n return this;\n }\n\n /**\n * @returns {Boolean} true if the value has deviated from initialValue\n */\n isModified() {\n return this.initialValue !== this.getValue();\n }\n}\n\nexport default Controller;\n","/**\n * dat-gui JavaScript Controller Library\n * http://code.google.com/p/dat-gui\n *\n * Copyright 2011 Data Arts Team, Google Creative Lab\n *\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n */\n\nimport common from '../utils/common';\n\nconst EVENT_MAP = {\n HTMLEvents: ['change'],\n MouseEvents: ['click', 'mousemove', 'mousedown', 'mouseup', 'mouseover'],\n KeyboardEvents: ['keydown']\n};\n\nconst EVENT_MAP_INV = {};\ncommon.each(EVENT_MAP, function(v, k) {\n common.each(v, function(e) {\n EVENT_MAP_INV[e] = k;\n });\n});\n\nconst CSS_VALUE_PIXELS = /(\\d+(\\.\\d+)?)px/;\n\nfunction cssValueToPixels(val) {\n if (val === '0' || common.isUndefined(val)) {\n return 0;\n }\n\n const match = val.match(CSS_VALUE_PIXELS);\n\n if (!common.isNull(match)) {\n return parseFloat(match[1]);\n }\n\n // TODO ...ems? %?\n\n return 0;\n}\n\n/**\n * @namespace\n * @member dat.dom\n */\nconst dom = {\n\n /**\n *\n * @param elem\n * @param selectable\n */\n makeSelectable: function(elem, selectable) {\n if (elem === undefined || elem.style === undefined) return;\n\n elem.onselectstart = selectable ? function() {\n return false;\n } : function() {\n };\n\n elem.style.MozUserSelect = selectable ? 'auto' : 'none';\n elem.style.KhtmlUserSelect = selectable ? 'auto' : 'none';\n elem.unselectable = selectable ? 'on' : 'off';\n },\n\n /**\n *\n * @param elem\n * @param horizontal\n * @param vert\n */\n makeFullscreen: function(elem, hor, vert) {\n let vertical = vert;\n let horizontal = hor;\n\n if (common.isUndefined(horizontal)) {\n horizontal = true;\n }\n\n if (common.isUndefined(vertical)) {\n vertical = true;\n }\n\n elem.style.position = 'absolute';\n\n if (horizontal) {\n elem.style.left = 0;\n elem.style.right = 0;\n }\n if (vertical) {\n elem.style.top = 0;\n elem.style.bottom = 0;\n }\n },\n\n /**\n *\n * @param elem\n * @param eventType\n * @param params\n */\n fakeEvent: function(elem, eventType, pars, aux) {\n const params = pars || {};\n const className = EVENT_MAP_INV[eventType];\n if (!className) {\n throw new Error('Event type ' + eventType + ' not supported.');\n }\n const evt = document.createEvent(className);\n switch (className) {\n case 'MouseEvents':\n {\n const clientX = params.x || params.clientX || 0;\n const clientY = params.y || params.clientY || 0;\n evt.initMouseEvent(eventType, params.bubbles || false,\n params.cancelable || true, window, params.clickCount || 1,\n 0, // screen X\n 0, // screen Y\n clientX, // client X\n clientY, // client

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Y\n false, false, false, false, 0, null);\n break;\n }\n case 'KeyboardEvents':\n {\n const init = evt.initKeyboardEvent || evt.initKeyEvent; // webkit || moz\n common.defaults(params, {\n cancelable: true,\n ctrlKey: false,\n altKey: false,\n shiftKey: false,\n metaKey: false,\n keyCode: undefined,\n charCode: undefined\n });\n init(eventType, params.bubbles || false,\n params.cancelable, window,\n params.ctrlKey, params.altKey,\n params.shiftKey, params.metaKey,\n params.keyCode, params.charCode);\n break;\n }\n default:\n {\n evt.initEvent(eventType, params.bubbles || false, params.cancelable || true);\n break;\n }\n }\n common.defaults(evt, aux);\n elem.dispatchEvent(evt);\n },\n\n /**\n *\n * @param elem\n * @param event\n
 * @param func\n * @param bool\n */\n bind: function(elem, event, func, newBool) {\n const bool = newBool || false;\n if (elem.addEventListener) {\n elem.addEventListener(event, func, bool);\n } else if (elem.attachEvent) {\n elem.attachEvent('on' + event, func);\n }\n return dom;\n },\n\n /**\n *\n * @param elem\n * @param event\n * @param func\n * @param bool\n */\n unbind: function(elem, event, func, newBool) {\n const bool = newBool || false;\n if (elem.removeEventListener) {\n elem.removeEventListener(event, func, bool);\n } else if (elem.detachEvent) {\n elem.detachEvent('on' + event, func);\n }\n return dom;\n },\n\n /**\n *\n * @param elem\n * @param className\n */\n addClass: function(elem, className) {\n if (elem.className === undefined) {\n elem.className = className;\n } else if (elem.className !== className) {\n const classes = elem.className.split(/ +/);\n if (classes.indexOf(className)
 === -1) {\n classes.push(className);\n elem.className = classes.join(' ').replace(/^\\s+/, '').replace(/\\s+$/, '');\n }\n }\n return dom;\n },\n\n /**\n *\n * @param elem\n * @param className\n */\n removeClass: function(elem, className) {\n if (className) {\n if (elem.className === className) {\n elem.removeAttribute('class');\n } else {\n const classes = elem.className.split(/ +/);\n const index = classes.indexOf(className);\n if (index !== -1) {\n classes.splice(index, 1);\n elem.className = classes.join(' ');\n }\n }\n } else {\n elem.className = undefined;\n }\n return dom;\n },\n\n hasClass: function(elem, className) {\n return new RegExp('(?:^|\\\\s+)' + className + '(?:\\\\s+|$)').test(elem.className) || false;\n },\n\n /**\n *\n * @param elem\n */\n getWidth: function(elem) {\n const style = getComputedStyle(elem);\n\n
 return cssValueToPixels(style['border-left-width']) +\n cssValueToPixels(style['border-right-width']) +\n cssValueToPixels(style['padding-left']) +\n cssValueToPixels(style['padding-right']) +\n cssValueToPixels(style.width);\n },\n\n /**\n *\n * @param elem\n */\n getHeight: function(elem) {\n const style = getComputedStyle(elem);\n\n return cssValueToPixels(style['border-top-width']) +\n cssValueToPixels(style['border-bottom-width']) +\n cssValueToPixels(style['padding-top']) +\n cssValueToPixels(style['padding-bottom']) +\n cssValueToPixels(style.height);\n },\n\n /**\n *\n * @param el\n */\n getOffset: function(el) {\n let elem = el;\n const offset = { left: 0, top: 0 };\n if (elem.offsetParent) {\n do {\n offset.left += elem.offsetLeft;\n offset.top += elem.offsetTop;\n elem = elem.offsetParent;\n } while (elem);\n }\n return offset;\n },\n\n //
http://stackoverflow.com/posts/2684561/revisions\n
 /**\n *\n * @param elem\n */\n isActive: function(elem) {\n return elem === document.activeElement && (elem.type || elem.href);\n }\n\n};\n\nexport default dom;\n","/**\n * dat-gui JavaScript Controller Library\n * http://code.google.com/p/dat-gui\n *\n * Copyright 2011 Data Arts Team, Google Creative Lab\n *\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n */\n\nimport Controller from './Controller';\nimport dom from '../dom/dom';\n\n/**\n * @class Provides a checkbox input to alter the boolean property of an object.\n *\n * @extends dat.controllers.Controller\n *\n * @param {Object} object The object to be manipulated\n * @param {string} property The name of the property to be manipulated\n */\nclass BooleanController extends Controller {\n constructor(object,
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property) {\n super(object, property);\n\n const _this = this;\n this.__prev = this.getValue();\n\n this.__checkbox = document.createElement('input');\n this.__checkbox.setAttribute('type', 'checkbox');\n\n function onChange() {\n _this.setValue(!_this.__prev);\n }\n\n dom.bind(this.__checkbox, 'change', onChange, false);\n\n this.domElement.appendChild(this.__checkbox);\n\n // Match original value\n this.updateDisplay();\n }\n\n setValue(v) {\n const toReturn = super.setValue(v);\n if (this.__onFinishChange) {\n this.__onFinishChange.call(this, this.getValue());\n }\n this.__prev = this.getValue();\n return toReturn;\n }\n\n updateDisplay() {\n if (this.getValue() === true) {\n this.__checkbox.setAttribute('checked', 'checked');\n this.__checkbox.checked = true;\n this.__prev = true;\n } else {\n this.__checkbox.checked = false;\n this.__prev = false;\n }\n\n return super.updateDisplay();\n }\n}\n\nexport default BooleanController;\n","/**\n * dat-gui JavaScript Controller Library\n * http://code.google.com/p/dat-gui\n *\n * Copyright 2011 Data Arts Team, Google Creative Lab\n *\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n */\n\nimport Controller from './Controller';\nimport dom from '../dom/dom';\nimport common from '../utils/common';\n\n/**\n * @class Provides a select input to alter the property of an object, using a\n * list of accepted values.\n *\n * @extends dat.controllers.Controller\n *\n * @param {Object} object The object to be manipulated\n * @param {string} property The name of the property to be manipulated\n * @param {Object|string[]} options A map of labels to acceptable values, or\n * a list of acceptable string values.\n */\nclass OptionController extends Controller
{\n constructor(object, property, opts) {\n super(object, property);\n\n let options = opts;\n\n const _this = this;\n\n /**\n * The drop down menu\n * @ignore\n */\n this.__select = document.createElement('select');\n\n if (common.isArray(options)) {\n const map = {};\n common.each(options, function(element) {\n map[element] = element;\n });\n options = map;\n }\n\n common.each(options, function(value, key) {\n const opt = document.createElement('option');\n opt.innerHTML = key;\n opt.setAttribute('value', value);\n _this.__select.appendChild(opt);\n });\n\n // Acknowledge original value\n this.updateDisplay();\n\n dom.bind(this.__select, 'change', function() {\n const desiredValue = this.options[this.selectedIndex].value;\n _this.setValue(desiredValue);\n });\n\n this.domElement.appendChild(this.__select);\n }\n\n setValue(v) {\n const toReturn = super.setValue(v);\n\n if (this.__onFinishChange) {\n this.__onFinishChange.call(this, this.getValue());\n }\n return toReturn;\n }\n\n updateDisplay() {\n if (dom.isActive(this.__select)) return this; // prevent number from updating if user is trying to manually update\n this.__select.value = this.getValue();\n return super.updateDisplay();\n }\n}\n\nexport default OptionController;\n","/**\n * dat-gui JavaScript Controller Library\n * http://code.google.com/p/dat-gui\n *\n * Copyright 2011 Data Arts Team, Google Creative Lab\n *\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n */\n\nimport Controller from './Controller';\nimport dom from '../dom/dom';\n\n/**\n * @class Provides a text input to alter the string property of an object.\n *\n * @extends dat.controllers.Controller\n *\n * @param {Object} object The object to be manipulated\n * @param {string} property The name of the property to be manipulated\n */\nclass StringController extends Controller {\n constructor(object, property) {\n super(object, property);\n\n const _this = this;\n\n function onChange() {\n _this.setValue(_this.__input.value);\n }\n\n function onBlur() {\n if (_this.__onFinishChange) {\n _this.__onFinishChange.call(_this, _this.getValue());\n }\n }\n\n this.__input = document.createElement('input');\n this.__input.setAttribute('type', 'text');\n\n dom.bind(this.__input, 'keyup', onChange);\n dom.bind(this.__input, 'change', onChange);\n dom.bind(this.__input, 'blur', onBlur);\n dom.bind(this.__input, 'keydown', function(e) {\n if (e.keyCode === 13) {\n this.blur();\n }\n });\n\n this.updateDisplay();\n\n this.domElement.appendChild(this.__input);\n }\n\n updateDisplay() {\n // Stops the caret from moving on account of:\n // keyup -> setValue -> updateDisplay\n if (!dom.isActive(this.__input)) {\n this.__input.value = this.getValue();\n }\n return super.updateDisplay();\n }\n}\n\nexport default StringController;\n","/**\n * dat-

gui JavaScript Controller Library\n * http://code.google.com/p/dat-gui\n *\n * Copyright 2011 Data Arts Team, Google Creative Lab\n *\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n */\n\nimport Controller from './Controller';\nimport common from '../utils/common';\n\nfunction numDecimals(x) {\n const _x = x.toString();\n if (_x.indexOf('.') > -1) {\n   return _x.length - _x.indexOf('.') - 1;\n }\n\n return 0;\n}\n\n/**\n * @class Represents a given property of an object that is a number.\n *\n * @extends dat.controllers.Controller\n *\n * @param {Object} object
 The object to be manipulated\n * @param {string} property The name of the property to be manipulated\n * @param {Object} [params] Optional parameters\n * @param {Number} [params.min] Minimum allowed value\n * @param {Number} [params.max] Maximum allowed value\n * @param {Number} [params.step] Increment by which to change value\n */\nclass NumberController extends Controller {\n constructor(object, property, params) {\n   super(object, property);\n\n   const _params = params || {};\n\n   this.__min = _params.min;\n   this.__max = _params.max;\n   this.__step = _params.step;\n\n   if (common.isUndefined(this.__step)) {\n   if (this.initialValue === 0) {\n   this.__impliedStep = 1; // What are we, psychics?\n   } else {\n   // Hey Doug, check this out.\n
    this.__impliedStep = Math.pow(10, Math.floor(Math.log(Math.abs(this.initialValue)) / Math.LN10)) / 10;\n
  }\n   } else {\n   this.__impliedStep = this.__step;\n   }\n\n   this.__precision = numDecimals(this.__impliedStep);\n
  }\n\n setValue(v) {\n   let _v = v;\n\n   if (this.__min !== undefined && _v < this.__min) {\n   _v = this.__min;\n   } else if (this.__max !== undefined && _v > this.__max) {\n   _v = this.__max;\n   }\n\n   if (this.__step !== undefined && _v % this.__step !== 0) {\n   _v = Math.round(_v / this.__step) * this.__step;\n
  }\n\n   return super.setValue(_v);\n }\n\n /**\n   * Specify a minimum value for <code>object[property]</code>.\n
   *\n   * @param {Number} minValue The minimum value for\n   * <code>object[property]</code>\n   * @returns {dat.controllers.NumberController} this\n   */\n min(minValue) {\n   this.__min = minValue;\n   return this;\n
  }\n\n /**\n   * Specify a maximum value for <code>object[property]</code>.\n   *\n   * @param {Number} maxValue The maximum value for\n   * <code>object[property]</code>\n   * @returns {dat.controllers.NumberController} this\n   */\n max(maxValue) {\n   this.__max = maxValue;\n   return this;\n }\n\n /**\n   * Specify a step value that dat.controllers.NumberController\n   * increments by.\n   *\n   * @param {Number} stepValue The step value for\n   * dat.controllers.NumberController\n   * @default if minimum and maximum specified increment is 1% of the\n   * difference otherwise stepValue is 1\n   * @returns {dat.controllers.NumberController} this\n   */\n step(stepValue) {\n   this.__step = stepValue;\n   this.__impliedStep = stepValue;\n   this.__precision = numDecimals(stepValue);\n   return this;\n }\n}\n\nexport default NumberController;\n","/**\n * dat-gui JavaScript Controller Library\n * http://code.google.com/p/dat-gui\n *\n * Copyright 2011 Data Arts Team, Google Creative Lab\n *\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n */\n\nimport NumberController from './NumberController';\nimport dom from '../dom/dom';\nimport common from '../utils/common';\n\nfunction roundToDecimal(value, decimals) {\n const tenTo = Math.pow(10, decimals);\n return Math.round(value * tenTo) / tenTo;\n}\n\n/**\n * @class Represents a given property of an object that is a number and\n * provides an input element with which to manipulate it.\n *\n * @extends dat.controllers.Controller\n * @extends dat.controllers.NumberController\n *\n * @param {Object} object The object to be manipulated\n * @param {string} property The name of the property to be manipulated\n * @param {Object} [params] Optional parameters\n * @param {Number} [params.min] Minimum allowed value\n * @param {Number} [params.max] Maximum allowed value\n * @param {Number} [params.step] Increment by which to change value\n */\nclass NumberControllerBox extends NumberController {\n constructor(object, property, params) {\n   super(object, property, params);\n\n   this.__truncationSuspended = false;\n\n
    const _this = this;\n\n   /**\n   * {Number} Previous mouse y position\n   * @ignore\n   */\n   let prevY;\n\n   function onChange() {\n   const attempted = parseFloat(_this.__input.value);\n   if (!common.isNaN(attempted)) {\n   _this.setValue(attempted);\n   }\n   }\n\n   function onFinish() {\n   if (_this.__onFinishChange) {\n

_this.__onFinishChange.call(_this, _this.getValue());\n }\n }\n\n function onBlur() {\n onFinish();\n }\n\n function onMouseDrag(e) {\n const diff = prevY - e.clientY;\n _this.setValue(_this.getValue() + diff * _this.__impliedStep);\n\n prevY = e.clientY;\n }\n\n function onMouseUp() {\n dom.unbind(window, 'mousemove', onMouseDrag);\n dom.unbind(window, 'mouseup', onMouseUp);\n onFinish();\n }\n\n function onMouseDown(e) {\n dom.bind(window, 'mousemove', onMouseDrag);\n dom.bind(window, 'mouseup', onMouseUp);\n prevY = e.clientY;\n }\n\n this.__input = document.createElement('input');\n this.__input.setAttribute('type', 'text');\n\n // Makes it so manually specified values are not truncated.\n\n dom.bind(this.__input, 'change', onChange);\n dom.bind(this.__input, 'blur', onBlur);\n dom.bind(this.__input, 'mousedown', onMouseDown);\n dom.bind(this.__input, 'keydown', function(e) {\n // When pressing enter, you can be as precise as you want.\n if (e.keyCode === 13) {\n _this.__truncationSuspended = true;\n this.blur();\n _this.__truncationSuspended = false;\n onFinish();\n }\n });\n\n this.updateDisplay();\n\n this.domElement.appendChild(this.__input);\n }\n\n updateDisplay() {\n this.__input.value = this.__truncationSuspended ? this.getValue() : roundToDecimal(this.getValue(), this.__precision);\n return super.updateDisplay();\n }\n}\n\nexport default NumberControllerBox;\n","/**\n * dat-gui JavaScript Controller Library\n * http://code.google.com/p/dat-gui\n *\n * Copyright 2011 Data Arts Team, Google Creative Lab\n *\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n */\n\nimport NumberController from './NumberController';\nimport dom from '../dom/dom';\n\nfunction map(v, i1, i2, o1, o2) {\n return o1 + (o2 - o1) * ((v - i1) / (i2 - i1));\n}\n\n/**\n * @class Represents a given property of an object that is a number, contains\n * a minimum and maximum, and provides a slider element with which to\n * manipulate it. It should be noted that the slider element is made up of\n * <code><div></code> tags, not the html5\n * <code><slider></code> element.\n *\n * @extends dat.controllers.Controller\n * @extends dat.controllers.NumberController\n *\n * @param {Object} object The object to be manipulated\n * @param {string} property The name of the property to be manipulated\n * @param {Number} minValue Minimum allowed value\n * @param {Number} maxValue Maximum allowed value\n * @param {Number} stepValue Increment by which to change value\n */\nclass NumberControllerSlider extends NumberController {\n constructor(object, property, min, max, step) {\n super(object, property, { min: min, max: max, step: step });\n\n const _this = this;\n\n this.__background = document.createElement('div');\n this.__foreground = document.createElement('div');\n\n dom.bind(this.__background, 'mousedown', onMouseDown);\n dom.bind(this.__background, 'touchstart', onTouchStart);\n\n dom.addClass(this.__background, 'slider');\n dom.addClass(this.__foreground, 'slider-fg');\n\n function onMouseDown(e) {\n document.activeElement.blur();\n\n dom.bind(window, 'mousemove', onMouseDrag);\n dom.bind(window, 'mouseup', onMouseUp);\n\n onMouseDrag(e);\n }\n\n function onMouseDrag(e) {\n e.preventDefault();\n\n const bgRect = _this.__background.getBoundingClientRect();\n\n _this.setValue(\n map(e.clientX, bgRect.left, bgRect.right, _this.__min, _this.__max)\n);\n\n return false;\n }\n\n function onMouseUp() {\n dom.unbind(window, 'mousemove', onMouseDrag);\n dom.unbind(window, 'mouseup', onMouseUp);\n if (_this.__onFinishChange) {\n _this.__onFinishChange.call(_this, _this.getValue());\n }\n }\n\n function onTouchStart(e) {\n if (e.touches.length !== 1) { return; }\n dom.bind(window, 'touchmove', onTouchMove);\n dom.bind(window, 'touchend', onTouchEnd);\n onTouchMove(e);\n }\n\n function onTouchMove(e) {\n const clientX = e.touches[0].clientX;\n const bgRect = _this.__background.getBoundingClientRect();\n\n _this.setValue(\n map(clientX, bgRect.left, bgRect.right, _this.__min, _this.__max)\n);\n }\n\n function onTouchEnd() {\n dom.unbind(window, 'touchmove', onTouchMove);\n dom.unbind(window, 'touchend', onTouchEnd);\n if (_this.__onFinishChange) {\n _this.__onFinishChange.call(_this, _this.getValue());\n }\n }\n\n this.updateDisplay();\n\n this.__background.appendChild(this.__foreground);\n this.domElement.appendChild(this.__background);\n }\n\n updateDisplay() {\n const pct = (this.getValue() -

this.__min) / (this.__max - this.__min);\n   this.__foreground.style.width = pct * 100 + '%';\n   return super.updateDisplay();\n }\n}\n\nexport default NumberControllerSlider;\n","/**\n * dat-gui JavaScript Controller Library\n * http://code.google.com/p/dat-gui\n *\n * Copyright 2011 Data Arts Team, Google Creative Lab\n *\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n */\n\nimport Controller from './Controller';\nimport dom from '../dom/dom';\n\n/**\n * @class Provides a GUI interface to fire a specified method, a property of an object.\n *\n * @extends dat.controllers.Controller\n *\n * @param {Object} object The object to be manipulated\n * @param {string} property The name of the property to be manipulated\n */\nclass FunctionController extends Controller {\n constructor(object, property, text) {\n   super(object, property);\n\n   const _this = this;\n\n   this.__button = document.createElement('div');\n   this.__button.innerHTML = text === undefined ? 'Fire' : text;\n\n   dom.bind(this.__button, 'click', function(e) {\n   e.preventDefault();\n   _this.fire();\n   return false;\n   });\n\n   dom.addClass(this.__button, 'button');\n\n   this.domElement.appendChild(this.__button);\n }\n\n fire() {\n   if (this.__onChange) {\n   this.__onChange.call(this);\n   }\n   this.getValue().call(this.object);\n   if (this.__onFinishChange) {\n   this.__onFinishChange.call(this, this.getValue());\n   }\n }\n}\n\nexport default FunctionController;\n","/**\n * dat-gui JavaScript Controller Library\n * http://code.google.com/p/dat-gui\n *\n * Copyright 2011 Data Arts Team, Google Creative Lab\n *\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n */\n\nimport Controller from './Controller';\nimport dom from '../dom/dom';\nimport Color from '../color/Color';\nimport interpret from '../color/interpret';\nimport common from '../utils/common';\n\n/**\n * @class Represents a given property of an object that is a color.\n * @param {Object} object\n * @param {string} property\n */\nclass ColorController extends Controller {\n constructor(object, property) {\n   super(object, property);\n\n   this.__color = new Color(this.getValue());\n   this.__temp = new Color(0);\n\n   const _this = this;\n\n   this.domElement = document.createElement('div');\n\n   dom.makeSelectable(this.domElement, false);\n\n   this.__selector = document.createElement('div');\n   this.__selector.className = 'selector';\n\n   this.__saturation_field = document.createElement('div');\n   this.__saturation_field.className = 'saturation-field';\n\n   this.__field_knob = document.createElement('div');\n   this.__field_knob.className = 'field-knob';\n   this.__field_knob_border = '2px solid ';\n\n   this.__hue_knob = document.createElement('div');\n   this.__hue_knob.className = 'hue-knob';\n\n   this.__hue_field = document.createElement('div');\n   this.__hue_field.className = 'hue-field';\n\n   this.__input = document.createElement('input');\n   this.__input.type = 'text';\n   this.__input_textShadow = '0 1px 1px ';\n\n   dom.bind(this.__input, 'keydown', function(e) {\n   if (e.keyCode === 13) { // on enter\n   onBlur.call(this);\n   }\n   });\n\n   dom.bind(this.__input, 'blur', onBlur);\n\n   dom.bind(this.__selector, 'mousedown', function(/* e */) {\n   dom\n   .addClass(this, 'drag')\n   .bind(window, 'mouseup', function(/* e */) {\n   dom.removeClass(_this.__selector, 'drag');\n   });\n   });\n\n   dom.bind(this.__selector, 'touchstart', function(/* e */) {\n   dom\n   .addClass(this, 'drag')\n   .bind(window, 'touchend', function(/* e */) {\n   dom.removeClass(_this.__selector, 'drag');\n   });\n   });\n\n   const valueField = document.createElement('div');\n\n   common.extend(this.__selector.style, {\n   width: '122px',\n   height: '102px',\n   padding: '3px',\n   backgroundColor: '#222',\n   boxShadow: '0px 1px 3px rgba(0,0,0,0.3)'\n   });\n\n   common.extend(this.__field_knob.style, {\n   position: 'absolute',\n   width: '12px',\n   height: '12px',\n   border: this.__field_knob_border + (this.__color.v < 0.5 ? '#fff' : '#000'),\n   boxShadow: '0px 1px 3px rgba(0,0,0,0.5)',\n   borderRadius: '12px',\n   zIndex: 1\n   });\n\n   common.extend(this.__hue_knob.style, {\n   position: 'absolute',\n   width: '15px',\n   height: '2px',\n   borderRight: '4px solid #fff',\n   zIndex: 1\n   });\n\n   common.extend(this.__saturation_field.style, {\n   width: '100px',\n   height: '100px',\n   border: '1px solid #555',\n   marginRight: '3px',\n   display: 'inline-block',\n   cursor: 'pointer'\n   });\n\n   common.extend(valueField.style, {\n   width: '100%',\n   height: '100%',\n   background: 'none'\n   });\n\n   linearGradient(valueField, 'top', 'rgba(0,0,0,0)', '#000');\n\n

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common.extend(this.__hue_field.style, {\n      width: '15px',\n      height: '100px',\n      border: '1px solid #555',\n
cursor: 'ns-resize',\n      position: 'absolute',\n      top: '3px',\n      right: '3px'\n    });\n\n
hueGradient(this.__hue_field);\n\n    common.extend(this.__input.style,
 {\n      outline: 'none',\n//      width: '120px',\n      textAlign: 'center',\n//      padding: '4px',\n//      marginBottom:
'6px',\n      color: '#fff',\n      border: 0,\n      fontWeight: 'bold',\n      textShadow: this.__input_textShadow +
'rgba(0,0,0,0.7)'\n    });\n\n    dom.bind(this.__saturation_field, 'mousedown', fieldDown);\n
dom.bind(this.__saturation_field, 'touchstart', fieldDown);\n\n    dom.bind(this.__field_knob, 'mousedown',
fieldDown);\n    dom.bind(this.__field_knob, 'touchstart', fieldDown);\n\n    dom.bind(this.__hue_field,
'mousedown', fieldDownH);\n    dom.bind(this.__hue_field, 'touchstart', fieldDownH);\n\n    function fieldDown(e)
{\n      setSV(e);\n      dom.bind(window, 'mousemove', setSV);\n      dom.bind(window, 'touchmove', setSV);\n
dom.bind(window, 'mouseup', fieldUpSV);\n      dom.bind(window, 'touchend', fieldUpSV);\n    }\n\n    function
fieldDownH(e) {\n      setH(e);\n      dom.bind(window, 'mousemove', setH);\n
    dom.bind(window, 'touchmove', setH);\n      dom.bind(window, 'mouseup', fieldUpH);\n      dom.bind(window,
'touchend', fieldUpH);\n    }\n\n    function fieldUpSV() {\n      dom.unbind(window, 'mousemove', setSV);\n
dom.unbind(window, 'touchmove', setSV);\n      dom.unbind(window, 'mouseup', fieldUpSV);\n
dom.unbind(window, 'touchend', fieldUpSV);\n      onFinish();\n    }\n\n    function fieldUpH() {\n
dom.unbind(window, 'mousemove', setH);\n      dom.unbind(window, 'touchmove', setH);\n      dom.unbind(window,
'mouseup', fieldUpH);\n      dom.unbind(window, 'touchend', fieldUpH);\n      onFinish();\n    }\n\n    function
onBlur() {\n      const i = interpret(this.value);\n      if (i !== false) {\n        _this.__color.__state = i;\n
_this.setValue(_this.__color.toOriginal());\n      } else {\n        this.value = _this.__color.toString();\n      }\n    }\n\n
function onFinish() {\n      if (_this.__onFinishChange) {\n        _this.__onFinishChange.call(_this,
 _this.__color.toOriginal());\n      }\n    }\n\n    this.__saturation_field.appendChild(valueField);\n
this.__selector.appendChild(this.__field_knob);\n    this.__selector.appendChild(this.__saturation_field);\n
this.__selector.appendChild(this.__hue_field);\n    this.__hue_field.appendChild(this.__hue_knob);\n\n
this.domElement.appendChild(this.__input);\n    this.domElement.appendChild(this.__selector);\n\n
this.updateDisplay();\n\n    function setSV(e) {\n      if (e.type.indexOf('touch') === -1) { e.preventDefault(); }\n\n
const fieldRect = _this.__saturation_field.getBoundingClientRect();\n      const { clientX, clientY } = (e.touches &&
e.touches[0]) || e;\n      let s = (clientX - fieldRect.left) / (fieldRect.right - fieldRect.left);\n      let v = 1 - (clientY -
fieldRect.top) / (fieldRect.bottom - fieldRect.top);\n\n      if (v > 1) {\n        v = 1;\n      } else if (v < 0) {\n        v =
0;\n      }\n\n      if (s > 1) {\n        s = 1;\n      } else
 if (s < 0) {\n        s = 0;\n      }\n\n      _this.__color.v = v;\n      _this.__color.s = s;\n\n
_this.setValue(_this.__color.toOriginal());\n\n\n      return false;\n    }\n\n    function setH(e) {\n      if
(e.type.indexOf('touch') === -1) { e.preventDefault(); }\n\n      const fieldRect =
_this.__hue_field.getBoundingClientRect();\n      const { clientY } = (e.touches && e.touches[0]) || e;\n      let h = 1
- (clientY - fieldRect.top) / (fieldRect.bottom - fieldRect.top);\n\n      if (h > 1) {\n        h = 1;\n      } else if (h < 0)
{\n        h = 0;\n      }\n\n      _this.__color.h = h * 360;\n\n      _this.setValue(_this.__color.toOriginal());\n\n
return false;\n    }\n  }\n\n  updateDisplay() {\n    const i = interpret(this.getValue());\n\n    if (i !== false) {\n      let
mismatch = false;\n\n      // Check for mismatch on the interpreted value.\n\n
common.each(Color.COMPONENTS, function(component) {\n        if (!common.isUndefined(i[component]) &&
!common.isUndefined(this.__color.__state[component])
 &&\n            i[component] !== this.__color.__state[component]) {\n          mismatch = true;\n          return {}; //
break\n        }\n      }, this);\n\n      // If nothing diverges, we keep our previous values\n      // for statefulness,
otherwise we recalculate fresh\n      if (mismatch) {\n        common.extend(this.__color.__state, i);\n      }\n    }\n\n
common.extend(this.__temp.__state, this.__color.__state);\n\n    this.__temp.a = 1;\n\n    const flip = (this.__color.v
< 0.5 || this.__color.s > 0.5) ? 255 : 0;\n    const _flip = 255 - flip;\n\n    common.extend(this.__field_knob.style, {\n
  marginLeft: 100 * this.__color.s - 7 + 'px',\n      marginTop: 100 * (1 - this.__color.v) - 7 + 'px',\n
backgroundColor: this.__temp.toHexString(),\n      border: this.__field_knob_border + 'rgb(' + flip + ',' + flip + ',' +
flip + ')'\n    });\n\n    this.__hue_knob.style.marginTop = (1 - this.__color.h / 360) * 100 + 'px';\n\n    this.__temp.s
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= 1;\n this.__temp.v = 1;\n\n linearGradient(this.__saturation_field, 'left', '#fff', this.__temp.toHexString());\n\n this.__input.value = this.__color.toString();\n\n common.extend(this.__input.style, {\n backgroundColor: this.__color.toHexString(),\n color: 'rgb(' + flip + ',' + flip + ',' + flip + ')',\n textShadow: this.__input_textShadow + 'rgba(' + _flip + ',' + _flip + ',' + _flip + ',.7)'\n });\n }\n}\n\nconst vendors = ['-moz-', '-o-', '-webkit-', '-ms-', ''];\n\nfunction linearGradient(elem, x, a, b) {\n elem.style.background = '';\n common.each(vendors, function(vendor) {\n elem.style.cssText += 'background: ' + vendor + 'linear-gradient(' + x + ', ' + a + ' 0%, ' + b + ' 100%); ';\n });\n}\n\nfunction hueGradient(elem) {\n elem.style.background = '';\n elem.style.cssText += 'background: -moz-linear-gradient(top, #ff0000 0%, #ff00ff 17%, #0000ff 34%, #00ffff 50%, #00ff00 67%, #ffff00 84%, #ff0000 100%);';\n elem.style.cssText
 += 'background: -webkit-linear-gradient(top, #ff0000 0%,#ff00ff 17%,#0000ff 34%,#00ffff 50%,#00ff00 67%,#ffff00 84%,#ff0000 100%);';\n elem.style.cssText += 'background: -o-linear-gradient(top, #ff0000 0%,#ff00ff 17%,#0000ff 34%,#00ffff 50%,#00ff00 67%,#ffff00 84%,#ff0000 100%);';\n elem.style.cssText += 'background: -ms-linear-gradient(top, #ff0000 0%,#ff00ff 17%,#0000ff 34%,#00ffff 50%,#00ff00 67%,#ffff00 84%,#ff0000 100%);';\n elem.style.cssText += 'background: linear-gradient(top, #ff0000 0%,#ff00ff 17%,#0000ff 34%,#00ffff 50%,#00ff00 67%,#ffff00 84%,#ff0000 100%);';\n}\n\nexport default ColorController;\n","/**\n * dat-gui JavaScript Controller Library\n * http://code.google.com/p/dat-gui\n *\n * Copyright 2011 Data Arts Team, Google Creative Lab\n *\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n *
http://www.apache.org/licenses/LICENSE-2.0\n
 */\n\nconst css = {\n load: function(url, indoc) {\n const doc = indoc || document;\n const link = doc.createElement('link');\n link.type = 'text/css';\n link.rel = 'stylesheet';\n link.href = url;\n doc.getElementsByTagName('head')[0].appendChild(link);\n },\n\n inject: function(cssContent, indoc) {\n const doc = indoc || document;\n const injected = document.createElement('style');\n injected.type = 'text/css';\n injected.innerHTML = cssContent;\n const head = doc.getElementsByTagName('head')[0];\n try {\n head.appendChild(injected);\n } catch (e) { // Unable to inject CSS, probably because of a Content Security Policy\n }\n }\n};\n\nexport default css;\n","const saveDialogContents = `<div id=\"dg-save\" class=\"dg dialogue\">\n\n Here's the new load parameter for your <code>GUI</code>'s constructor:\n\n <textarea id=\"dg-new-constructor\"></textarea>\n\n <div id=\"dg-save-locally\">\n\n <input id=\"dg-local-storage\"
 type=\"checkbox\"/> Automatically save\n values to <code>localStorage</code> on exit.\n\n <div id=\"dg-local-explain\">The values saved to <code>localStorage</code> will\n override those passed to <code>dat.GUI</code>'s constructor. This makes it\n easier to work incrementally, but <code>localStorage</code> is fragile,\n and your friends may not see the same values you do.\n\n \n\n \n\n `;\n\nexport default saveDialogContents;\n","/**\n * dat-gui JavaScript Controller Library\n * http://code.google.com/p/dat-gui\n *\n * Copyright 2011 Data Arts Team, Google Creative Lab\n *\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n
 */\n\nimport OptionController from './OptionController';\nimport NumberControllerBox from './NumberControllerBox';\nimport NumberControllerSlider
 from './NumberControllerSlider';\nimport StringController from './StringController';\nimport FunctionController from './FunctionController';\nimport BooleanController from './BooleanController';\nimport common from '../utils/common';\n\nconst ControllerFactory = function(object, property) {\n const initialValue = object[property];\n\n // Providing options?\n if (common.isArray(arguments[2]) || common.isObject(arguments[2])) {\n return new OptionController(object, property, arguments[2]);\n }\n\n // Providing a map?\n if (common.isNumber(initialValue)) {\n // Has min and max? (slider)\n if (common.isNumber(arguments[2]) && common.isNumber(arguments[3])) {\n // has step?\n if (common.isNumber(arguments[4])) {\n return new NumberControllerSlider(object, property,\n arguments[2], arguments[3], arguments[4]);\n }\n\n return new NumberControllerSlider(object, property, arguments[2], arguments[3]);\n }\n\n // number

box\n if (common.isNumber(arguments[4])) { // has step\n return new NumberControllerBox(object, property,\n { min: arguments[2], max: arguments[3], step: arguments[4] });\n }\n return new NumberControllerBox(object, property, { min: arguments[2], max: arguments[3] });\n }\n\n if (common.isString(initialValue)) {\n return new StringController(object, property);\n }\n\n if (common.isFunction(initialValue)) {\n return new FunctionController(object, property, '');\n }\n\n if (common.isBoolean(initialValue)) {\n return new BooleanController(object, property);\n }\n\n return null;\n};\n\nexport default ControllerFactory;\n","/**\n * dat-gui JavaScript Controller Library\n * http://code.google.com/p/dat-gui\n *\n * Copyright 2011 Data Arts Team, Google Creative Lab\n *\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the
License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n */\n\nfunction requestAnimationFrame(callback) {\n setTimeout(callback, 1000 / 60);\n}\n\nexport default window.requestAnimationFrame ||\n window.webkitRequestAnimationFrame ||\n window.mozRequestAnimationFrame ||\n window.oRequestAnimationFrame ||\n window.msRequestAnimationFrame ||\n requestAnimationFrame;\n","/**\n * dat-gui JavaScript Controller Library\n * http://code.google.com/p/dat-gui\n *\n * Copyright 2011 Data Arts Team, Google Creative Lab\n *\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n */\n\nimport dom from '../dom/dom';\nimport common from '../utils/common';\n\nclass CenteredDiv {\n constructor() {\n this.backgroundElement = document.createElement('div');\n common.extend(this.backgroundElement.style,
  {\n backgroundColor: 'rgba(0,0,0,0.8)',\n top: 0,\n left: 0,\n display: 'none',\n zIndex: '1000',\n opacity: 0,\n WebkitTransition: 'opacity 0.2s linear',\n transition: 'opacity 0.2s linear'\n });\n\n dom.makeFullscreen(this.backgroundElement);\n this.backgroundElement.style.position = 'fixed';\n\n this.domElement = document.createElement('div');\n common.extend(this.domElement.style, {\n position: 'fixed',\n display: 'none',\n zIndex: '1001',\n opacity: 0,\n WebkitTransition: '-webkit-transform 0.2s ease-out, opacity 0.2s linear',\n transition: 'transform 0.2s ease-out, opacity 0.2s linear'\n });\n\n\n document.body.appendChild(this.backgroundElement);\n document.body.appendChild(this.domElement);\n\n const _this = this;\n dom.bind(this.backgroundElement, 'click', function() {\n _this.hide();\n });\n }\n\n show() {\n const _this = this;\n\n this.backgroundElement.style.display
  = 'block';\n\n this.domElement.style.display = 'block';\n this.domElement.style.opacity = 0;\n// this.domElement.style.top = '52%';\n this.domElement.style.webkitTransform = 'scale(1.1)';\n\n this.layout();\n\n common.defer(function() {\n _this.backgroundElement.style.opacity = 1;\n _this.domElement.style.opacity = 1;\n _this.domElement.style.webkitTransform = 'scale(1)';\n });\n }\n\n /**\n * Hide centered div\n */\n hide() {\n const _this = this;\n\n const hide = function() {\n _this.domElement.style.display = 'none';\n _this.backgroundElement.style.display = 'none';\n\n dom.unbind(_this.domElement, 'webkitTransitionEnd', hide);\n dom.unbind(_this.domElement, 'transitionend', hide);\n dom.unbind(_this.domElement, 'oTransitionEnd', hide);\n };\n\n dom.bind(this.domElement, 'webkitTransitionEnd', hide);\n dom.bind(this.domElement, 'transitionend', hide);\n dom.bind(this.domElement, 'oTransitionEnd', hide);\n\n this.backgroundElement.style.opacity = 0;\n// this.domElement.style.top = '48%';\n this.domElement.style.opacity = 0;\n this.domElement.style.webkitTransform = 'scale(1.1)';\n }\n\n layout() {\n this.domElement.style.left = window.innerWidth / 2 - dom.getWidth(this.domElement) / 2 + 'px';\n this.domElement.style.top = window.innerHeight / 2 - dom.getHeight(this.domElement) / 2 + 'px';\n }\n}\n\nexport default CenteredDiv;\n","/**\n * dat-gui JavaScript Controller Library\n * http://code.google.com/p/dat-gui\n *\n * Copyright 2011 Data Arts Team, Google Creative Lab\n *\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n */\n\nimport css from '../utils/css';\nimport saveDialogueContents from './saveDialogue.html';\nimport ControllerFactory from

'../controllers/ControllerFactory';\nimport
Controller from '../controllers/Controller';\nimport BooleanController from
'../controllers/BooleanController';\nimport FunctionController from '../controllers/FunctionController';\nimport
NumberControllerBox from '../controllers/NumberControllerBox';\nimport NumberControllerSlider from
'../controllers/NumberControllerSlider';\nimport ColorController from '../controllers/ColorController';\nimport
requestAnimationFrame from '../utils/requestAnimationFrame';\nimport CenteredDiv from
'../dom/CenteredDiv';\nimport dom from '../dom/dom';\nimport common from '../utils/common';\n\nimport
styleSheet from './style.scss'; // CSS to embed in build\n\ncss.inject(styleSheet);\n\n/** @ignore Outer-most
className for GUI's */\nconst CSS_NAMESPACE = 'dg';\n\nconst HIDE_KEY_CODE = 72;\n\n/** @ignore The
only value shared between the JS and SCSS. Use caution. */\nconst CLOSE_BUTTON_HEIGHT = 20;\n\nconst
DEFAULT_DEFAULT_PRESET_NAME = 'Default';\n\nconst SUPPORTS_LOCAL_STORAGE =
(function() {\n try {\n   return !!window.localStorage;\n } catch (e) {\n   return false;\n }\n}());\n\nlet
SAVE_DIALOGUE;\n\n/** @ignore Have we yet to create an autoPlace GUI? */\nlet autoPlaceVirgin =
true;\n\n/** @ignore Fixed position div that auto place GUI's go inside */\nlet autoPlaceContainer;\n\n/** @ignore
Are we hiding the GUI's ? */\nlet hide = false;\n\n/** @private GUI's which should be hidden */\nconst
hideableGuis = [];\n\n/**\n * @class A lightweight controller library for JavaScript. It allows you to easily\n *
manipulate variables and fire functions on the fly.\n *\n * @typicalname gui\n *\n * @example\n * // Creating a
GUI with options.\n * var gui = new dat.GUI({name: 'My GUI'});\n *\n * @example\n * // Creating a GUI and a
subfolder.\n * var gui = new dat.GUI();\n * var folder1 = gui.addFolder('Flow Field');\n *\n * @param {Object}
[params]\n * @param {String} [params.name] The name of this GUI.\n * @param {Object} [params.load] JSON
object representing the
saved state of\n * this GUI.\n * @param {dat.gui.GUI} [params.parent] The GUI I'm nested in.\n * @param
{Boolean} [params.autoPlace=true]\n * @param {Boolean} [params.hideable=true] If true, GUI is shown/hidden by
<kbd>h</kbd> keypress.\n * @param {Boolean} [params.closed=false] If true, starts closed\n * @param {Boolean}
[params.closeOnTop=false] If true, close/open button shows on top of the GUI\n */\nconst GUI = function(pars) {\n
const _this = this;\n\n let params = pars || {};\n\n /**\n   * Outermost DOM Element\n   * @type {DOMElement}\n
*/\n this.domElement = document.createElement('div');\n this.__ul = document.createElement('ul');\n
this.domElement.appendChild(this.__ul);\n\n dom.addClass(this.domElement, CSS_NAMESPACE);\n\n /**\n   *
Nested GUI's by name\n   * @ignore\n   */\n this.__folders = {};\n\n this.__controllers = [];\n\n /**\n   * List of
objects I'm remembering for save, only used in top level GUI\n   * @ignore\n   */\n this.__rememberedObjects =
[];\n\n
  /**\n   * Maps the index of remembered objects to a map of controllers, only used\n   * in top level GUI.\n   *\n   *
@private\n   * @ignore\n   *\n   * @example\n   * [\n   * {\n   *   propertyName: Controller,\n   *
anotherPropertyName: Controller\n   * },\n   * {\n   *   propertyName: Controller\n   * }\n   *]\n   */\n
this.__rememberedObjectIndecesToControllers = [];\n\n this.__listening = [];\n\n // Default parameters\n params =
common.defaults(params, {\n   closeOnTop: false,\n   autoPlace: true,\n   width: GUI.DEFAULT_WIDTH\n
});\n\n params = common.defaults(params, {\n   resizable: params.autoPlace,\n   hideable: params.autoPlace\n
});\n\n if (!common.isUndefined(params.load)) {\n   // Explicit preset\n   if (params.preset) {\n
params.load.preset = params.preset;\n   }\n } else {\n   params.load = { preset:
DEFAULT_DEFAULT_PRESET_NAME };\n }\n\n if (common.isUndefined(params.parent) &&
params.hideable) {\n   hideableGuis.push(this);\n
  }\n\n // Only root level GUI's are resizable.\n params.resizable = common.isUndefined(params.parent) &&
params.resizable;\n\n if (params.autoPlace && common.isUndefined(params.scrollable)) {\n   params.scrollable =
true;\n }\n//   params.scrollable = common.isUndefined(params.parent) && params.scrollable === true;\n\n // Not
part of params because I don't want people passing this in via\n // constructor. Should be a 'remembered' value.\n
let useLocalStorage =\n   SUPPORTS_LOCAL_STORAGE &&\n
localStorage.getItem(getLocalStorageHash(this, 'isLocal')) === 'true';\n\n let saveToLocalStorage;\n let
titleRow;\n\n Object.defineProperties(this,\n   /** @lends GUI.prototype */\n   {\n   /**\n   * The parent

<code>GUI</code>\n * @type dat.gui.GUI\n */\n parent: {\n get: function() {\n return params.parent;\n }\n },\n\n scrollable: {\n get: function() {\n return params.scrollable;\n }\n

},\n\n /**\n * Handles <code>GUI</code>'s element placement for you\n * @type Boolean\n */\n autoPlace: {\n get: function() {\n return params.autoPlace;\n }\n },\n\n /**\n * Handles <code>GUI</code>'s position of open/close button\n * @type Boolean\n */\n closeOnTop: {\n get: function() {\n return params.closeOnTop;\n }\n },\n\n /**\n * The identifier for a set of saved values\n * @type String\n */\n preset: {\n get: function() {\n if (_this.parent) {\n return _this.getRoot().preset;\n }\n\n return params.load.preset;\n },\n\n set: function(v) {\n if (_this.parent) {\n _this.getRoot().preset = v;\n } else {\n params.load.preset = v;\n }\n setPresetSelectIndex(this);\n _this.revert();\n }\n },\n\n /**\n
* The width of <code>GUI</code> element\n * @type Number\n */\n width: {\n get: function() {\n return params.width;\n },\n set: function(v) {\n params.width = v;\n setWidth(_this, v);\n }\n },\n\n /**\n * The name of <code>GUI</code>. Used for folders. i.e\n * a folder's name\n * @type String\n */\n name: {\n get: function() {\n return params.name;\n },\n set: function(v) {\n // TODO Check for collisions among sibling folders\n params.name = v;\n if (titleRow) {\n titleRow.innerHTML = params.name;\n }\n }\n },\n\n /**\n * Whether the <code>GUI</code> is collapsed or not\n * @type Boolean\n */\n closed: {\n get: function() {\n return params.closed;\n },\n set: function(v) {\n params.closed = v;\n if (params.closed) {\n dom.addClass(_this.__ul, GUI.CLASS_CLOSED);\n } else {\n dom.removeClass(_this.__ul, GUI.CLASS_CLOSED);\n }\n // For browsers that aren't going to respect the CSS transition,\n // Lets just check our height against the window height right off\n // the bat.\n this.onResize();\n\n if (_this.__closeButton) {\n _this.__closeButton.innerHTML = v ? GUI.TEXT_OPEN : GUI.TEXT_CLOSED;\n }\n }\n },\n\n /**\n * Contains all presets\n * @type Object\n */\n load: {\n get: function() {\n return params.load;\n }\n },\n\n /**\n
* Determines whether or not to use localStorage as the means for\n * <code>remember</code>ing\n * @type Boolean\n */\n useLocalStorage: {\n\n get: function() {\n return useLocalStorage;\n
},\n set: function(bool) {\n if (SUPPORTS_LOCAL_STORAGE) {\n useLocalStorage = bool;\n if (bool) {\n dom.bind(window, 'unload', saveToLocalStorage);\n } else {\n dom.unbind(window, 'unload', saveToLocalStorage);\n }\n localStorage.setItem(getLocalStorageHash(_this, 'isLocal'), bool);\n }\n }\n }\n });\n\n // Are we a root level GUI?\n if (common.isUndefined(params.parent)) {\n this.closed = params.closed || false;\n\n dom.addClass(this.domElement, GUI.CLASS_MAIN);\n dom.makeSelectable(this.domElement, false);\n\n // Are we supposed to be loading locally?\n if (SUPPORTS_LOCAL_STORAGE) {\n if (useLocalStorage) {\n _this.useLocalStorage = true;\n\n const savedGui = localStorage.getItem(getLocalStorageHash(this, 'gui'));\n\n if (savedGui) {\n params.load = JSON.parse(savedGui);\n }\n }\n }\n\n this.__closeButton = document.createElement('div');\n this.__closeButton.innerHTML = GUI.TEXT_CLOSED;\n dom.addClass(this.__closeButton, GUI.CLASS_CLOSE_BUTTON);\n if (params.closeOnTop) {\n dom.addClass(this.__closeButton, GUI.CLASS_CLOSE_TOP);\n this.domElement.insertBefore(this.__closeButton, this.domElement.childNodes[0]);\n } else {\n dom.addClass(this.__closeButton, GUI.CLASS_CLOSE_BOTTOM);\n this.domElement.appendChild(this.__closeButton);\n }\n\n dom.bind(this.__closeButton, 'click', function() {\n _this.closed = !_this.closed;\n });\n // Oh, you're a nested GUI!\n } else {\n if (params.closed === undefined) {\n params.closed = true;\n }\n\n const titleRowName = document.createTextNode(params.name);\n dom.addClass(titleRowName, 'controller-name');\n\n titleRow = addRow(_this, titleRowName);\n\n const onClickTitle = function(e) {\n e.preventDefault();\n _this.closed = !_this.closed;\n return

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 false;\n    };\n\n    dom.addClass(this.__ul, GUI.CLASS_CLOSED);\n\n    dom.addClass(titleRow, 'title');\n
dom.bind(titleRow, 'click', onClickTitle);\n\n    if (!params.closed) {\n      this.closed = false;\n    }\n  }\n\n  if
(params.autoPlace) {\n    if (common.isUndefined(params.parent)) {\n      if (autoPlaceVirgin) {\n
autoPlaceContainer = document.createElement('div');\n        dom.addClass(autoPlaceContainer,
CSS_NAMESPACE);\n        dom.addClass(autoPlaceContainer, GUI.CLASS_AUTO_PLACE_CONTAINER);\n
  document.body.appendChild(autoPlaceContainer);\n        autoPlaceVirgin = false;\n      }\n\n      // Put it in the dom
for you.\n      autoPlaceContainer.appendChild(this.domElement);\n\n      // Apply the auto styles\n
dom.addClass(this.domElement, GUI.CLASS_AUTO_PLACE);\n    }\n\n\n    // Make it not elastic.\n    if
(!this.parent) {\n      setWidth(_this, params.width);\n    }\n  }\n\n  this.__resizeHandler = function() {\n
_this.onResizeDebounced();\n
  };\n\n  dom.bind(window, 'resize', this.__resizeHandler);\n  dom.bind(this.__ul, 'webkitTransitionEnd',
this.__resizeHandler);\n  dom.bind(this.__ul, 'transitionend', this.__resizeHandler);\n  dom.bind(this.__ul,
'oTransitionEnd', this.__resizeHandler);\n  this.onResize();\n\n  if (params.resizable) {\n    addResizeHandle(this);\n
}\n\n  saveToLocalStorage = function() {\n    if (SUPPORTS_LOCAL_STORAGE &&
localStorage.getItem(getLocalStorageHash(_this, 'isLocal')) === 'true') {\n
localStorage.setItem(getLocalStorageHash(_this, 'gui'), JSON.stringify(_this.getSaveObject()));\n    }\n  };\n\n  //
expose this method publicly\n  this.saveToLocalStorageIfPossible = saveToLocalStorage;\n\n  function resetWidth()
{\n    const root = _this.getRoot();\n    root.width += 1;\n    common.defer(function() {\n      root.width -= 1;\n
});\n  }\n\n  if (!params.parent) {\n    resetWidth();\n  }\n};\n\nGUI.toggleHide = function() {\n  hide = !hide;\n
common.each(hideableGuis, function(gui)
 {\n    gui.domElement.style.display = hide ? 'none' : '';\n  });\n};\n\nGUI.CLASS_AUTO_PLACE =
'a';\nGUI.CLASS_AUTO_PLACE_CONTAINER = 'ac';\nGUI.CLASS_MAIN =
'main';\nGUI.CLASS_CONTROLLER_ROW = 'cr';\nGUI.CLASS_TOO_TALL = 'taller-than-
window';\nGUI.CLASS_CLOSED = 'closed';\nGUI.CLASS_CLOSE_BUTTON = 'close-
button';\nGUI.CLASS_CLOSE_TOP = 'close-top';\nGUI.CLASS_CLOSE_BOTTOM = 'close-
bottom';\nGUI.CLASS_DRAG = 'drag';\n\nGUI.DEFAULT_WIDTH = 245;\nGUI.TEXT_CLOSED = 'Close
Controls';\nGUI.TEXT_OPEN = 'Open Controls';\n\nGUI._keydownHandler = function(e) {\n  if
(document.activeElement.type !== 'text' &&\n    (e.which === HIDE_KEY_CODE || e.keyCode ===
HIDE_KEY_CODE)) {\n    GUI.toggleHide();\n  }\n};\ndom.bind(window, 'keydown', GUI._keydownHandler,
false);\n\ncommon.extend(\n  GUI.prototype,\n\n  /** @lends GUI.prototype */\n  {\n\n    /**\n     * Adds a new
{@link Controller} to the GUI. The type of controller created\n     * is inferred from the initial value of
<code>object[property]</code>.
 For\n     * color properties, see {@link addColor}.\n     *\n     * @param {Object} object The object to be
manipulated\n     * @param {String} property The name of the property to be manipulated\n     * @param
{Number} [min] Minimum allowed value\n     * @param {Number} [max] Maximum allowed value\n     * @param
{Number} [step] Increment by which to change value\n     * @returns {Controller} The controller that was added to
the GUI.\n     * @instance\n     *\n     * @example\n     * // Add a string controller.\n     * var person = {name:
'Sam'};\n     * gui.add(person, 'name');\n     *\n     * @example\n     * // Add a number controller slider.\n     * var
person = {age: 45};\n     * gui.add(person, 'age', 0, 100);\n     */\n    add: function(object, property) {\n      return
add(\n        this,\n        object,\n        property,\n        {\n          factoryArgs: Array.prototype.slice.call(arguments, 2)\n
        }\n      );\n    },\n\n    /**\n     * Adds a new color controller
 to the GUI.\n     *\n     * @param object\n     * @param property\n     * @returns {Controller} The controller that
was added to the GUI.\n     * @instance\n     *\n     * @example\n     * var palette = {\n     *   color1: '#FF0000', //
CSS string\n     *   color2: [ 0, 128, 255 ], // RGB array\n     *   color3: [ 0, 128, 255, 0.3 ], // RGB with alpha\n     *
color4: { h: 350, s: 0.9, v: 0.3 } // Hue, saturation, value\n     * };\n     * gui.addColor(palette, 'color1');\n     *
gui.addColor(palette, 'color2');\n     * gui.addColor(palette, 'color3');\n     * gui.addColor(palette, 'color4');\n     */\n
addColor: function(object, property) {\n      return add(\n        this,\n        object,\n        property,\n        {\n
color: true\n        }\n      );\n    },\n\n    /**\n     * Removes the given controller from the GUI.\n     * @param
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{Controller} controller\n     * @instance\n     */\n    remove: function(controller) {\n      // TODO listening?\n      this.__ul.removeChild(controller.__li);\n
    this.__controllers.splice(this.__controllers.indexOf(controller), 1);\n      const _this = this;\n      common.defer(function() {\n        _this.onResize();\n      });\n    },\n\n    /**\n     * Removes the root GUI from the document and unbinds all event listeners.\n     * For subfolders, use `gui.removeFolder(folder)` instead.\n     * @instance\n     */\n    destroy: function() {\n      if (this.parent) {\n        throw new Error(\n          'Only the root GUI should be removed with .destroy(). ' +\n          'For subfolders, use gui.removeFolder(folder) instead.'\n        );\n      }\n\n      if (this.autoPlace) {\n        autoPlaceContainer.removeChild(this.domElement);\n      }\n\n      const _this = this;\n      common.each(this.__folders, function(subfolder) {\n        _this.removeFolder(subfolder);\n      });\n\n      dom.unbind(window, 'keydown', GUI._keydownHandler, false);\n\n      removeListeners(this);\n    },\n\n    /**\n     * Creates
 a new subfolder GUI instance.\n     * @param name\n     * @returns {dat.gui.GUI} The new folder.\n     * @throws {Error} if this GUI already has a folder by the specified\n     * name\n     * @instance\n     */\n    addFolder: function(name) {\n      // We have to prevent collisions on names in order to have a key\n      // by which to remember saved values\n      if (this.__folders[name] !== undefined) {\n        throw new Error('You already have a folder in this GUI by the' +\n          ' name \"' + name + '\"');\n      }\n\n      const newGuiParams = { name: name, parent: this };\n\n      // We need to pass down the autoPlace trait so that we can\n      // attach event listeners to open/close folder actions to\n      // ensure that a scrollbar appears if the window is too short.\n      newGuiParams.autoPlace = this.autoPlace;\n\n      // Do we have saved appearance data for this folder?\n      if (this.load && // Anything loaded?\n          this.load.folders && // Was my parent a dead-end?\n
        this.load.folders[name]) { // Did daddy remember me?\n        // Start me closed if I was closed\n        newGuiParams.closed = this.load.folders[name].closed;\n\n        // Pass down the loaded data\n        newGuiParams.load = this.load.folders[name];\n      }\n\n      const gui = new GUI(newGuiParams);\n      this.__folders[name] = gui;\n\n      const li = addRow(this, gui.domElement);\n      dom.addClass(li, 'folder');\n      return gui;\n    },\n\n    /**\n     * Removes a subfolder GUI instance.\n     * @param {dat.gui.GUI} folder The folder to remove.\n     * @instance\n     */\n    removeFolder: function(folder) {\n      this.__ul.removeChild(folder.domElement.parentElement);\n\n      delete this.__folders[folder.name];\n\n      // Do we have saved appearance data for this folder?\n      if (this.load && // Anything loaded?\n          this.load.folders && // Was my parent a dead-end?\n          this.load.folders[folder.name]) {\n        delete this.load.folders[folder.name];\n
      }\n\n      removeListeners(folder);\n\n      const _this = this;\n\n      common.each(folder.__folders, function(subfolder) {\n        folder.removeFolder(subfolder);\n      });\n\n      common.defer(function() {\n        _this.onResize();\n      });\n    },\n\n    /**\n     * Opens the GUI.\n     */\n    open: function() {\n      this.closed = false;\n    },\n\n    /**\n     * Closes the GUI.\n     */\n    close: function() {\n      this.closed = true;\n    },\n\n    /**\n     * Hides the GUI.\n     */\n    hide: function() {\n      this.domElement.style.display = 'none';\n    },\n\n    /**\n     * Shows the GUI.\n     */\n    show: function() {\n      this.domElement.style.display = '';\n    },\n\n\n    onResize: function() {\n      // we debounce this function to prevent performance issues when rotating on tablet/mobile\n      const root = this.getRoot();\n      if (root.scrollable) {\n        const top = dom.getOffset(root.__ul).top;\n        let h = 0;\n\n        common.each(root.__ul.childNodes,
 function(node) {\n          if (!(root.autoPlace && node === root.__save_row)) {\n            h +=
 dom.getHeight(node);\n          }\n        });\n\n        if (window.innerHeight - top - CLOSE_BUTTON_HEIGHT < h) {\n          dom.addClass(root.domElement, GUI.CLASS_TOO_TALL);\n          root.__ul.style.height =
 window.innerHeight - top - CLOSE_BUTTON_HEIGHT + 'px';\n        } else {\n
 dom.removeClass(root.domElement, GUI.CLASS_TOO_TALL);\n          root.__ul.style.height = 'auto';\n        }\n      }\n\n      if (root.__resize_handle) {\n        common.defer(function() {\n          root.__resize_handle.style.height =
 root.__ul.offsetHeight + 'px';\n        });\n      }\n\n      if (root.__closeButton) {\n        root.__closeButton.style.width
 = root.width + 'px';\n      }\n    },\n\n    onResizeDebounced: common.debounce(function() { this.onResize(); },
 50),\n\n    /**\n     * Mark objects for saving. The order of these objects cannot change as\n
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 * the GUI grows. When remembering new objects, append them to the end\n * of the list.\n *\n * @param {...Object} objects\n * @throws {Error} if not called on a top level GUI.\n * @instance\n * @ignore\n */\n remember: function() {\n if (common.isUndefined(SAVE_DIALOGUE)) {\n SAVE_DIALOGUE = new CenteredDiv();\n SAVE_DIALOGUE.domElement.innerHTML = saveDialogueContents;\n }\n\n if (this.parent) {\n throw new Error('You can only call remember on a top level GUI.');\n }\n\n const _this = this;\n\n common.each(Array.prototype.slice.call(arguments), function(object) {\n if (_this.__rememberedObjects.length === 0) {\n addSaveMenu(_this);\n }\n if (_this.__rememberedObjects.indexOf(object) === -1) {\n _this.__rememberedObjects.push(object);\n }\n });\n\n if (this.autoPlace) {\n // Set save row width\n setWidth(this, this.width);\n }\n },\n\n /**\n * @returns {dat.gui.GUI} the topmost parent GUI of a nested GUI.\n * @instance\n */\n getRoot: function() {\n let gui = this;\n while (gui.parent) {\n gui = gui.parent;\n }\n return gui;\n },\n\n /**\n * @returns {Object} a JSON object representing the current state of\n * this GUI as well as its remembered properties.\n * @instance\n */\n getSaveObject: function() {\n const toReturn = this.load;\n toReturn.closed = this.closed;\n\n // Am I remembering any values?\n if (this.__rememberedObjects.length > 0) {\n toReturn.preset = this.preset;\n\n if (!toReturn.remembered) {\n toReturn.remembered = {};\n }\n\n toReturn.remembered[this.preset] = getCurrentPreset(this);\n }\n\n toReturn.folders = {};\n common.each(this.__folders, function(element, key) {\n toReturn.folders[key] = element.getSaveObject();\n });\n\n return toReturn;\n },\n\n save: function() {\n if (!this.load.remembered) {\n this.load.remembered = {};\n }\n\n this.load.remembered[this.preset] = getCurrentPreset(this);\n markPresetModified(this, false);\n this.saveToLocalStorageIfPossible();\n },\n\n saveAs: function(presetName) {\n if (!this.load.remembered) {\n // Retain default values upon first save\n this.load.remembered = {};\n this.load.remembered[DEFAULT_DEFAULT_PRESET_NAME] = getCurrentPreset(this, true);\n }\n\n this.load.remembered[presetName] = getCurrentPreset(this);\n this.preset = presetName;\n addPresetOption(this, presetName, true);\n this.saveToLocalStorageIfPossible();\n },\n\n revert: function(gui) {\n common.each(this.__controllers, function(controller) {\n // Make revert work on Default.\n if (!this.getRoot().load.remembered) {\n controller.setValue(controller.initialValue);\n } else {\n recallSavedValue(gui || this.getRoot(), controller);\n }\n\n // fire onFinishChange callback\n if (controller.__onFinishChange) {\n controller.__onFinishChange.call(controller, controller.getValue());\n }\n }, this);\n\n common.each(this.__folders, function(folder) {\n folder.revert(folder);\n });\n\n if (!gui) {\n markPresetModified(this.getRoot(), false);\n }\n },\n\n listen: function(controller) {\n const init = this.__listening.length === 0;\n this.__listening.push(controller);\n if (init) {\n updateDisplays(this.__listening);\n }\n },\n\n updateDisplay: function() {\n common.each(this.__controllers, function(controller) {\n controller.updateDisplay();\n });\n common.each(this.__folders, function(folder) {\n folder.updateDisplay();\n });\n }\n });\n\n/**\n * Add a row to the end of the GUI or before another row.\n *\n * @param gui\n * @param [newDom] If specified, inserts the dom content in the new row\n * @param [liBefore] If specified, places the new row before another row\n *\n * @ignore\n */\nfunction addRow(gui, newDom, liBefore) {\n const li = document.createElement('li');\n if (newDom) {\n li.appendChild(newDom);\n }\n\n if (liBefore) {\n gui.__ul.insertBefore(li, liBefore);\n } else {\n gui.__ul.appendChild(li);\n }\n gui.onResize();\n return li;\n}\n\nfunction removeListeners(gui) {\n dom.unbind(window, 'resize', gui.__resizeHandler);\n\n if (gui.saveToLocalStorageIfPossible) {\n dom.unbind(window, 'unload', gui.saveToLocalStorageIfPossible);\n }\n}\n\nfunction markPresetModified(gui, modified) {\n const opt = gui.__preset_select[gui.__preset_select.selectedIndex];\n\n if (modified) {\n opt.innerHTML = opt.value + '*';\n } else {\n opt.innerHTML = opt.value;\n }\n}\n\nfunction augmentController(gui, li, controller) {\n controller.__li = li;\n controller.__gui
 = gui;\n\n common.extend(controller, /** @lends Controller.prototype */ {\n /**\n * @param {Array|Object} options\n * @return {Controller}\n */\n options: function(options) {\n if (arguments.length > 1) {\n
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const nextSibling = controller.__li.nextElementSibling;\n controller.remove();\n\n return add(\n gui,\n controller.object,\n controller.property,\n {\n before: nextSibling,\n factoryArgs: [common.toArray(arguments)]\n }\n );\n }\n\n if (common.isArray(options) || common.isObject(options)) {\n const nextSibling = controller.__li.nextElementSibling;\n controller.remove();\n\n return add(\n gui,\n controller.object,\n controller.property,\n {\n before: nextSibling,\n factoryArgs: [options]\n }\n );\n }\n },\n\n /**\n * Sets the name of the
 controller.\n * @param {string} name\n * @return {Controller}\n */\n name: function(name) {\n controller.__li.firstElementChild.firstElementChild.innerHTML = name;\n return controller;\n },\n\n /**\n * Sets controller to listen for changes on its underlying object.\n * @return {Controller}\n */\n listen: function() {\n controller.__gui.listen(controller);\n return controller;\n },\n\n /**\n * Removes the controller from its parent GUI.\n * @return {Controller}\n */\n remove: function() {\n controller.__gui.remove(controller);\n return controller;\n }\n });\n\n // All sliders should be accompanied by a box.\n if (controller instanceof NumberControllerSlider) {\n const box = new NumberControllerBox(controller.object, controller.property,\n { min: controller.__min, max: controller.__max, step: controller.__step });\n\n common.each(['updateDisplay', 'onChange', 'onFinishChange', 'step',
 'min', 'max'], function(method) {\n const pc = controller[method];\n const pb = box[method];\n controller[method] = box[method] = function() {\n const args = Array.prototype.slice.call(arguments);\n pb.apply(box, args);\n return pc.apply(controller, args);\n };\n });\n\n dom.addClass(li, 'has-slider');\n controller.domElement.insertBefore(box.domElement, controller.domElement.firstElementChild);\n } else if (controller instanceof NumberControllerBox) {\n const r = function(returned) {\n // Have we defined both boundaries?\n if (common.isNumber(controller.__min) && common.isNumber(controller.__max)) {\n // Well, then lets just replace this with a slider.\n\n // lets remember if the old controller had a specific name or was listening\n const oldName = controller.__li.firstElementChild.firstElementChild.innerHTML;\n const wasListening = controller.__gui.__listening.indexOf(controller) > -1;\n\n controller.remove();\n const newController = add(\n gui,\n controller.object,\n controller.property,\n {\n before: controller.__li.nextElementSibling,\n factoryArgs: [controller.__min, controller.__max, controller.__step]\n });\n\n newController.name(oldName);\n if (wasListening) newController.listen();\n\n return newController;\n }\n\n return returned;\n };\n\n controller.min = common.compose(r, controller.min);\n controller.max = common.compose(r, controller.max);\n } else if (controller instanceof BooleanController) {\n dom.bind(li, 'click', function() {\n dom.fakeEvent(controller.__checkbox, 'click');\n });\n\n dom.bind(controller.__checkbox, 'click', function(e) {\n e.stopPropagation(); // Prevents double-toggle\n });\n } else if (controller instanceof FunctionController) {\n dom.bind(li, 'click', function() {\n dom.fakeEvent(controller.__button,
 'click');\n });\n\n dom.bind(li, 'mouseover', function() {\n dom.addClass(controller.__button, 'hover');\n });\n\n dom.bind(li, 'mouseout', function() {\n dom.removeClass(controller.__button, 'hover');\n });\n } else if (controller instanceof ColorController) {\n dom.addClass(li, 'color');\n controller.updateDisplay = common.compose(function(val) {\n li.style.borderLeftColor = controller.__color.toString();\n return val;\n }, controller.updateDisplay);\n\n controller.updateDisplay();\n }\n\n controller.setValue = common.compose(function(val) {\n if (gui.getRoot().__preset_select && controller.isModified()) {\n markPresetModified(gui.getRoot(), true);\n }\n\n return val;\n }, controller.setValue);\n}\n\nfunction recallSavedValue(gui, controller) {\n // Find the topmost GUI, that's where remembered objects live.\n const root = gui.getRoot();\n\n // Does the object we're controlling match anything we've
 been told to\n // remember?\n const matchedIndex = root.__rememberedObjects.indexOf(controller.object);\n\n // Why yes, it does!\n if (matchedIndex !== -1) {\n // Let me fetch a map of controllers for thcommon.isObject.\n let controllerMap = root.__rememberedObjectIndecesToControllers[matchedIndex];\n\n // Ohp, I believe this is the first controller we've created for this\n // object. Lets make the map fresh.\n if (controllerMap === undefined) {\n controllerMap = {};\n root.__rememberedObjectIndecesToControllers[matchedIndex] =\n
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controllerMap;\n    }\n\n    // Keep track of this controller\n    controllerMap[controller.property] = controller;\n\n
// Okay, now have we saved any values for this controller?\n    if (root.load && root.load.remembered) {\n      const
presetMap = root.load.remembered;\n\n      // Which preset are we trying to load?\n      let preset;\n\n      if
(presetMap[gui.preset]) {\n        preset = presetMap[gui.preset];\n
 } else if (presetMap[DEFAULT_DEFAULT_PRESET_NAME]) {\n        // Uhh, you can have the default
instead?\n        preset = presetMap[DEFAULT_DEFAULT_PRESET_NAME];\n      } else {\n        // Nada.\n
return;\n      }\n\n      // Did the loaded object remember thcommon.isObject? &&  Did we remember this particular
property?\n      if (preset[matchedIndex] && preset[matchedIndex][controller.property] !== undefined) {\n        //
We did remember something for this guy ...\n        const value = preset[matchedIndex][controller.property];\n\n
// And that's what it is.\n        controller.initialValue = value;\n        controller.setValue(value);\n      }\n    }\n
}\n}\n\nfunction add(gui, object, property, params) {\n  if (object[property] === undefined) {\n    throw new
Error(`Object \"${object}\" has no property \"${property}\"`);\n  }\n\n  let controller;\n\n  if (params.color) {\n
controller = new ColorController(object, property);\n  } else {\n    const factoryArgs = [object,
 property].concat(params.factoryArgs);\n    controller = ControllerFactory.apply(gui, factoryArgs);\n  }\n\n  if
(params.before instanceof Controller) {\n    params.before = params.before.__li;\n  }\n\n  recallSavedValue(gui,
controller);\n\n  dom.addClass(controller.domElement, 'c');\n\n  const name = document.createElement('span');\n
dom.addClass(name, 'property-name');\n  name.innerHTML = controller.property;\n\n  const container =
document.createElement('div');\n  container.appendChild(name);\n
container.appendChild(controller.domElement);\n\n  const li = addRow(gui, container, params.before);\n\n
dom.addClass(li, GUI.CLASS_CONTROLLER_ROW);\n  if (controller instanceof ColorController) {\n
dom.addClass(li, 'color');\n  } else {\n    dom.addClass(li, typeof controller.getValue());\n  }\n\n
augmentController(gui, li, controller);\n\n  gui.__controllers.push(controller);\n\n  return controller;\n}\n\nfunction
getLocalStorageHash(gui, key) {\n  // TODO how does this deal with
 multiple GUI's?\n  return document.location.href + '.' + key;\n}\n\nfunction addPresetOption(gui, name,
setSelected) {\n  const opt = document.createElement('option');\n  opt.innerHTML = name;\n  opt.value = name;\n
gui.__preset_select.appendChild(opt);\n  if (setSelected) {\n    gui.__preset_select.selectedIndex =
gui.__preset_select.length - 1;\n  }\n}\n\nfunction showHideExplain(gui, explain) {\n  explain.style.display =
gui.useLocalStorage ? 'block' : 'none';\n}\n\nfunction addSaveMenu(gui) {\n  const div = gui.__save_row =
document.createElement('li');\n\n  dom.addClass(gui.domElement, 'has-save');\n\n  gui.__ul.insertBefore(div,
gui.__ul.firstChild);\n\n  dom.addClass(div, 'save-row');\n\n  const gears = document.createElement('span');\n
gears.innerHTML = ' ';\n  dom.addClass(gears, 'button gears');\n\n  // TODO replace with
FunctionController\n  const button = document.createElement('span');\n  button.innerHTML = 'Save';\n
dom.addClass(button, 'button');\n  dom.addClass(button,
 'save');\n\n  const button2 = document.createElement('span');\n  button2.innerHTML = 'New';\n
dom.addClass(button2, 'button');\n  dom.addClass(button2, 'save-as');\n\n  const button3 =
document.createElement('span');\n  button3.innerHTML = 'Revert';\n  dom.addClass(button3, 'button');\n
dom.addClass(button3, 'revert');\n\n  const select = gui.__preset_select = document.createElement('select');\n\n  if
(gui.load && gui.load.remembered) {\n    common.each(gui.load.remembered, function(value, key) {\n
addPresetOption(gui, key, key === gui.preset);\n    });\n  } else {\n    addPresetOption(gui,
DEFAULT_DEFAULT_PRESET_NAME, false);\n  }\n\n  dom.bind(select, 'change', function() {\n    for (let index
= 0; index < gui.__preset_select.length; index++) {\n      gui.__preset_select[index].innerHTML =
gui.__preset_select[index].value;\n    }\n\n    gui.preset = this.value;\n  });\n\n  div.appendChild(select);\n
div.appendChild(gears);\n  div.appendChild(button);\n  div.appendChild(button2);\n
  div.appendChild(button3);\n\n  if (SUPPORTS_LOCAL_STORAGE) {\n    const explain =
document.getElementById('dg-local-explain');\n    const localStorageCheckBox = document.getElementById('dg-
local-storage');\n    const saveLocally = document.getElementById('dg-save-locally');\n\n
saveLocally.style.display = 'block';\n\n    if (localStorage.getItem(getLocalStorageHash(gui, 'isLocal')) === 'true')
{\n      localStorageCheckBox.setAttribute('checked', 'checked');\n    }\n\n    showHideExplain(gui, explain);\n\n    //
```

TODO: Use a boolean controller, fool!\n dom.bind(localStorageCheckBox, 'change', function() {\n gui.useLocalStorage = !gui.useLocalStorage;\n showHideExplain(gui, explain);\n });\n }\n\n const newConstructorTextArea = document.getElementById('dg-new-constructor');\n\n dom.bind(newConstructorTextArea, 'keydown', function(e) {\n if (e.metaKey && (e.which === 67 || e.keyCode === 67)) {\n SAVE_DIALOGUE.hide();\n }\n });\n\n dom.bind(gears, 'click', function() {\n newConstructorTextArea.innerHTML = JSON.stringify(gui.getSaveObject(), undefined, 2);\n SAVE_DIALOGUE.show();\n newConstructorTextArea.focus();\n newConstructorTextArea.select();\n });\n\n dom.bind(button, 'click', function() {\n gui.save();\n });\n\n dom.bind(button2, 'click', function() {\n const presetName = prompt('Enter a new preset name.');\n if (presetName) {\n gui.saveAs(presetName);\n }\n });\n\n dom.bind(button3, 'click', function() {\n gui.revert();\n });\n\n // div.appendChild(button2);\n}\n\nfunction addResizeHandle(gui) {\n let pmouseX;\n\n gui.__resize_handle = document.createElement('div');\n\n common.extend(gui.__resize_handle.style, {\n\n width: '6px',\n marginLeft: '-3px',\n height: '200px',\n cursor: 'ew-resize',\n position: 'absolute'\n // border: '1px solid blue'\n\n });\n\n function drag(e) {\n e.preventDefault();\n\n gui.width += pmouseX - e.clientX;\n gui.onResize();\n pmouseX = e.clientX;\n\n return false;\n }\n\n function dragStop() {\n dom.removeClass(gui.__closeButton, GUI.CLASS_DRAG);\n dom.unbind(window, 'mousemove', drag);\n dom.unbind(window, 'mouseup', dragStop);\n }\n\n function dragStart(e) {\n e.preventDefault();\n\n pmouseX = e.clientX;\n\n dom.addClass(gui.__closeButton, GUI.CLASS_DRAG);\n dom.bind(window, 'mousemove', drag);\n dom.bind(window, 'mouseup', dragStop);\n\n return false;\n }\n\n dom.bind(gui.__resize_handle, 'mousedown', dragStart);\n dom.bind(gui.__closeButton, 'mousedown', dragStart);\n\n gui.domElement.insertBefore(gui.__resize_handle, gui.domElement.firstElementChild);\n}\n\nfunction setWidth(gui, w) {\n gui.domElement.style.width = w + 'px';\n // Auto placed save-rows are position fixed, so we have to\n // set the width manually if we want it to bleed to the edge\n if (gui.__save_row && gui.autoPlace) {\n gui.__save_row.style.width = w + 'px';\n }\n if (gui.__closeButton) {\n gui.__closeButton.style.width = w + 'px';\n }\n}\n\nfunction getCurrentPreset(gui, useInitialValues) {\n const toReturn = {};\n\n // For each object I'm remembering\n common.each(gui.__rememberedObjects, function(val, index) {\n const savedValues = {};\n\n // The controllers I've made for thcommon.isObject by property\n const controllerMap =\n gui.__rememberedObjectIndecesToControllers[index];\n\n // Remember each value for each property\n common.each(controllerMap, function(controller, property) {\n savedValues[property] = useInitialValues ? controller.initialValue : controller.getValue();\n });\n\n // Save the values for thcommon.isObject\n toReturn[index] = savedValues;\n });\n\n return toReturn;\n}\n\nfunction setPresetSelectIndex(gui) {\n for (let index = 0; index < gui.__preset_select.length; index++) {\n if (gui.__preset_select[index].value === gui.preset) {\n gui.__preset_select.selectedIndex = index;\n }\n }\n}\n\nfunction updateDisplays(controllerArray) {\n if (controllerArray.length !== 0) {\n requestAnimationFrame.call(window, function() {\n updateDisplays(controllerArray);\n });\n }\n\n common.each(controllerArray, function(c) {\n c.updateDisplay();\n });\n}\n\nexport default GUI;\n","// stats.js - http://github.com/mrdoob/stats.js\n(function(f,e){\"object\"===typeof exports&&\"undefined\"!==typeof module?module.exports=e():\"function\"===typeof define&&define.amd?define(e):f.Stats=e()})(this,function(){var f=function(){function e(a){c.appendChild(a.dom);return a}function u(a){for(var d=0;d<c.children.length;d++)c.children[d].style.display=d===a?\"block\":\"none\";l=a}var l=0,c=document.createElement(\"div\");c.style.cssText=\"position:fixed;top:0;left:0;cursor:pointer;opacity:0.9;z-index:10000\";c.addEventListener(\"click\",function(a){a.preventDefault();\nu(++l%c.children.length)},!1);var k=(performance||Date).now(),g=k,a=0,r=e(new f.Panel(\"FPS\",\"#0ff\",\"#002\")),h=e(new f.Panel(\"MS\",\"#0f0\",\"#020\"));if(self.performance&&self.performance.memory)var t=e(new f.Panel(\"MB\",\"#f08\",\"#201\"));u(0);return{REVISION:16,dom:c,addPanel:e,showPanel:u,begin:function(){k=(performance||Date).now()},end:function(){a++;var c=(performance||Date).now();h.update(c-k,200);if(c>g+1E3&&(r.update(1E3*a/(c-g),100),g=c,a=0,t)){var d=performance.memory;t.update(d.usedJSHeapSize/\n1048576,d.jsHeapSizeLimit/1048576)}return

c},update:function(){k=this.end()},domElement:c,setMode:u}};f.Panel=function(e,f,l){var c=Infinity,k=0,g=Math.round,a=g(window.devicePixelRatio||1),r=80*a,h=48*a,t=3*a,v=2*a,d=3*a,m=15*a,n=74*a,p=30*a,q=document.createElement(\"canvas\");q.width=r;q.height=h;q.style.cssText=\"width:80px;height:48px\";var b=q.getContext(\"2d\");b.font=\"bold \"+9*a+\"px Helvetica,Arial,sans-serif\";b.textBaseline=\"top\";b.fillStyle=l;b.fillRect(0,0,r,h);b.fillStyle=f;b.fillText(e,t,v);\nb.fillRect(d,m,n,p);b.fillStyle=l;b.globalAlpha=.9;b.fillRect(d,m,n,p);return{dom:q,update:function(h,w){c=Math.min(c,h);k=Math.max(k,h);b.fillStyle=l;b.globalAlpha=1;b.fillRect(0,0,r,m);b.fillStyle=f;b.fillText(g(h)+\" \"+e+\" (\"+g(c)+\"-\"+g(k)+\")\",t,v);b.drawImage(q,d+a,m,n-a,p,d,m,n-a,p);b.fillRect(d+n-a,m,a,p);b.fillStyle=l;b.globalAlpha=.9;b.fillRect(d+n-a,m,a,g((1-h/w)*p))}}};return f});\n","/**\n * @license\n * Copyright 2019 Google LLC. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * http://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *\n ==*/\nimport*as tf from\"@tensorflow/tfjs-core\";import{util,tidy,div,sub,buffer,Tensor,browser,pad3d,scalar,concat,tensor2d,tensor}from\"@tensorflow/tfjs-core\";import{loadGraphModel}from\"@tensorflow/tfjs-converter\";var VALID_OUTPUT_STRIDES=[8,16,32];function assertValidOutputStride(e){util.assert(\"number\"==typeof e,function(){return\"outputStride is not a number\"}),util.assert(VALID_OUTPUT_STRIDES.indexOf(e)>=0,function(){return\"outputStride of \"+e+\" is invalid. It must be either 8, 16, or 32\"})}function assertValidResolution(e,t){util.assert(\"number\"==typeof e,function(){return\"resolution is not a number\"}),util.assert((e-1)%t==0,function(){return\"resolution of \"+e+\" is invalid for output stride \"+t+\".\"})}function toFloatIfInt(e){return tidy(function(){return\"int32\"===e.dtype&&(e=e.toFloat()),e=div(e,127.5),sub(e,1)})}var MobileNet=function(){function e(e,t){this.model=e;var r=this.model.inputs[0].shape;util.assert(-1===r[1]&&-1===r[2],function(){return\"Input shape [\"+r[1]+\", \"+r[2]+\"] must both be -1\"}),this.outputStride=t}return e.prototype.predict=function(e){var t=this;return tidy(function(){var r=toFloatIfInt(e).expandDims(0),n=t.model.predict(r),o=n[0],i=n[1],s=n[2],a=n[3];return{heatmapScores:i.squeeze().sigmoid(),offsets:o.squeeze(),displacementFwd:s.squeeze(),displacementBwd:a.squeeze()}})},e.prototype.dispose=function(){this.model.dispose()},e}();function half(e){return Math.floor(e/2)}var MaxHeap=function(){function e(e,t){this.priorityQueue=new Array(e),this.numberOfElements=-1,this.getElementValue=t}return e.prototype.enqueue=function(e){this.priorityQueue[++this.numberOfElements]=e,this.swim(this.numberOfElements)},e.prototype.dequeue=function(){var e=this.priorityQueue[0];return this.exchange(0,this.numberOfElements--),this.sink(0),this.priorityQueue[this.numberOfElements+1]=null,e},e.prototype.empty=function(){return-1===this.numberOfElements},e.prototype.size=function(){return this.numberOfElements+1},e.prototype.all=function(){return this.priorityQueue.slice(0,this.numberOfElements+1)},e.prototype.max=function(){return this.priorityQueue[0]},e.prototype.swim=function(e){for(;e>0&&this.less(half(e),e);)this.exchange(e,half(e)),e=half(e)},e.prototype.sink=function(e){for(;2*e<=this.numberOfElements;){var t=2*e;if(t<this.numberOfElements&&this.less(t,t+1)&&t++,!this.less(e,t))break;this.exchange(e,t),e=t}},e.prototype.getValueAt=function(e){return this.getElementValue(this.priorityQueue[e])},e.prototype.less=function(e,t){return this.getValueAt(e)<this.getValueAt(t)},e.prototype.exchange=function(e,t){var r=this.priorityQueue[e];this.priorityQueue[e]=this.priorityQueue[t],this.priorityQueue[t]=r},e}();function scoreIsMaximumInLocalWindow(e,t,r,n,o,i){for(var s=i.shape,a=s[0],u=s[1],l=!0,f=Math.max(r-

o,0),c=Math.min(r+o+1,a),d=f;d<c;++d){for(var p=Math.max(n-
o,0),h=Math.min(n+o+1,u),m=p;m<h;++m)if(i.get(d,m,e)>t){l=!1;break}if(!l)break}return
l}function buildPartWithScoreQueue(e,t,r){for(var n=r.shape,o=n[0],i=n[1],s=n[2],a=new
MaxHeap(o*i*s,function(e){return e.score}),u=0;u<o;++u)for(var l=0;l<i;++l)for(var f=0;f<s;++f){var
c=r.get(u,l,f);c<e||scoreIsMaximumInLocalWindow(f,c,u,l,t,r)&&a.enqueue({score:c,part:{heatmapY:u,heatmapX:l,
id:f}})}return a}var
partNames=[\"nose\",\"leftEye\",\"rightEye\",\"leftEar\",\"rightEar\",\"leftShoulder\",\"rightShoulder\",\"leftElbow\",
\"rightElbow\",\"leftWrist\",\"rightWrist\",\"leftHip\",\"rightHip\",\"leftKnee\",\"rightKnee\",\"leftAnkle\",\"rightAn
kle\"],NUM_KEYPOINTS=partNames.length,partIds=partNames.reduce(function(e,t,r){return
e[t]=r,e},{}),connectedPartNames=[[\"leftHip\",\"leftShoulder\"],[\"leftElbow\",\"leftShoulder\"],[\"leftElbow\",\"lef
tWrist\"],[\"leftHip\",\"leftKnee\"],[\"leftKnee\",\"leftAnkle\"],[\"rightHip\",\"rightShoulder\"],[\"rightElbow\",\"righ
tShoulder\"],[\"rightElbow\",\"rightWrist\"],[\"rightHip\",\"rightKnee\"],[\"rightKnee\",\"rightAnkle\"],[\"leftShould
er\",\"rightShoulder\"],[\"leftHip\",\"rightHip\"]],poseChain=[[\"nose\",\"leftEye\"],[\"leftEye\",\"leftEar\"],[\"nose\",
\"rightEye\"],[\"rightEye\",\"rightEar\"],[\"nose\",\"leftShoulder\"],[\"leftShoulder\",\"leftElbow\"],[\"leftElbow\",\"l
eftWrist\"],[\"leftShoulder\",\"leftHip\"],[\"leftHip\",\"leftKnee\"],[\"leftKnee\",\"leftAnkle\"],[\"nose\",\"rightShould
er\"],[\"rightShoulder\",\"rightElbow\"],[\"rightElbow\",\"rightWrist\"],[\"rightShoulder\",\"rightHip\"],[\"rightHip\",
\"rightKnee\"],[\"rightKnee\",\"rightAnkle\"]],connectedPartIndices=connectedPartNames.map(function(e){var
t=e[0],r=e[1];return[partIds[t],partIds[r]]}),partChannels=[\"left_face\",\"right_face\",\"right_upper_leg_front\",\"rig
ht_lower_leg_back\",\"right_upper_leg_back\",\"left_lower_leg_front\",\"left_upper_leg_front\",\"left_upper_leg_ba
ck\",\"left_lower_leg_back\",\"right_feet\",\"right_lower_leg_front\",\"left_feet\",\"torso_front\",\"torso_back\",\"rig
ht_upper_arm_front\",\"right_upper_arm_back\",\"right_lower_arm_back\",\"left_lower_arm_front\",\"left_upper_ar
m_front\",\"left_upper_arm_back\",\"left_lower_arm_back\",\"right_hand\",\"right_lower_arm_front\",\"left_hand\"]
;function
getOffsetPoint(e,t,r,n){return{y:n.get(e,t,r),x:n.get(e,t,r+NUM_KEYPOINTS)}}function getImageCoords(e,t,r){var
n=getOffsetPoint(e.heatmapY,e.heatmapX,e.id,r),o=n.y,i=n.x;return{x:e.heatmapX*t+i,y:e.heatmapY*t+o}}functio
n clamp(e,t,r){return e<t?t:e>r?r:e}function squaredDistance(e,t,r,n){var o=r-e,i=n-t;return o*o+i*i}function
addVectors(e,t){return{x:e.x+t.x,y:e.y+t.y}}var parentChildrenTuples=poseChain.map(function(e){var
t=e[0],r=e[1];return[partIds[t],partIds[r]]}),parentToChildEdges=parentChildrenTuples.map(function(e){return
e[1]}),childToParentEdges=parentChildrenTuples.map(function(e){return e[0]});function
getDisplacement(e,t,r){var n=r.shape[2]/2;return{y:r.get(t.y,t.x,e),x:r.get(t.y,t.x,n+e)}}function
getStridedIndexNearPoint(e,t,r,n){return{y:clamp(Math.round(e.y/t),0,r-1),x:clamp(Math.round(e.x/t),0,n-
1)}}function
traverseToTargetKeypoint(e,t,r,n,o,i,s,a){void 0===a&&(a=2);for(var
u=n.shape,l=u[0],f=u[1],c=getDisplacement(e,getStridedIndexNearPoint(t.position,i,l,f),s),d=addVectors(t.position,c
),p=0;p<a;p++){var
h=getStridedIndexNearPoint(d,i,l,f),m=getOffsetPoint(h.y,h.x,r,o);d=addVectors({x:h.x*i,y:h.y*i},{x:m.x,y:m.y})}
var g=getStridedIndexNearPoint(d,i,l,f),_=n.get(g.y,g.x,r);return{position:d,part:partNames[r],score:_}}function
decodePose(e,t,r,n,o,i){var s=t.shape[2],a=parentToChildEdges.length,u=new
Array(s),l=e.part,f=e.score,c=getImageCoords(l,n,r);u[l.id]={score:f,part:partNames[l.id],position:c};for(var d=a-
1;d>=0;--d){var
p=parentToChildEdges[d],h=childToParentEdges[d];u[p]&&!u[h]&&(u[h]=traverseToTargetKeypoint(d,u[p],h,t,r,n
,i))}for(d=0;d<a;++d){p=childToParentEdges[d],h=parentToChildEdges[d];u[p]&&!u[h]&&(u[h]=traverseToTarge
tKeypoint(d,u[p],h,t,r,n,o))}return u}function withinNmsRadiusOfCorrespondingPoint(e,t,r,n){var o=r.x,i=r.y;return
e.some(function(e){var r=e.keypoints[n].position;return squaredDistance(i,o,r.y,r.x)<=t})}function
getInstanceScore(e,t,r){return r.reduce(function(r,n,o){var i=n.position,s=n.score;return
withinNmsRadiusOfCorrespondingPoint(e,t,i,o)||(r+=s),r},0)/r.length}var kLocalMaximumRadius=1;function
decodeMultiplePoses(e,t,r,n,o,i,s,a){void 0===s&&(s=.5),void 0===a&&(a=20);for(var
u=[],l=buildPartWithScoreQueue(s,kLocalMaximumRadius,e),f=a*a;u.length<i&&!l.empty();){var

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c=l.dequeue();if(!withinNmsRadiusOfCorrespondingPoint(u,f,getImageCoords(c.part,o,t),c.part.id)){var
d=decodePose(c,e,t,o,r,n),p=getInstanceScore(u,f,d);u.push({keypoints:d,score:p})}}return u}var
__assign=function(){return(__assign=Object.assign||function(e){for(var t,r=1,n=arguments.length;r<n;r++)for(var o
in t=arguments[r])Object.prototype.hasOwnProperty.call(t,o)&&(e[o]=t[o]);return
e}).apply(this,arguments)};function __awaiter(e,t,r,n){return new(r||(r=Promise))(function(o,i){function
s(e){try{u(n.next(e))}catch(e){i(e)}}function
 a(e){try{u(n.throw(e))}catch(e){i(e)}}function u(e){e.done?o(e.value):new
r(function(t){t(e.value)}).then(s,a)}u((n=n.apply(e,t||[])).next())})}function __generator(e,t){var
r,n,o,i,s={label:0,sent:function(){if(1&o[0])throw o[1];return o[1]},trys:[],ops:[]};return
i={next:a(0),throw:a(1),return:a(2)},\"function\"==typeof Symbol&&(i[Symbol.iterator]=function(){return
this}),i;function a(i){return function(a){return function(i){if(r)throw new TypeError(\"Generator is already
executing.\");for(;s;)try{if(r=1,n&&(o=2&i[0]?n.return:i[0]?n.throw||((o=n.return)&&o.call(n),0):n.next)&&!(o=o.c
all(n,i[1])).done)return o;switch(n=0,o&&(i=[2&i[0],o.value]),i[0]){case 0:case 1:o=i;break;case 4:return
s.label++,{value:i[1],done:!1};case 5:s.label++,n=i[1],i=[0];continue;case
7:i=s.ops.pop(),s.trys.pop();continue;default:if(!(o=(o=s.trys).length>0&&o[o.length-
1])&&(6===i[0]||2===i[0])){s=0;continue}if(3===i[0]&&(!o||i[1]>o[0]&&i[1]<o[3])){s.label=i[1];break}if(6===i[
0]&&s.label<o[1]){s.label=o[1],o=i;break}if(o&&s.label<o[2]){s.label=o[2],s.ops.push(i);break}o[2]&&s.ops.pop(
),s.trys.pop();continue}i=t.call(e,s)}catch(e){i=[6,e],n=0}finally{r=o=0}if(5&i[0])throw
 i[1];return{value:i[0]?i[1]:void 0,done:!0}}([i,a])}}}function eitherPointDoesntMeetConfidence(e,t,r){return
e<r||t<r}function getAdjacentKeyPoints(e,t){return connectedPartIndices.reduce(function(r,n){var
o=n[0],i=n[1];return eitherPointDoesntMeetConfidence(e[o].score,e[i].score,t)?r:(r.push([e[o],e[i]]),r)},[])}var
NEGATIVE_INFINITY=Number.NEGATIVE_INFINITY,POSITIVE_INFINITY=Number.POSITIVE_INFINITY
;function getBoundingBox(e){return e.reduce(function(e,t){var
r=e.maxX,n=e.maxY,o=e.minX,i=e.minY,s=t.position,a=s.x,u=s.y;return{maxX:Math.max(r,a),maxY:Math.max(n,
u),minX:Math.min(o,a),minY:Math.min(i,u)}},{maxX:NEGATIVE_INFINITY,maxY:NEGATIVE_INFINITY,min
X:POSITIVE_INFINITY,minY:POSITIVE_INFINITY})}function getBoundingBoxPoints(e){var
t=getBoundingBox(e),r=t.minX,n=t.minY,o=t.maxX,i=t.maxY;return[{x:r,y:n},{x:o,y:n},{x:o,y:i},{x:r,y:i}]}functi
on
 toTensorBuffer(e,t){return void 0===t&&(t=\"float32\"),__awaiter(this,void 0,void 0,function(){var r;return
__generator(this,function(n){switch(n.label){case 0:return[4,e.data()];case 1:return
r=n.sent(),[2,buffer(e.shape,t,r)]}})})}function toTensorBuffers3D(e){return __awaiter(this,void 0,void
0,function(){return __generator(this,function(t){return[2,Promise.all(e.map(function(e){return
toTensorBuffer(e,\"float32\")}))]})})}function scalePose(e,t,r,n,o){return void 0===n&&(n=0),void
0===o&&(o=0),{score:e.score,keypoints:e.keypoints.map(function(e){var
i=e.score,s=e.part,a=e.position;return{score:i,part:s,position:{x:a.x*r+o,y:a.y*t+n}}})}}function
scalePoses(e,t,r,n,o){return void 0===n&&(n=0),void
0===o&&(o=0),1===r&&1===t&&0===n&&0===o?e:e.map(function(e){return scalePose(e,t,r,n,o)})}function
flipPoseHorizontal(e,t){return{score:e.score,keypoints:e.keypoints.map(function(e){var
r=e.score,n=e.part,o=e.position;return{score:r,part:n,position:{x:t-1-o.x,y:o.y}}})}}function
 flipPosesHorizontal(e,t){return t<=0?e:e.map(function(e){return flipPoseHorizontal(e,t)})}function
getInputTensorDimensions(e){return e instanceof Tensor?[e.shape[0],e.shape[1]]:[e.height,e.width]}function
toInputTensor(e){return e instanceof Tensor?e:browser.fromPixels(e)}function padAndResizeTo(e,t){var
r=t[0],n=t[1],o=getInputTensorDimensions(e),i=o[0],s=o[1],a=n/r,u=[0,0,0,0],l=u[0],f=u[1],c=u[2],d=u[3];return
s/i<a?(l=0,f=0,c=Math.round(.5*(a*i-s)),d=Math.round(.5*(a*i-s))):(l=Math.round(.5*(1/a*s-
i)),f=Math.round(.5*(1/a*s-i)),c=0,d=0),{resized:tidy(function(){var
t=toInputTensor(e);return(t=pad3d(t,[[l,f],[c,d],[0,0]])).resizeBilinear([r,n])}),padding:{top:l,left:c,right:d,bottom:f}
}}function scaleAndFlipPoses(e,t,r,n,o){var
i=t[0],s=t[1],a=r[0],u=r[1],l=scalePoses(e,(i+n.top+n.bottom)/a,(s+n.left+n.right)/u,-n.top,-n.left);return
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o?flipPosesHorizontal(l,s):l}function mod(e,t){return tidy(function(){var r=e.div(scalar(t,\"int32\"));return e.sub(r.mul(scalar(t,\"int32\")))})}function argmax2d(e){var t=e.shape,r=t[0],n=t[1],o=t[2];return tidy(function(){var t=e.reshape([r*n,o]).argMax(0),i=t.div(scalar(n,\"int32\")).expandDims(1),s=mod(t,n).expandDims(1);return concat([i,s],1)})}function getPointsConfidence(e,t){for(var r=t.shape[0],n=new Float32Array(r),o=0;o<r;o++){var i=t.get(o,0),s=t.get(o,1);n[o]=e.get(i,s,o)}return n}function getOffsetPoint$1(e,t,r,n){return{y:n.get(e,t,r),x:n.get(e,t,r+NUM_KEYPOINTS)}}function getOffsetVectors(e,t){for(var r=[],n=0;n<NUM_KEYPOINTS;n++){var o=getOffsetPoint$1(e.get(n,0).valueOf(),e.get(n,1).valueOf(),n,t),i=o.x,s=o.y;r.push(s),r.push(i)}return tensor2d(r,[NUM_KEYPOINTS,2])}function getOffsetPoints(e,t,r){return tidy(function(){var n=getOffsetVectors(e,r);return e.toTensor().mul(scalar(t,\"int32\")).toFloat().add(n)})}function decodeSinglePose(e,t,r){return __awaiter(this,void 0,void 0,function(){var n,o,i,s,a,u,l,f,c,d;return __generator(this,function(p){switch(p.label){case 0:return n=0,o=argmax2d(e),[4,Promise.all([toTensorBuffer(e),toTensorBuffer(t),toTensorBuffer(o,\"int32\")])];case 1:return i=p.sent(),s=i[0],a=i[1],u=i[2],[4,toTensorBuffer(l=getOffsetPoints(u,r,a))];case 2:return f=p.sent(),c=Array.from(getPointsConfidence(s,u)),d=c.map(function(e,t){return n+=e,{position:{y:f.get(t,0),x:f.get(t,1)},part:partNames[t],score:e}}),o.dispose(),l.dispose(),[2,{keypoints:d,score:n/d.length}]}})})}var MOBILENET_BASE_URL=\"https://storage.googleapis.com/tfjs-models/savedmodel/posenet/mobilenet/\",RESNET50_BASE_URL=\"https://storage.googleapis.com/tfjs-models/savedmodel/posenet/resnet50/\";function resNet50Checkpoint(e,t){var r=\"model-stride\"+e+\".json\";return 4==t?RESNET50_BASE_URL+\"float/\"+r:RESNET50_BASE_URL+\"quant\"+t+\"/\"+r}function mobileNetCheckpoint(e,t,r){var n={1:\"100\",.75:\"075\",.5:\"050\"},o=\"model-stride\"+e+\".json\";return 4==r?MOBILENET_BASE_URL+\"float/\"+n[t]+\"/\"+o:MOBILENET_BASE_URL+\"quant\"+r+\"/\"+n[t]+\"/\"+o}function toFloatIfInt$1(e){return tidy(function(){\"int32\"===e.dtype&&(e=e.toFloat());var t=tensor([-123.15,-115.9,-103.06]);return e.add(t)})}var ResNet=function(){function e(e,t){this.model=e;var r=this.model.inputs[0].shape;util.assert(-1===r[1]&&-1===r[2],function(){return\"Input shape [\"+r[1]+\", \"+r[2]+\"] must both be equal to or -1\"}),this.outputStride=t}return e.prototype.predict=function(e){var t=this;return tidy(function(){var r=toFloatIfInt$1(e).expandDims(0),n=t.model.predict(r),o=n[0],i=n[1],s=n[2];return{heatmapScores:n[3].squeeze().sigmoid(),offsets:s.squeeze(),displacementFwd:o.squeeze(),displacementBwd:i.squeeze()}})},e.prototype.dispose=function(){this.model.dispose()},e}(),MOBILENET_V1_CONFIG={architecture:\"MobileNetV1\",outputStride:16,multiplier:.75,inputResolution:257},VALID_ARCHITECTURE=[\"MobileNetV1\",\"ResNet50\"],VALID_STRIDE={MobileNetV1:[8,16,32],ResNet50:[32,16]},VALID_INPUT_RESOLUTION=[161,193,257,289,321,353,385,417,449,481,513,801],VALID_MULTIPLIER={MobileNetV1:[.5,.75,1],ResNet50:[1]},VALID_QUANT_BYTES=[1,2,4];function validateModelConfig(e){if(null==(e=e||MOBILENET_V1_CONFIG).architecture&&(e.architecture=\"MobileNetV1\"),VALID_ARCHITECTURE.indexOf(e.architecture)<0)throw new Error(\"Invalid architecture \"+e.architecture+\". Should be one of \"+VALID_ARCHITECTURE);if(null==e.inputResolution&&(e.inputResolution=257),VALID_INPUT_RESOLUTION.indexOf(e.inputResolution)<0)throw new Error(\"Invalid inputResolution \"+e.inputResolution+\". Should be one of \"+VALID_INPUT_RESOLUTION);if(null==e.outputStride&&(e.outputStride=16),VALID_STRIDE[e.architecture].indexOf(e.outputStride)<0)throw new Error(\"Invalid outputStride \"+e.outputStride+\". Should be one of \"+VALID_STRIDE[e.architecture]+\" for architecutre \"+e.architecture+\".\");if(null==e.multiplier&&(e.multiplier=1),VALID_MULTIPLIER[e.architecture].indexOf(e.multiplier)<0)throw new Error(\"Invalid multiplier \"+e.multiplier+\". Should be one of \"+VALID_MULTIPLIER[e.architecture]+\" for architecutre \"+e.architecture+\".\");if(null==e.quantBytes&&(e.quantBytes=4),VALID_QUANT_BYTES.indexOf(e.quantByte

s)<0)throw
new Error(\"Invalid quantBytes \"+e.quantBytes+\". Should be one of \"+VALID_QUANT_BYTES+\" for architecutre \"+e.architecture+\".\");return e}var SINGLE_PERSON_INFERENCE_CONFIG={flipHorizontal:!1},MULTI_PERSON_INFERENCE_CONFIG={flipHorizontal:!1,maxDetections:5,scoreThreshold:.5,nmsRadius:20};function validateMultiPersonInputConfig(e){var t=e.maxDetections,r=e.scoreThreshold,n=e.nmsRadius;if(t<=0)throw new Error(\"Invalid maxDetections \"+t+\". Should be > 0\");if(r<0||r>1)throw new Error(\"Invalid scoreThreshold \"+r+\". Should be in range [0.0, 1.0]\");if(n<=0)throw new Error(\"Invalid nmsRadius \"+n+\".\")}var PoseNet=function(){function e(e,t){this.baseModel=e,this.inputResolution=t}return e.prototype.estimateMultiplePoses=function(e,t){return void 0===t&&(t=MULTI_PERSON_INFERENCE_CONFIG),__awaiter(this,void 0,void 0,function(){var r,n,o,i,s,a,u,l,f,c,d,p,h,m,g,_,I,E,v,N,y;return
__generator(this,function(T){switch(T.label){case 0:return
r=__assign({},MULTI_PERSON_INFERENCE_CONFIG,t),validateMultiPersonInputConfig(t),n=this.baseModel.outputStride,o=this.inputResolution,assertValidOutputStride(n),assertValidResolution(this.inputResolution,n),i=getInputTensorDimensions(e),s=i[0],a=i[1],u=padAndResizeTo(e,[o,o]),l=u.resized,f=u.padding,c=this.baseModel.predict(l),d=c.heatmapScores,p=c.offsets,h=c.displacementFwd,m=c.displacementBwd,[4,toTensorBuffers3D([d,p,h,m])];case 1:return
g=T.sent(),_=g[0],I=g[1],E=g[2],v=g[3],[4,decodeMultiplePoses(_,I,E,v,n,r.maxDetections,r.scoreThreshold,r.nmsRadius)];case 2:return
N=T.sent(),y=scaleAndFlipPoses(N,[s,a],[o,o],f,r.flipHorizontal),d.dispose(),p.dispose(),h.dispose(),m.dispose(),l.dispose(),[2,y]}})})},e.prototype.estimateSinglePose=function(e,t){return void 0===t&&(t=SINGLE_PERSON_INFERENCE_CONFIG),__awaiter(this,void 0,void 0,function(){var r,n,o,i,s,a,u,l,f,c,d,p,h,m,g,_;return __generator(this,function(I){switch(I.label){case
0:return
r=__assign({},SINGLE_PERSON_INFERENCE_CONFIG,t),n=this.baseModel.outputStride,o=this.inputResolution,assertValidOutputStride(n),assertValidResolution(o,n),i=getInputTensorDimensions(e),s=i[0],a=i[1],u=padAndResizeTo(e,[o,o]),l=u.resized,f=u.padding,c=this.baseModel.predict(l),d=c.heatmapScores,p=c.offsets,h=c.displacementFwd,m=c.displacementBwd,[4,decodeSinglePose(d,p,n)];case 1:return
g=I.sent(),_=scaleAndFlipPoses([g],[s,a],[o,o],f,r.flipHorizontal),d.dispose(),p.dispose(),h.dispose(),m.dispose(),l.dispose(),[2,_[0]]}})})},e.prototype.estimatePoses=function(e,t){return __awaiter(this,void 0,void 0,function(){return __generator(this,function(r){switch(r.label){case 0:return\"single-person\"!=t.decodingMethod?[3,2]:[4,this.estimateSinglePose(e,t)];case 1:return[2,[r.sent()]];case 2:return[2,this.estimateMultiplePoses(e,t)]}})})},e.prototype.dispose=function(){this.baseModel.dispose()},e}();function loadMobileNet(e){return __awaiter(this,void 0,void 0,function(){var t,r,n,o,i,s;return __generator(this,function(a){switch(a.label){case
0:if(t=e.outputStride,r=e.quantBytes,n=e.multiplier,null==tf)throw new Error(\"Cannot find TensorFlow.js. If you are using a <script> tag, please also include @tensorflow/tfjs on the page before using this\\n model.\");return
o=mobileNetCheckpoint(t,n,r),[4,loadGraphModel(e.modelUrl||o)];case 1:return i=a.sent(),s=new MobileNet(i,t),[2,new PoseNet(s,e.inputResolution)]}})})}function loadResNet(e){return __awaiter(this,void 0,void 0,function(){var t,r,n,o,i;return __generator(this,function(s){switch(s.label){case
0:if(t=e.outputStride,r=e.quantBytes,null==tf)throw new Error(\"Cannot find TensorFlow.js. If you are using a <script> tag, please also include @tensorflow/tfjs on the page before using this\\n model.\");return
n=resNet50Checkpoint(t,r),[4,loadGraphModel(e.modelUrl||n)];case 1:return o=s.sent(),i=new ResNet(o,t),[2,new PoseNet(i,e.inputResolution)]}})})}function load(e){return void 0===e&&(e=MOBILENET_V1_CONFIG),__awaiter(this,void
0,void 0,function(){return
__generator(this,function(t){return\"ResNet50\"===(e=validateModelConfig(e)).architecture?[2,loadResNet(e)]:\"MobileNetV1\"===e.architecture?[2,loadMobileNet(e)]:[2,null]})})}export{decodeMultiplePoses,decodeSinglePose,

MobileNet,partChannels,partIds,partNames,poseChain,load,PoseNet,VALID_INPUT_RESOLUTION,getAdjacentKeyPoints,getBoundingBox,getBoundingBoxPoints,scalePose};\n","/**\n * @license\n * Copyright 2019 Google Inc. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * https://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========\n */\nimport * as posenet from '@tensorflow-models/posenet';\nimport * as tf from '@tensorflow/tfjs-core';\n\nconst COLOR = 'aqua';\nconst BOUNDING_BOX_COLOR = 'red';\nconst LINE_WIDTH = 2;\n\nexport const TRY_RESNET_BUTTON_NAME = 'tryResNetButton';\nexport const TRY_RESNET_BUTTON_TEXT = '[New] Try ResNet50';\nconst TRY_RESNET_BUTTON_TEXT_CSS = 'width:100%;text-decoration:underline;';\nconst TRY_RESNET_BUTTON_BACKGROUND_CSS = 'background:#e61d5f;';\n\nfunction isAndroid() {\n return /Android/i.test(navigator.userAgent);\n}\n\nfunction isiOS() {\n return /iPhone|iPad|iPod/i.test(navigator.userAgent);\n}\n\nexport function isMobile() {\n return isAndroid() || isiOS();\n}\n\nfunction setDatGuiPropertyCss(propertyText, liCssString, spanCssString = '') {\n var spans = document.getElementsByClassName('property-name');\n for (var i = 0; i < spans.length; i++) {\n var text = spans[i].textContent || spans[i].innerText;\n if (text == propertyText) {\n spans[i].parentNode.parentNode.style = liCssString;\n if (spanCssString !== '') {\n spans[i].style = spanCssString;\n }\n }\n }\n}\nexport function updateTryResNetButtonDatGuiCss() {\n setDatGuiPropertyCss(\n TRY_RESNET_BUTTON_TEXT, TRY_RESNET_BUTTON_BACKGROUND_CSS,\n TRY_RESNET_BUTTON_TEXT_CSS);\n}\n\n/**\n * Toggles between the loading UI and the main canvas UI.\n */\nexport function toggleLoadingUI(\n showLoadingUI, loadingDivId = 'loading', mainDivId = 'main') {\n if (showLoadingUI) {\n document.getElementById(loadingDivId).style.display = 'block';\n document.getElementById(mainDivId).style.display = 'none';\n } else {\n document.getElementById(loadingDivId).style.display = 'none';\n document.getElementById(mainDivId).style.display = 'block';\n }\n}\n\nexport function drawPoint(ctx, y, x, r, color) {\n ctx.beginPath();\n ctx.arc(x, y, r, 0, 2 * Math.PI);\n ctx.fillStyle = color;\n ctx.fill();\n}\n\n/**\n * Draws a line on a canvas, i.e. a joint\n */\nexport function drawSegment([ay, ax], [by, bx], color, scale, ctx) {\n ctx.beginPath();\n ctx.moveTo(ax * scale, ay * scale);\n ctx.lineTo(bx * scale, by * scale);\n ctx.lineWidth = LINE_WIDTH;\n ctx.strokeStyle = color;\n ctx.stroke();\n}\n\n/**\n * Draws a pose skeleton by looking up all adjacent keypoints/joints\n */\nexport function drawSkeleton(keypoints, minConfidence, ctx, scale = 1) {\n const adjacentKeyPoints =\n posenet.getAdjacentKeyPoints(keypoints, minConfidence);\n\n function toTuple({y, x}) {\n return [y, x];\n }\n\n adjacentKeyPoints.forEach((keypoints) => {\n drawSegment(\n toTuple(keypoints[0].position), toTuple(keypoints[1].position), COLOR,\n scale, ctx);\n });\n}\n\n/**\n * Draw pose keypoints onto a canvas\n */\nexport function drawKeypoints(keypoints, minConfidence, ctx, scale = 1) {\n for (let i = 0; i < keypoints.length; i++) {\n const keypoint = keypoints[i];\n\n if (keypoint.score < minConfidence) {\n continue;\n }\n\n const {y, x} = keypoint.position;\n drawPoint(ctx, y * scale, x * scale, 3, COLOR);\n }\n}\n\n/**\n * Draw the bounding box of a pose. For example, for a whole person standing\n * in an image, the bounding box will begin at the nose and extend to one of\n * ankles\n */\nexport function drawBoundingBox(keypoints, ctx) {\n const boundingBox = posenet.getBoundingBox(keypoints);\n\n ctx.rect(\n boundingBox.minX, boundingBox.minY, boundingBox.maxX - boundingBox.minX,\n boundingBox.maxY - boundingBox.minY);\n\n ctx.strokeStyle = boundingBoxColor;\n ctx.stroke();\n}\n\n/**\n * Converts an array of pixel data into an ImageData object\n */\nexport async function renderToCanvas(a, ctx) {\n const [height, width] = a.shape;\n const imageData = new

ImageData(width, height);\n\n const data = await a.data();\n\n
  for (let i = 0; i < height * width; ++i) {\n   const j = i * 4;\n   const k = i * 3;\n\n   imageData.data[j + 0] = data[k + 0];\n   imageData.data[j + 1] = data[k + 1];\n   imageData.data[j + 2] = data[k + 2];\n   imageData.data[j + 3] = 255;\n }\n\n ctx.putImageData(imageData, 0, 0);\n}\n\n/**\n * Draw an image on a canvas\n */\nexport function renderImageToCanvas(image, size, canvas) {\n canvas.width = size[0];\n canvas.height = size[1];\n const ctx = canvas.getContext('2d');\n\n ctx.drawImage(image, 0, 0);\n}\n\n/**\n * Draw heatmap values, one of the model outputs, on to the canvas\n * Read our blog post for a description of PoseNet's heatmap outputs\n * https://medium.com/tensorflow/real-time-human-pose-estimation-in-the-browser-with-tensorflow-js-7dd0bc881cd5\n */\nexport function drawHeatMapValues(heatMapValues, outputStride, canvas) {\n const ctx = canvas.getContext('2d');\n const radius = 5;\n const scaledValues = heatMapValues.mul(tf.scalar(outputStride, 'int32'));\n\n drawPoints(ctx, scaledValues, radius, COLOR);\n}\n\n/**\n * Used by the drawHeatMapValues method to draw heatmap points on to\n * the canvas\n */\nfunction drawPoints(ctx, points, radius, color) {\n const data = points.buffer().values;\n\n for (let i = 0; i < data.length; i += 2) {\n   const pointY = data[i];\n   const pointX = data[i + 1];\n\n   if (pointX !== 0 && pointY !== 0) {\n   ctx.beginPath();\n   ctx.arc(pointX, pointY, radius, 0, 2 * Math.PI);\n   ctx.fillStyle = color;\n   ctx.fill();\n   }\n }\n}\n\n/**\n * Draw offset vector values, one of the model outputs, on to the canvas\n * Read our blog post for a description of PoseNet's offset vector outputs\n * https://medium.com/tensorflow/real-time-human-pose-estimation-in-the-browser-with-tensorflow-js-7dd0bc881cd5\n */\nexport function drawOffsetVectors(\n   heatMapValues, offsets, outputStride, scale = 1, ctx) {\n const offsetPoints =\n   posenet.singlePose.getOffsetPoints(heatMapValues,
 outputStride, offsets);\n\n const heatmapData = heatMapValues.buffer().values;\n const offsetPointsData = offsetPoints.buffer().values;\n\n for (let i = 0; i < heatmapData.length; i += 2) {\n   const heatmapY = heatmapData[i] * outputStride;\n   const heatmapX = heatmapData[i + 1] * outputStride;\n   const offsetPointY = offsetPointsData[i];\n   const offsetPointX = offsetPointsData[i + 1];\n\n   drawSegment(\n   [heatmapY, heatmapX], [offsetPointY, offsetPointX], COLOR, scale, ctx);\n }\n}\n","/**\n * @license\n * Copyright 2019 Google Inc. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * https://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS
 OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n *
==\n */\n// color schemes generated using d3-scale-chromatic:\n// https://github.com/d3/d3-scale-chromatic\n\nexport const rainbow = [\n [110, 64, 170], [143, 61, 178], [178, 60, 178], [210, 62, 167],\n [238, 67, 149], [255, 78, 125], [255, 94, 99], [255, 115, 75],\n [255, 140, 56], [239, 167, 47], [217, 194, 49], [194, 219, 64],\n [175, 240, 91], [135, 245, 87], [96, 247, 96], [64, 243, 115],\n [40, 234, 141], [28, 219, 169], [26, 199, 194], [33, 176, 213],\n [47, 150, 224], [65, 125, 224], [84, 101, 214], [99, 81, 195]\n];\n\nexport const warm = [\n [110, 64, 170], [106, 72, 183], [100, 81, 196], [92, 91, 206],\n [84, 101, 214], [75, 113, 221], [66, 125, 224], [56, 138, 226],\n [48, 150, 224], [40, 163, 220], [33, 176, 214], [29, 188, 205],\n
  [26, 199, 194], [26, 210, 182], [28, 219, 169], [33, 227, 155],\n [41, 234, 141], [51, 240, 128], [64, 243, 116], [79, 246, 105],\n [96, 247, 97], [115, 246, 91], [134, 245, 88], [155, 243, 88]\n];\n\nexport const spectral = [\n [158, 1, 66], [181, 26, 71], [202, 50, 74], [219, 73, 74],\n [232, 94, 73], [242, 117, 75], [248, 142, 83], [251, 167, 96],\n [253, 190, 112], [254, 210, 129], [254, 227, 149], [254, 240, 166],\n [251, 248, 176], [243, 249, 172], [231, 245, 163], [213, 238, 159],\n [190, 229, 160], [164, 218, 163], [137, 207, 165], [110, 192, 168],\n [86, 173, 174], [70, 150, 179], [67, 127, 180], [77, 103, 173]\n];\n","/**\n * @license\n * Copyright 2019 Google Inc. All Rights Reserved.\n * Licensed under the Apache License, Version 2.0 (the \"License\");\n * you may not use this file except in compliance with the License.\n * You may obtain a copy of the License at\n *\n * https://www.apache.org/licenses/LICENSE-2.0\n *\n * Unless required by applicable

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 law or agreed to in writing, software\n * distributed under the License is distributed on an \"AS IS\" BASIS,\n * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.\n * See the License for the specific language governing permissions and\n * limitations under the License.\n * ==========================================================================\n */\nimport '@tensorflow/tfjs-backend-webgl';\nimport * as bodyPix from '@tensorflow-models/body-pix';\nimport dat from 'dat.gui';\nimport Stats from 'stats.js';\n\nimport {drawKeypoints, drawSkeleton, toggleLoadingUI, TRY_RESNET_BUTTON_NAME, TRY_RESNET_BUTTON_TEXT, updateTryResNetButtonDatGuiCss} from './demo_util';\nimport * as partColorScales from './part_color_scales';\n\n\nconst stats = new Stats();\n\nconst state = {\n  video: null,\n  stream: null,\n  net: null,\n  videoConstraints: {},\n  // Triggers the TensorFlow model to reload\n changingArchitecture: false,\n  changingMultiplier: false,\n  changingStride: false,\n  changingResolution: false,\n  changingQuantBytes: false,\n};\n\nfunction isAndroid() {\n  return /Android/i.test(navigator.userAgent);\n}\n\nfunction isiOS() {\n  return /iPhone|iPad|iPod/i.test(navigator.userAgent);\n}\n\nfunction isMobile() {\n  return isAndroid() || isiOS();\n}\n\nasync function getVideoInputs() {\n  if (!navigator.mediaDevices || !navigator.mediaDevices.enumerateDevices) {\n    console.log('enumerateDevices() not supported.');\n    return [];\n  }\n\n  const devices = await navigator.mediaDevices.enumerateDevices();\n\n  const videoDevices = devices.filter(device => device.kind === 'videoinput');\n\n  return videoDevices;\n}\n\nfunction stopExistingVideoCapture() {\n  if (state.video && state.video.srcObject) {\n state.video.srcObject.getTracks().forEach(track => {\n    track.stop();\n  })\n  state.video.srcObject = null;\n }\n}\n\nasync function getDeviceIdForLabel(cameraLabel) {\n  const videoInputs = await getVideoInputs();\n\n  for (let i = 0; i < videoInputs.length; i++) {\n    const videoInput = videoInputs[i];\n    if (videoInput.label === cameraLabel) {\n      return videoInput.deviceId;\n    }\n  }\n\n  return null;\n}\n\n// on mobile, facing mode is the preferred way to select a camera.\n// Here we use the camera label to determine if its the environment or\n// user facing camera\nfunction getFacingMode(cameraLabel) {\n  if (!cameraLabel) {\n    return 'user';\n  }\n  if (cameraLabel.toLowerCase().includes('back')) {\n    return 'environment';\n  } else {\n    return 'user';\n  }\n}\n\nasync function getConstraints(cameraLabel) {\n  let deviceId;\n  let facingMode;\n\n  if (cameraLabel) {\n deviceId = await getDeviceIdForLabel(cameraLabel);\n    // on mobile, use the facing mode based on the camera.\n facingMode = isMobile() ? getFacingMode(cameraLabel) : null;\n  };\n  return {deviceId, facingMode};\n}\n\n/**\n * Loads a the camera to be used in the demo\n *\n */\nasync function setupCamera(cameraLabel) {\n  if (!navigator.mediaDevices || !navigator.mediaDevices.getUserMedia) {\n    throw new Error(\n      'Browser API navigator.mediaDevices.getUserMedia not available');\n  }\n\n  const videoElement = document.getElementById('video');\n\n  stopExistingVideoCapture();\n\n  const videoConstraints = await getConstraints(cameraLabel);\n\n  const stream = await navigator.mediaDevices.getUserMedia(\n      {'audio': false, 'video': videoConstraints});\n  videoElement.srcObject = stream;\n\n  return new Promise((resolve) => {\n videoElement.onloadedmetadata = () => {\n    videoElement.width = videoElement.videoWidth;\n videoElement.height = videoElement.videoHeight;\n    resolve(videoElement);\n  };\n  });\n}\n\nasync function loadVideo(cameraLabel) {\n  try {\n    state.video = await setupCamera(cameraLabel);\n  } catch (e) {\n    let info = document.getElementById('info');\n    info.textContent = 'this browser does not support video capture,' +\n      'or this device does not have a camera';\n    info.style.display = 'block';\n    throw e;\n  }\n\n  state.video.play();\n}\n\nconst defaultQuantBytes = 2;\n\nconst defaultMobileNetMultiplier = isMobile() ? 0.50 : 0.75;\nconst defaultMobileNetStride = 16;\nconst defaultMobileNetInternalResolution = 'medium';\n\nconst defaultResNetMultiplier = 1.0;\nconst defaultResNetStride = 16;\nconst defaultResNetInternalResolution = 'low';\n\nconst guiState = {\n  algorithm: 'multi-person-instance',\n  estimate: 'partmap',\n  camera: null,\n flipHorizontal: true,\n  input: {\n    architecture: 'MobileNetV1',\n    outputStride: 16,\n    internalResolution: 'low',\n    multiplier: 0.50,\n    quantBytes: 2\n  },\n  multiPersonDecoding: {\n    maxDetections: 5,\n    scoreThreshold: 0.3,\n    nmsRadius: 20,\n    numKeypointForMatching: 17,\n    refineSteps: 10\n  },\n  segmentation: {\n
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segmentationThreshold: 0.7,\n    effect: 'mask',\n    maskBackground: true,\n    opacity: 0.7,\n
backgroundBlurAmount: 3,\n    maskBlurAmount:
 0,\n    edgeBlurAmount: 3\n  },\n  partMap: {\n    colorScale: 'rainbow',\n    effect: 'partMap',\n
segmentationThreshold: 0.5,\n    opacity: 0.9,\n    blurBodyPartAmount: 3,\n    bodyPartEdgeBlurAmount: 3,\n  },\n
showFps: !isMobile()\n};\n\nfunction toCameraOptions(cameras) {\n  const result = {default: null};\n\n
cameras.forEach(camera => {\n    result[camera.label] = camera.label;\n  })\n\n  return result;\n}\n\n/**\n * Sets up
dat.gui controller on the top-right of the window\n */\nfunction setupGui(cameras) {\n  const gui = new
dat.GUI({width: 300});\n\n  let architectureController = null;\n  guiState[TRY_RESNET_BUTTON_NAME] =
function() {\n    architectureController.setValue('ResNet50')\n  };\n  gui.add(guiState,
TRY_RESNET_BUTTON_NAME).name(TRY_RESNET_BUTTON_TEXT);\n
updateTryResNetButtonDatGuiCss();\n\n  gui.add(guiState, 'camera', toCameraOptions(cameras))\n
.onChange(async function(cameraLabel) {\n        state.changingCamera = true;\n\n        await
loadVideo(cameraLabel);\n\n
        state.changingCamera = false;\n      });\n\n  gui.add(guiState, 'flipHorizontal');\n\n  // There are two algorithms
'person' and 'multi-person-instance'.\n  // The 'person' algorithm returns one single segmentation mask (or body\n  //
part map) for all people in the image. The 'multi-person-instance'\n  // algorithm returns an array of segmentation
mask (or body part map).\n  // Each element in the array corresponding to one of the people. In other\n  // words,
'multi-person-instance' algorithm does instance-level person\n  // segmentation and body part segmentation for every
person in the image.\n  const algorithmController =\n      gui.add(guiState, 'algorithm', ['person', 'multi-person-
instance']);\n\n  // Architecture: there are a few BodyPix models varying in size and\n  // accuracy.\n  // The input
parameters have the most effect on accuracy and speed of the\n  // network\n  let input = gui.addFolder('Input');\n\n
// Updates outputStride\n  // Output
 stride:  Internally, this parameter affects the height and width\n  // of the layers in the neural network. The lower the
value of the output\n  // stride the higher the accuracy but slower the speed, the higher the\n  // value the faster the
speed but lower the accuracy.\n  let outputStrideController = null;\n  function updateGuiOutputStride(outputStride,
outputStrideArray) {\n    if (outputStrideController) {\n      outputStrideController.remove();\n    }\n
guiState.input.outputStride = outputStride;\n    outputStrideController =\n        input.add(guiState.input,
'outputStride', outputStrideArray);\n    outputStrideController.onChange(function(outputStride) {\n
state.changingStride = true;\n      guiState.input.outputStride = +outputStride;\n    });\n  }\n\n  // Updates internal
resolution\n  // Internal resolution:  Internally, this parameter affects the height and\n  // width of the layers in the
neural network. The higher the value of the\n  // internal resolution the
 better the accuracy but slower the speed.\n  let internalResolutionController = null;\n  function
updateGuiInternalResolution(\n      internalResolution,\n      internalResolutionArray,\n  ) {\n    if
(internalResolutionController) {\n      internalResolutionController.remove();\n    }\n
guiState.input.internalResolution = internalResolution;\n    internalResolutionController = input.add(\n
guiState.input, 'internalResolution', internalResolutionArray);\n
internalResolutionController.onChange(function(internalResolution) {\n      guiState.input.internalResolution =
internalResolution;\n    });\n  }\n\n  // Updates depth multiplier\n  // Multiplier: this parameter affects the number of
feature map channels\n  // in the MobileNet. The higher the value, the higher the accuracy but\n  // slower the speed,
the lower the value the faster the speed but lower\n  // the accuracy.\n  let multiplierController = null;\n  function
updateGuiMultiplier(multiplier, multiplierArray) {\n
    if (multiplierController) {\n      multiplierController.remove();\n    }\n    guiState.input.multiplier = multiplier;\n
multiplierController =\n        input.add(guiState.input, 'multiplier', multiplierArray);\n
multiplierController.onChange(function(multiplier) {\n      state.changingMultiplier = true;\n
guiState.input.multiplier = +multiplier;\n    });\n  }\n\n  // updates quantBytes\n  // QuantBytes: this parameter
affects weight quantization in the ResNet50\n  // model. The available options are 1 byte, 2 bytes, and 4 bytes. The\n
// higher the value, the larger the model size and thus the longer the\n  // loading time, the lower the value, the
shorter the loading time but\n  // lower the accuracy.\n  let quantBytesController = null;\n  function
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updateGuiQuantBytes(quantBytes, quantBytesArray) {\n    if (quantBytesController) {\n
quantBytesController.remove();\n    }\n    guiState.quantBytes = +quantBytes;\n    guiState.input.quantBytes =
+quantBytes;\n    quantBytesController
 =\n        input.add(guiState.input, 'quantBytes', quantBytesArray);\n
quantBytesController.onChange(function(quantBytes) {\n      state.changingQuantBytes = true;\n
guiState.input.quantBytes = +quantBytes;\n    });\n  }\n\n  function updateGuiInputSection() {\n    if
(guiState.input.architecture === 'MobileNetV1') {\n      updateGuiInternalResolution(\n
defaultMobileNetInternalResolution,\n          ['low', 'medium', 'high', 'full']);\n
updateGuiOutputStride(defaultMobileNetStride, [8, 16]);\n      updateGuiMultiplier(defaultMobileNetMultiplier,
[0.50, 0.75, 1.0])\n    } else {  // guiState.input.architecture === \"ResNet50\"\n      updateGuiInternalResolution(\n
    defaultResNetInternalResolution, ['low', 'medium', 'high', 'full']);\n
updateGuiOutputStride(defaultResNetStride, [32, 16]);\n      updateGuiMultiplier(defaultResNetMultiplier, [1.0]);\n
  }\n    updateGuiQuantBytes(defaultQuantBytes, [1, 2, 4]);\n  }\n\n  // Architecture:
 there are a few PoseNet models varying in size and\n  // accuracy. 1.01 is the largest, but will be the slowest. 0.50 is
the\n  // fastest, but least accurate.\n  architectureController =\n      input.add(guiState.input, 'architecture',
['ResNet50', 'MobileNetV1']);\n  guiState.architecture = guiState.input.architecture;\n
architectureController.onChange(function(architecture) {\n    // if architecture is ResNet50, then show ResNet50
options\n    state.changingArchitecture = true;\n    guiState.input.architecture = architecture;\n
updateGuiInputSection();\n  });\n\n  updateGuiInputSection();\n  input.open()\n\n  const estimateController =\n
gui.add(guiState, 'estimate', ['segmentation', 'partmap']);\n\n  let segmentation = gui.addFolder('Segmentation');\n
segmentation.add(guiState.segmentation, 'segmentationThreshold', 0.0, 1.0);\n  const segmentationEffectController
=\n      segmentation.add(guiState.segmentation, 'effect', ['mask', 'bokeh']);\n\n  let multiPersonDecoding =
 gui.addFolder('MultiPersonDecoding');\n  multiPersonDecoding.add(\n      guiState.multiPersonDecoding,
'maxDetections', 0, 20, 1);\n  multiPersonDecoding.add(\n      guiState.multiPersonDecoding, 'scoreThreshold', 0.0,
1.0);\n  multiPersonDecoding.add(guiState.multiPersonDecoding, 'nmsRadius', 0, 30, 1);\n
multiPersonDecoding.add(\n      guiState.multiPersonDecoding, 'numKeypointForMatching', 1, 17, 1);\n
multiPersonDecoding.add(\n      guiState.multiPersonDecoding, 'refineSteps', 1, 10, 1);\n
multiPersonDecoding.open();\n\n  algorithmController.onChange(function(value) {\n    switch (guiState.algorithm)
{\n      case 'single-person':\n        multiPersonDecoding.close();\n        singlePersonDecoding.open();\n        break;\n
    case 'multi-person':\n        singlePersonDecoding.close();\n        multiPersonDecoding.open();\n        break;\n    }\n
});\n\n  let darknessLevel;\n  let bokehBlurAmount;\n  let edgeBlurAmount;\n  let maskBlurAmount;\n  let
maskBackground;\n\n  segmentationEffectController.onChange(function(effectType)
 {\n    if (effectType === 'mask') {\n      if (bokehBlurAmount) {\n        bokehBlurAmount.remove();\n      }\n      if
(edgeBlurAmount) {\n        edgeBlurAmount.remove();\n      }\n      darknessLevel =\n
segmentation.add(guiState.segmentation, 'opacity', 0.0, 1.0);\n      maskBlurAmount =
segmentation.add(guiState.segmentation, 'maskBlurAmount')\n                          .min(0)\n
.max(20)\n                          .step(1);\n      maskBackground =\n          segmentation.add(guiState.segmentation,
'maskBackground');\n    } else if (effectType === 'bokeh') {\n      if (darknessLevel) {\n
darknessLevel.remove();\n      }\n      if (maskBlurAmount) {\n        maskBlurAmount.remove();\n      }\n      if
(maskBackground) {\n        maskBackground.remove();\n      }\n      bokehBlurAmount = segmentation\n
        .add(\n                            guiState.segmentation,\n
                    'backgroundBlurAmount',\n                          )\n                          .min(1)\n
.max(20)\n                          .step(1);\n      edgeBlurAmount = segmentation.add(guiState.segmentation,
'edgeBlurAmount')\n                          .min(0)\n                          .max(20)\n                          .step(1);\n    }\n  });\n\n
// manually set the effect so that the options are shown.\n
segmentationEffectController.setValue(guiState.segmentation.effect);\n\n  let partMap = gui.addFolder('Part
Map');\n  partMap.add(guiState.partMap, 'segmentationThreshold', 0.0, 1.0);\n  partMap.add(\n      guiState.partMap,
'effect', ['partMap', 'pixelation', 'blurBodyPart']);\n  partMap.add(guiState.partMap, 'opacity', 0.0, 1.0);\n
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partMap.add(guiState.partMap, 'colorScale', Object.keys(partColorScales))\n      .onChange(colorScale => {\n setShownPartColorScales(colorScale);\n      });\n  setShownPartColorScales(guiState.partMap.colorScale);\n
  partMap.add(guiState.partMap, 'blurBodyPartAmount').min(1).max(20).step(1);\n  partMap.add(guiState.partMap,
'bodyPartEdgeBlurAmount')\n      .min(1)\n      .max(20)\n      .step(1);\n  partMap.open();\n\n
estimateController.onChange(function(estimationType) {\n    if (estimationType === 'segmentation') {\n
segmentation.open();\n      partMap.close();\n      document.getElementById('colors').style.display = 'none';\n    }
else {\n      segmentation.close();\n      partMap.open();\n      document.getElementById('colors').style.display =
'inline-block';\n    }\n  });\n\n  gui.add(guiState, 'showFps').onChange(showFps => {\n    if (showFps) {\n
document.body.appendChild(stats.dom);\n    } else {\n      document.body.removeChild(stats.dom);\n    }\n
})\n}\n\nfunction setShownPartColorScales(colorScale) {\n  const colors = document.getElementById('colors');\n
colors.innerHTML = '';\n\n  const partColors = partColorScales[colorScale];\n
  const partNames = bodyPix.PART_CHANNELS;\n\n  for (let i = 0; i < partColors.length; i++) {\n    const
partColor = partColors[i];\n    const child = document.createElement('li');\n\n    child.innerHTML = `\n        <div
class='color' style='background-color:rgb(${partColor[0]},${\n        partColor[1]},${partColor[2]})' ></div>\n
${partNames[i]}`;\n\n    colors.appendChild(child);\n  }\n}\n\n/**\n * Sets up a frames per second panel on the top-
left of the window\n */\nfunction setupFPS() {\n  stats.showPanel(0);  // 0: fps, 1: ms, 2: mb, 3+: custom\n  if
(guiState.showFps) {\n    document.body.appendChild(stats.dom);\n  }\n}\n\nasync function estimateSegmentation()
{\n  let multiPersonSegmentation = null;\n  switch (guiState.algorithm) {\n    case 'multi-person-instance':\n
return await state.net.segmentMultiPerson(state.video, {\n        internalResolution:
guiState.input.internalResolution,\n        segmentationThreshold: guiState.segmentation.segmentationThreshold,\n
      maxDetections: guiState.multiPersonDecoding.maxDetections,\n        scoreThreshold:
guiState.multiPersonDecoding.scoreThreshold,\n        nmsRadius: guiState.multiPersonDecoding.nmsRadius,\n
numKeypointForMatching:\n            guiState.multiPersonDecoding.numKeypointForMatching,\n        refineSteps:
guiState.multiPersonDecoding.refineSteps\n      });\n    case 'person':\n      return await
state.net.segmentPerson(state.video, {\n        internalResolution: guiState.input.internalResolution,\n
segmentationThreshold: guiState.segmentation.segmentationThreshold,\n        maxDetections:
guiState.multiPersonDecoding.maxDetections,\n        scoreThreshold:
guiState.multiPersonDecoding.scoreThreshold,\n        nmsRadius: guiState.multiPersonDecoding.nmsRadius,\n
});\n    default:\n      break;\n  };\n  return multiPersonSegmentation;\n}\n\nasync function
estimatePartSegmentation() {\n  switch (guiState.algorithm) {\n    case 'multi-person-instance':\n      return await
 state.net.segmentMultiPersonParts(state.video, {\n        internalResolution: guiState.input.internalResolution,\n
segmentationThreshold: guiState.segmentation.segmentationThreshold,\n        maxDetections:
guiState.multiPersonDecoding.maxDetections,\n        scoreThreshold:
guiState.multiPersonDecoding.scoreThreshold,\n        nmsRadius: guiState.multiPersonDecoding.nmsRadius,\n
numKeypointForMatching:\n            guiState.multiPersonDecoding.numKeypointForMatching,\n        refineSteps:
guiState.multiPersonDecoding.refineSteps\n      });\n    case 'person':\n      return await
state.net.segmentPersonParts(state.video, {\n        internalResolution: guiState.input.internalResolution,\n
segmentationThreshold: guiState.segmentation.segmentationThreshold,\n        maxDetections:
guiState.multiPersonDecoding.maxDetections,\n        scoreThreshold:
guiState.multiPersonDecoding.scoreThreshold,\n        nmsRadius: guiState.multiPersonDecoding.nmsRadius,\n
});\n
   default:\n      break;\n  };\n  return multiPersonPartSegmentation;\n}\n\nfunction
drawPoses(personOrPersonPartSegmentation, flipHorizontally, ctx) {\n  if
(Array.isArray(personOrPersonPartSegmentation)) {\n
personOrPersonPartSegmentation.forEach(personSegmentation => {\n      let pose = personSegmentation.pose;\n
if (flipHorizontally) {\n        pose = bodyPix.flipPoseHorizontal(pose, personSegmentation.width);\n      }\n
drawKeypoints(pose.keypoints, 0.1, ctx);\n      drawSkeleton(pose.keypoints, 0.1, ctx);\n    });\n  } else {\n
personOrPersonPartSegmentation.allPoses.forEach(pose => {\n      if (flipHorizontally) {\n        pose =
```

bodyPix.flipPoseHorizontal(\n pose, personOrPersonPartSegmentation.width);\n }\n drawKeypoints(pose.keypoints, 0.1, ctx);\n drawSkeleton(pose.keypoints, 0.1, ctx);\n })\n }\n}\n\nasync function loadBodyPix() {\n toggleLoadingUI(true);\n state.net = await bodyPix.load({\n architecture: guiState.input.architecture,\n
outputStride: guiState.input.outputStride,\n multiplier: guiState.input.multiplier,\n quantBytes: guiState.input.quantBytes\n });\n toggleLoadingUI(false);\n}\n\n/**\n * Feeds an image to BodyPix to estimate segmentation - this is where the\n * magic happens. This function loops with a requestAnimationFrame method.\n */\nfunction segmentBodyInRealTime() {\n const canvas = document.getElementById('output');\n // since images are being fed from a webcam\n\n async function bodySegmentationFrame() {\n // if changing the model or the camera, wait a second for it to complete\n // then try again.\n if (state.changingArchitecture || state.changingMultiplier ||\n state.changingCamera || state.changingStride ||\n state.changingQuantBytes) {\n console.log('load model...');\n loadBodyPix();\n state.changingArchitecture = false;\n state.changingMultiplier = false;\n state.changingStride = false;\n state.changingQuantBytes = false;\n }\n\n // Begin monitoring code for frames per second\n stats.begin();\n\n const flipHorizontally = guiState.flipHorizontal;\n\n switch (guiState.estimate) {\n case 'segmentation':\n const multiPersonSegmentation = await estimateSegmentation();\n switch (guiState.segmentation.effect) {\n case 'mask':\n const ctx = canvas.getContext('2d');\n const foregroundColor = {r: 255, g: 255, b: 255, a: 255};\n const backgroundColor = {r: 0, g: 0, b: 0, a: 255};\n const mask = bodyPix.toMask(\n multiPersonSegmentation, foregroundColor, backgroundColor,\n true);\n\n bodyPix.drawMask(\n canvas, state.video, mask, guiState.segmentation.opacity,\n guiState.segmentation.maskBlurAmount, flipHorizontally);\n drawPoses(multiPersonSegmentation, flipHorizontally, ctx);\n break;\n case 'bokeh':\n bodyPix.drawBokehEffect(\n canvas, state.video, multiPersonSegmentation,\n +guiState.segmentation.backgroundBlurAmount,\n guiState.segmentation.edgeBlurAmount, flipHorizontally);\n break;\n }\n\n break;\n case 'partmap':\n const ctx = canvas.getContext('2d');\n const multiPersonPartSegmentation = await estimatePartSegmentation();\n const coloredPartImageData = bodyPix.toColoredPartMask(\n multiPersonPartSegmentation,\n partColorScales[guiState.partMap.colorScale]);\n\n const maskBlurAmount = 0;\n switch (guiState.partMap.effect) {\n case 'pixelation':\n const pixelCellWidth = 10.0;\n\n bodyPix.drawPixelatedMask(\n canvas, state.video, coloredPartImageData,\n guiState.partMap.opacity, maskBlurAmount, flipHorizontally,\n pixelCellWidth);\n break;\n case 'partMap':\n bodyPix.drawMask(\n canvas, state.video, coloredPartImageData, guiState.opacity,\n maskBlurAmount, flipHorizontally);\n break;\n case 'blurBodyPart':\n const blurBodyPartIds = [0, 1];\n bodyPix.blurBodyPart(\n canvas, state.video, multiPersonPartSegmentation,\n blurBodyPartIds, guiState.partMap.blurBodyPartAmount,\n guiState.partMap.edgeBlurAmount, flipHorizontally);\n }\n drawPoses(multiPersonPartSegmentation, flipHorizontally, ctx);\n break;\n default:\n break;\n }\n\n // End monitoring code for frames per second\n stats.end();\n\n requestAnimationFrame(bodySegmentationFrame);\n }\n\n bodySegmentationFrame();\n}\n\n/**\n * Kicks off the demo.\n */\nexport async function bindPage() {\n // Load the BodyPix model weights with architecture 0.75\n await loadBodyPix();\n document.getElementById('loading').style.display = 'none';\n document.getElementById('main').style.display = 'inline-block';\n\n await loadVideo(guiState.camera);\n\n let cameras = await getVideoInputs();\n\n setupFPS();\n setupGui(cameras);\n\n segmentBodyInRealTime();\n}\n\n\nnavigator.getUserMedia = navigator.getUserMedia ||\n navigator.webkitGetUserMedia || navigator.mozGetUserMedia;\n// kick off the demo\nbindPage();\n"]}

Found in path(s):
* /tensorflow-models-zip/@tensorflow-models/body-pix/demos/dist/demos.ab0c720b.js.map

1.125 libssh 0.9.3

1.125.1 Available under license :

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Upstream-Name: libssh
Upstream-Contact: libssh@libssh.org
Andreas Schneider <asn@cryptomilk.org>
Source: https://git.libssh.org/projects/libssh.git

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include/libssh/bind.h
include/libssh/buffer.h
include/libssh/channels.h
include/libssh/crc32.h
include/libssh/crypto.h
include/libssh/dh.h
include/libssh/ecdh.h
include/libssh/ed25519.h
include/libssh/gssapi.h
include/libssh/kex.h
include/libssh/keys.h
include/libssh/legacy.h
include/libssh/libcrypto.h
include/libssh/libgcrypt.h
include/libssh/libssh.h
include/libssh/libsshpp.hpp
include/libssh/messages.h
include/libssh/misc.h
include/libssh/packet.h

include/libssh/pcap.h
include/libssh/pki.h
include/libssh/pki_priv.h
include/libssh/poll.h
include/libssh/priv.h
include/libssh/scp.h
include/libssh/server.h
include/libssh/session.h
include/libssh/sftp.h

include/libssh/socket.h
include/libssh/string.h
include/libssh/threads.h
include/libssh/wrapper.h
src/auth1.c
src/base64.c
src/bignum.c
src/bind.c
src/buffer.c
src/client.c
src/connect.c
src/crc32.c
src/ecdh.c
src/error.c
src/gcrypt_missing.c
src/init.c
src/kex.c
src/kex1.c
src/legacy.c
src/libcrypto.c
src/libgcrypt.c
src/log.c
src/messages.c
src/packet.c
src/packet1.c
src/packet_cb.c
src/packet_crypt.c
src/pcap.c
src/pki_container_openssh.c
src/pki_ed25519.c
src/server.c
src/session.c
src/sftpserver.c
src/socket.c
src/string.c
src/threads.c
src/threads/pthread.c
src/wrapper.c
tests/benchmarks/bench_raw.c
tests/benchmarks/bench_scp.c
tests/benchmarks/bench_sftp.c
tests/benchmarks/benchmarks.c
tests/benchmarks/benchmarks.h
tests/benchmarks/latency.c
tests/client/torture_algorithms.c
tests/client/torture_auth.c
tests/client/torture_connect.c
tests/client/torture_knownhosts.c

tests/client/torture_session.c
tests/test_pcap.c
tests/test_socket.c
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Files: examples/exec.c
examples/senddata.c
examples/CMakeLists.txt
include/libssh/ssh1.h
include/libssh/ssh2.h
tests/authentication.c
tests/benchmarks/bench1.sh
tests/benchmarks/bench2.sh
tests/chmodtest.c
tests/client/torture_proxycommand.c
tests/client/torture_sftp_dir.c
tests/client/torture_sftp_read.c
tests/cmdline.c
tests/connection.c
tests/generate.py
tests/sftp_stress/main.c
tests/test_exec.c
tests/test_ssh_bind_accept_fd.c
tests/test_tunnel.c
tests/tests.h
tests/unittests/torture_buffer.c
tests/unittests/torture_callbacks.c
tests/unittests/torture_channel.c
tests/unittests/torture_init.c
tests/unittests/torture_isipaddr.c
tests/unittests/torture_keyfiles.c
tests/unittests/torture_list.c
tests/unittests/torture_misc.c
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Files: examples/authentication.c
examples/connect_ssh.c
examples/examples_common.h
examples/knownhosts.c
examples/libssh_scp.c
examples/libsshpp.cpp

examples/libsshpp_noexcept.cpp
examples/proxy.c
examples/sample.c
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src/external/fe25519.c
src/external/ge25519.c
src/external/ge25519_base.data
src/external/sc25519.c
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Files: tests/pkd/pkd_client.h
tests/pkd/pkd_daemon.c
tests/pkd/pkd_daemon.h
tests/pkd/pkd_hello.c
tests/pkd/pkd_keyutil.c
tests/pkd/pkd_keyutil.h
tests/pkd/pkd_util.c
tests/pkd/pkd_util.h
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Files: src/channels.c
src/channels1.c
src/gzip.c
src/known_hosts.c
src/misc.c
src/options.c
src/pki.c
src/pki_crypto.c
src/pki_gcrypt.c
src/sftp.c
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include/libssh/options.h
src/agent.c
src/callbacks.c
src/config.c
tests/client/torture_forward.c
tests/client/torture_request_env.c
tests/torture.c
tests/torture.c
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Files: src/match.c
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cmake/Modules/DefineCompilerFlags.cmake
cmake/Modules/DefineInstallationPaths.cmake
cmake/Modules/DefinePlatformDefaults.cmake
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Files: cmake/Modules/AddCMockaTest.cmake
cmake/Modules/CheckCCompilerFlagSSP.cmake
cmake/Modules/FindArgp.cmake
cmake/Modules/FindCMocka.cmake
cmake/Modules/FindGCrypt.cmake
cmake/Modules/FindGSSAPI.cmake
cmake/Modules/FindNaCl.cmake
cmake/Modules/FindNSIS.cmake
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Linking with OpenSSL

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1.126 golang 1.15.15

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  <xsl:param name="text"/>
  <xsl:value-of select="$isc.copyright.leader"/>
  <xsl:value-of select="normalize-space(substring-before($text, '&#10;'))"/>
  <xsl:text>&#10;</xsl:text>
  <xsl:variable name="rest" select="substring-after($text, '&#10;')"/>
  <xsl:if test="translate($rest, '&#9;&#32;', '')">
    <xsl:call-template name="isc.copyright.format">
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 <xsl:variable name="isc.copyright.text">
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  <xsl:call-template name="isc.copyright.format">
   <xsl:with-param name="text">
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  <xsl:text>Copyright (C) </xsl:text>
  <xsl:call-template name="copyright.years">
   <xsl:with-param name="years" select="db:year"/>
  </xsl:call-template>
  <xsl:text> </xsl:text>
  <xsl:value-of select="db:holder"/>
      <xsl:value-of select="$isc.copyright.breakline"/>
  <xsl:text>&#10;</xsl:text>
 </xsl:for-each>
 <xsl:value-of
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 select="$isc.copyright.text"/>
    </xsl:with-param>
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 </xsl:variable>
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1.134 postgre-sql 12.12

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1.135 iptables 1.8.8

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```
/*
* libipq.h
*
* IPQ library for userspace.
*
* Author: James Morris <jmorris@intercode.com.au>
*
* Copyright (c) 2000-2001 Netfilter Core Team
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*/
```

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* /iptables-1-1-8-3-1-x86-64-pkg-tar-xz/usr/include/libipq.h
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```
# $FreeBSD: head/etc/pf.os 258865 2013-12-03 04:32:02Z eadler $
# $OpenBSD: pf.os,v 1.27 2016/09/03 17:08:57 sthen Exp $
# passive OS fingerprinting
# -------------------------
#
# SYN signatures. Those signatures work for SYN packets only (duh!).
#
# (C) Copyright 2000-2003 by Michal Zalewski <lcamtuf@coredump.cx>
# (C) Copyright 2003 by Mike Frantzen <frantzen@w4g.org>
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#
#
# This fingerprint database is adapted from Michal Zalewski's p0f passive
# operating system package.  The last database sync was from a Nov 3 2003
# p0f.fp.
#
#
# Each line in this file specifies a single fingerprint. Please read the
# information below carefully before attempting to append any signatures
# reported as UNKNOWN to this file to avoid mistakes.
#
# We use the following set metrics for fingerprinting:
#
# - Window size (WSS) - a highly OS dependent setting used for TCP/IP
#   performance control (max. amount of data to be sent without ACK).
#   Some systems use a fixed value for initial packets. On other
#   systems, it is a multiple of MSS or MTU (MSS+40). In some rare
#   cases, the value is just arbitrary.
#
#   NEW SIGNATURE: if p0f reported a special value of 'Snn', the number
#   appears to be
 a multiple of MSS (MSS*nn); a special value of 'Tnn'
#   means it is a multiple of MTU ((MSS+40)*nn). Unless you notice the
#   value of nn is not fixed (unlikely), just copy the Snn or Tnn token
#   literally. If you know this device has a simple stack and a fixed
#   MTU, you can however multiply S value by MSS, or T value by MSS+40,
#   and put it instead of Snn or Tnn.
#
#   If WSS otherwise looks like a fixed value (for example a multiple
#   of two), or if you can confirm the value is fixed, please quote
#   it literally. If there's no apparent pattern in WSS chosen, you
#   should consider wildcarding this value.
#
# - Overall packet size - a function of all IP and TCP options and bugs.
#
#   NEW SIGNATURE: Copy this value literally.
#
# - Initial TTL - We check the actual TTL of a received packet. It can't
#   be higher than the initial TTL, and also shouldn't be dramatically
#   lower (maximum distance is defined as 40 hops).
#
#   NEW SIGNATURE: *Never* copy TTL from a p0f-reported
```

signature literally.
You need to determine the initial TTL. The best way to do it is to
check the documentation for a remote system, or check its settings.
A fairly good method is to simply round the observed TTL up to
32, 64, 128, or 255, but it should be noted that some obscure devices
might not use round TTLs (in particular, some shoddy appliances use
"original" initial TTL settings). If not sure, you can see how many
hops you're away from the remote party with traceroute or mtr.
#
- Don't fragment flag (DF) - some modern OSes set this to implement PMTU
discovery. Others do not bother.
#
NEW SIGNATURE: Copy this value literally.
#
- Maximum segment size (MSS) - this setting is usually link-dependent. P0f
uses it to determine link type of the remote host.
#
NEW SIGNATURE: Always wildcard this value, except for rare cases when
you have an appliance with a fixed value, know the system supports only
a very limited number of
 network interface types, or know the system
is using a value it pulled out of nowhere. Specific unique MSS
can be used to tell Google crawlbots from the rest of the population.
#
- Window scaling (WSCALE) - this feature is used to scale WSS.
It extends the size of a TCP/IP window to 32 bits. Some modern
systems implement this feature.
#
NEW SIGNATURE: Observe several signatures. Initial WSCALE is often set
to zero or other low value. There's usually no need to wildcard this
parameter.
#
- Timestamp - some systems that implement timestamps set them to
zero in the initial SYN. This case is detected and handled appropriately.
#
- Selective ACK permitted - a flag set by systems that implement
selective ACK functionality.
#
- The sequence of TCP all options (MSS, window scaling, selective ACK
permitted, timestamp, NOP). Other than the options previously
discussed, p0f also checks for timestamp option (a silly
extension to broadcast your
 uptime ;-), NOP options (used for
header padding) and sackOK option (selective ACK feature).
#
NEW SIGNATURE: Copy the sequence literally.
#
To wildcard any value (except for initial TTL or TCP options), replace

```
# it with '*'. You can also use a modulo operator to match any values
# that divide by nnn - '%nnn'.
#
# Fingerprint entry format:
#
# wwww:ttt:D:ss:OOO...:OS:Version:Subtype:Details
#
# wwww     - window size (can be *, %nnn, Snn or Tnn).  The special values
#            "S" and "T" which are a multiple of MSS or a multiple of MTU
#            respectively.
# ttt      - initial TTL
# D        - don't fragment bit (0 - not set, 1 - set)
# ss       - overall SYN packet size
# OOO      - option value and order specification (see below)
# OS       - OS genre (Linux, Solaris, Windows)
# Version  - OS Version (2.0.27 on x86, etc)
# Subtype  - OS subtype or patchlevel (SP3, lo0)
# details  - Generic OS details
#
# If OS genre starts with '*', p0f will not show distance,
 link type
# and timestamp data. It is useful for userland TCP/IP stacks of
# network scanners and so on, where many settings are randomized or
# bogus.
#
# If OS genre starts with @, it denotes an approximate hit for a group
# of operating systems (signature reporting still enabled in this case).
# Use this feature at the end of this file to catch cases for which
# you don't have a precise match, but can tell it's Windows or FreeBSD
# or whatnot by looking at, say, flag layout alone.
#
# Option block description is a list of comma or space separated
# options in the order they appear in the packet:
#
# N    - NOP option
# Wnnn    - window scaling option, value nnn (or * or %nnn)
# Mnnn    - maximum segment size option, value nnn (or * or %nnn)
# S    - selective ACK OK
# T    - timestamp
# T0    - timestamp with a zero value
#
# To denote no TCP options, use a single '.'.
#
# Please report any additions to this file, or any inaccuracies or
# problems spotted, to the maintainers: lcamtuf@coredump.cx,
#
 frantzen@openbsd.org and bugs@openbsd.org with a tcpdump packet
# capture of the relevant SYN packet(s)
```

```
#
# A test and submission page is available at
# http://lcamtuf.coredump.cx/p0f-help/
#
#
# WARNING WARNING WARNING
# ----------------------
#
# Do not add a system X as OS Y just because NMAP says so. It is often
# the case that X is a NAT firewall. While nmap is talking to the
# device itself, p0f is fingerprinting the guy behind the firewall
# instead.
#
# When in doubt, use common sense, don't add something that looks like
# a completely different system as Linux or FreeBSD or LinkSys router.
# Check DNS name, establish a connection to the remote host and look
# at SYN+ACK - does it look similar?
#
# Some users tweak their TCP/IP settings - enable or disable RFC1323
# functionality, enable or disable timestamps or selective ACK,
# disable PMTU discovery, change MTU and so on. Always compare a new rule
# to other fingerprints for this system, and verify the system
 isn't
# "customized" before adding it. It is OK to add signature variants
# caused by a commonly used software (personal firewalls, security
# packages, etc), but it makes no sense to try to add every single
# possible /proc/sys/net/ipv4 tweak on Linux or so.
#
# KEEP IN MIND: Some packet firewalls configured to normalize outgoing
# traffic (OpenBSD pf with "scrub" enabled, for example) will, well,
# normalize packets. Signatures will not correspond to the originating
# system (and probably not quite to the firewall either).
#
# NOTE: Try to keep this file in some reasonable order, from most to
# least likely systems. This will speed up operation. Also keep most
# generic and broad rules near the end.
#

############################
# Standard OS signatures #
############################

# ----------------- AIX ---------------------

# AIX is first because its signatures are close to NetBSD, MacOS X and
# Linux 2.0, but it uses a fairly rare MSSes, at least sometimes...
# This is a shoddy
```

hack, though.

45046:64:0:44:M*: AIX:4.3::AIX 4.3
16384:64:0:44:M512: AIX:4.3:2-3:AIX 4.3.2 and earlier

16384:64:0:60:M512,N,W%2,N,N,T: AIX:4.3:3:AIX 4.3.3-5.2
16384:64:0:60:M512,N,W%2,N,N,T: AIX:5.1-5.2::AIX 4.3.3-5.2
32768:64:0:60:M512,N,W%2,N,N,T: AIX:4.3:3:AIX 4.3.3-5.2
32768:64:0:60:M512,N,W%2,N,N,T: AIX:5.1-5.2::AIX 4.3.3-5.2
65535:64:0:60:M512,N,W%2,N,N,T: AIX:4.3:3:AIX 4.3.3-5.2
65535:64:0:60:M512,N,W%2,N,N,T: AIX:5.1-5.2::AIX 4.3.3-5.2
65535:64:0:64:M*,N,W1,N,N,T,N,N,S: AIX:5.3:ML1:AIX 5.3 ML1

---------- Linux ----------

S1:64:0:44:M*:A: Linux:1.2::Linux 1.2.x (XXX quirks support)
512:64:0:44:M*:   Linux:2.0:3x:Linux 2.0.3x
16384:64:0:44:M*: Linux:2.0:3x:Linux 2.0.3x

Endian snafu! Nelson says "ha-ha":
2:64:0:44:M*:   Linux:2.0:3x:Linux 2.0.3x (MkLinux) on Mac
64:64:0:44:M*:   Linux:2.0:3x:Linux 2.0.3x (MkLinux) on Mac

S4:64:1:60:M1360,S,T,N,W0: Linux:google::Linux (Google crawlbot)

S2:64:1:60:M*,S,T,N,W0: Linux:2.4::Linux 2.4 (big boy)
S3:64:1:60:M*,S,T,N,W0: Linux:2.4:.18-21:Linux
 2.4.18 and newer
S4:64:1:60:M*,S,T,N,W0: Linux:2.4::Linux 2.4/2.6 <= 2.6.7
S4:64:1:60:M*,S,T,N,W0: Linux:2.6:.1-7:Linux 2.4/2.6 <= 2.6.7

S4:64:1:60:M*,S,T,N,W5: Linux:2.6::Linux 2.6 (newer, 1)
S4:64:1:60:M*,S,T,N,W6: Linux:2.6::Linux 2.6 (newer, 2)
S4:64:1:60:M*,S,T,N,W7: Linux:2.6::Linux 2.6 (newer, 3)
T4:64:1:60:M*,S,T,N,W7: Linux:2.6::Linux 2.6 (newer, 4)

S10:64:1:60:M*,S,T,N,W4: Linux:3.0::Linux 3.0

S3:64:1:60:M*,S,T,N,W1: Linux:2.5::Linux 2.5 (sometimes 2.4)
S4:64:1:60:M*,S,T,N,W1: Linux:2.5-2.6::Linux 2.5/2.6
S3:64:1:60:M*,S,T,N,W2: Linux:2.5::Linux 2.5 (sometimes 2.4)
S4:64:1:60:M*,S,T,N,W2: Linux:2.5::Linux 2.5 (sometimes 2.4)

S20:64:1:60:M*,S,T,N,W0: Linux:2.2:20-25:Linux 2.2.20 and newer
S22:64:1:60:M*,S,T,N,W0: Linux:2.2::Linux 2.2
S11:64:1:60:M*,S,T,N,W0: Linux:2.2::Linux 2.2

```
# Popular cluster config scripts disable timestamps and
# selective ACK:
S4:64:1:48:M1460,N,W0:  Linux:2.4:cluster:Linux 2.4 in cluster

#
 This needs to be investigated. On some systems, WSS
# is selected as a multiple of MTU instead of MSS. I got
# many submissions for this for many late versions of 2.4:
T4:64:1:60:M1412,S,T,N,W0: Linux:2.4::Linux 2.4 (late, uncommon)

# This happens only over loopback, but let's make folks happy:
32767:64:1:60:M16396,S,T,N,W0: Linux:2.4:lo0:Linux 2.4 (local)
S8:64:1:60:M3884,S,T,N,W0: Linux:2.2:lo0:Linux 2.2 (local)

# Opera visitors:
16384:64:1:60:M*,S,T,N,W0: Linux:2.2:Opera:Linux 2.2 (Opera?)
32767:64:1:60:M*,S,T,N,W0: Linux:2.4:Opera:Linux 2.4 (Opera?)

# Some fairly common mods:
S4:64:1:52:M*,N,N,S,N,W0: Linux:2.4:ts:Linux 2.4 w/o timestamps
S22:64:1:52:M*,N,N,S,N,W0: Linux:2.2:ts:Linux 2.2 w/o timestamps


# ----------------- FreeBSD -----------------

16384:64:1:44:M*:  FreeBSD:2.0-2.2::FreeBSD 2.0-4.2
16384:64:1:44:M*:  FreeBSD:3.0-3.5::FreeBSD 2.0-4.2
16384:64:1:44:M*:  FreeBSD:4.0-4.2::FreeBSD 2.0-4.2
16384:64:1:60:M*,N,W0,N,N,T: FreeBSD:4.4::FreeBSD 4.4

1024:64:1:60:M*,N,W0,N,N,T: FreeBSD:4.4::FreeBSD
 4.4

57344:64:1:44:M*:  FreeBSD:4.6-4.8:noRFC1323:FreeBSD 4.6-4.8 (no RFC1323)
57344:64:1:60:M*,N,W0,N,N,T: FreeBSD:4.6-4.9::FreeBSD 4.6-4.9

32768:64:1:60:M*,N,W0,N,N,T: FreeBSD:4.8-4.11::FreeBSD 4.8-5.1 (or MacOS X)
32768:64:1:60:M*,N,W0,N,N,T: FreeBSD:5.0-5.1::FreeBSD 4.8-5.1 (or MacOS X)
65535:64:1:60:M*,N,W0,N,N,T: FreeBSD:4.8-4.11::FreeBSD 4.8-5.2 (or MacOS X)
65535:64:1:60:M*,N,W0,N,N,T: FreeBSD:5.0-5.2::FreeBSD 4.8-5.2 (or MacOS X)
65535:64:1:60:M*,N,W1,N,N,T: FreeBSD:4.7-4.11::FreeBSD 4.7-5.2
65535:64:1:60:M*,N,W1,N,N,T: FreeBSD:5.0-5.2::FreeBSD 4.7-5.2

# XXX need quirks support
# 65535:64:1:60:M*,N,W0,N,N,T:Z:FreeBSD:5.1-5.4::5.1-current (1)
# 65535:64:1:60:M*,N,W1,N,N,T:Z:FreeBSD:5.1-5.4::5.1-current (2)
# 65535:64:1:60:M*,N,W2,N,N,T:Z:FreeBSD:5.1-5.4::5.1-current (3)
# 65535:64:1:44:M*:Z:FreeBSD:5.2::FreeBSD 5.2 (no RFC1323)
```

```
# 16384:64:1:60:M*,N,N,N,N,N,N,T:FreeBSD:4.4:noTS:FreeBSD 4.4 (w/o timestamps)

# ---------- NetBSD ----------

16384:64:0:60:M*,N,W0,N,N,T: NetBSD:1.3::NetBSD
 1.3
65535:64:0:60:M*,N,W0,N,N,T0: NetBSD:1.6:opera:NetBSD 1.6 (Opera)
16384:64:0:60:M*,N,W0,N,N,T0: NetBSD:1.6::NetBSD 1.6
16384:64:1:60:M*,N,W0,N,N,T0: NetBSD:1.6:df:NetBSD 1.6 (DF)
65535:64:1:60:M*,N,W1,N,N,T0: NetBSD:1.6::NetBSD 1.6W-current (DF)
65535:64:1:60:M*,N,W0,N,N,T0: NetBSD:1.6::NetBSD 1.6X (DF)
32768:64:1:60:M*,N,W0,N,N,T0: NetBSD:1.6:randomization:NetBSD 1.6ZH-current (w/ ip_id randomization)

# ---------- OpenBSD ----------

16384:64:0:60:M*,N,W0,N,N,T:  OpenBSD:2.6::NetBSD 1.3 (or OpenBSD 2.6)
16384:64:1:64:M*,N,N,S,N,W0,N,N,T: OpenBSD:3.0-4.8::OpenBSD 3.0-4.8
16384:64:0:64:M*,N,N,S,N,W0,N,N,T: OpenBSD:3.0-4.8:no-df:OpenBSD 3.0-4.8 (scrub no-df)
57344:64:1:64:M*,N,N,S,N,W0,N,N,T: OpenBSD:3.3-4.0::OpenBSD 3.3-4.0
57344:64:0:64:M*,N,N,S,N,W0,N,N,T: OpenBSD:3.3-4.0:no-df:OpenBSD 3.3-4.0 (scrub no-df)

65535:64:1:64:M*,N,N,S,N,W0,N,N,T: OpenBSD:3.0-4.0:opera:OpenBSD 3.0-4.0 (Opera)

16384:64:1:64:M*,N,N,S,N,W3,N,N,T: OpenBSD:4.9::OpenBSD
 4.9
16384:64:0:64:M*,N,N,S,N,W3,N,N,T: OpenBSD:4.9:no-df:OpenBSD 4.9 (scrub no-df)

16384:64:1:64:M*,N,N,S,N,W6,N,N,T:      OpenBSD:6.1::OpenBSD 6.1
16384:64:0:64:M*,N,N,S,N,W6,N,N,T:      OpenBSD:6.1:no-df:OpenBSD 6.1 (scrub no-df)

# ---------- DragonFly BSD ----------

57344:64:1:60:M*,N,W0,N,N,T:  DragonFly:1.0:A:DragonFly 1.0A
57344:64:0:64:M*,N,W0,N,N,S,N,N,T: DragonFly:1.2-1.12::DragonFly 1.2-1.12
5840:64:1:60:M*,S,T,N,W4:   DragonFly:2.0-2.1::DragonFly 2.0-2.1
57344:64:0:64:M*,N,W0,N,N,S,N,N,T: DragonFly:2.2-2.3::DragonFly 2.2-2.3
57344:64:0:64:M*,N,W5,N,N,S,N,N,T: DragonFly:2.4-2.7::DragonFly 2.4-2.7

# ---------- Solaris ----------

S17:64:1:64:N,W3,N,N,T0,N,N,S,M*: Solaris:8:RFC1323:Solaris 8 RFC1323
S17:64:1:48:N,N,S,M*:   Solaris:8::Solaris 8
S17:255:1:44:M*:   Solaris:2.5-2.7::Solaris 2.5 to 7

S6:255:1:44:M*:    Solaris:2.6-2.7::Solaris 2.6 to 7
S23:255:1:44:M*:   Solaris:2.5:1:Solaris 2.5.1
S34:64:1:48:M*,N,N,S:   Solaris:2.9::Solaris
```

9
S44:255:1:44:M*: Solaris:2.7::Solaris 7

4096:64:0:44:M1460: SunOS:4.1::SunOS 4.1.x

S34:64:1:52:M*,N,W0,N,N,S: Solaris:10:beta:Solaris 10 (beta)
32850:64:1:64:M*,N,N,T,N,W1,N,N,S: Solaris:10::Solaris 10 1203

---------- IRIX ----------

49152:64:0:44:M*: IRIX:6.4::IRIX 6.4
61440:64:0:44:M*: IRIX:6.2-6.5::IRIX 6.2-6.5
49152:64:0:52:M*,N,W2,N,N,S: IRIX:6.5:RFC1323:IRIX 6.5 (RFC1323)
49152:64:0:52:M*,N,W3,N,N,S: IRIX:6.5:RFC1323:IRIX 6.5 (RFC1323)

61440:64:0:48:M*,N,N,S: IRIX:6.5:12-21:IRIX 6.5.12 - 6.5.21
49152:64:0:48:M*,N,N,S: IRIX:6.5:15-21:IRIX 6.5.15 - 6.5.21

49152:60:0:64:M*,N,W2,N,N,T,N,N,S: IRIX:6.5:IP27:IRIX 6.5 IP27

---------- Tru64 ----------

32768:64:1:48:M*,N,W0: Tru64:4.0::Tru64 4.0 (or OS/2 Warp 4)
32768:64:0:48:M*,N,W0: Tru64:5.0::Tru64 5.0
8192:64:0:44:M1460: Tru64:5.1:noRFC1323:Tru64 6.1 (no RFC1323) (or QNX 6)
61440:64:0:48:M*,N,W0: Tru64:5.1a:JP4:Tru64 v5.1a JP4 (or OpenVMS
7.x on Compaq 5.x stack)

---------- OpenVMS ----------

6144:64:1:60:M*,N,W0,N,N,T: OpenVMS:7.2::OpenVMS 7.2 (Multinet 4.4 stack)

---------- MacOS ----------

XXX Need EOL tcp opt support
S2:255:1:48:M*,W0,E:.:MacOS:8.6 classic

XXX some of these use EOL too
16616:255:1:48:M*,W0: MacOS:7.3-7.6:OTTCP:MacOS 7.3-8.6 (OTTCP)
16616:255:1:48:M*,W0: MacOS:8.0-8.6:OTTCP:MacOS 7.3-8.6 (OTTCP)
16616:255:1:48:M*,N,N,N: MacOS:8.1-8.6:OTTCP:MacOS 8.1-8.6 (OTTCP)
32768:255:1:48:M*,W0,N: MacOS:9.0-9.2::MacOS 9.0-9.2
65535:255:1:48:M*,N,N,N,N: MacOS:9.1::MacOS 9.1 (OT 2.7.4)

---------- Windows ----------

```
# Windows TCP/IP stack is a mess. For most recent XP, 2000 and
# even 98, the patchlevel, not the actual OS version, is more
# relevant to the signature. They share the same code, so it would
# seem. Luckily for us, almost all Windows 9x boxes have an
# awkward MSS of 536, which I use to tell one from another
# in most difficult cases.

8192:32:1:44:M*:   Windows:3.11::Windows
 3.11 (Tucows)
S44:64:1:64:M*,N,W0,N,N,T0,N,N,S: Windows:95::Windows 95
8192:128:1:64:M*,N,W0,N,N,T0,N,N,S: Windows:95:b:Windows 95b

# There were so many tweaking tools and so many stack versions for
# Windows 98 it is no longer possible to tell them from each other
# without some very serious research. Until then, there's an insane
# number of signatures, for your amusement:

S44:32:1:48:M*,N,N,S:   Windows:98:lowTTL:Windows 98 (low TTL)
8192:32:1:48:M*,N,N,S:   Windows:98:lowTTL:Windows 98 (low TTL)
%8192:64:1:48:M536,N,N,S:  Windows:98::Windows 98
%8192:128:1:48:M536,N,N,S:  Windows:98::Windows 98
S4:64:1:48:M*,N,N,S:   Windows:98::Windows 98
S6:64:1:48:M*,N,N,S:   Windows:98::Windows 98
S12:64:1:48:M*,N,N,S:   Windows:98::Windows 98
T30:64:1:64:M1460,N,W0,N,N,T0,N,N,S: Windows:98::Windows 98
32767:64:1:48:M*,N,N,S:   Windows:98::Windows 98
37300:64:1:48:M*,N,N,S:   Windows:98::Windows 98
46080:64:1:52:M*,N,W3,N,N,S:  Windows:98:RFC1323:Windows
 98 (RFC1323)
65535:64:1:44:M*:   Windows:98:noSack:Windows 98 (no sack)
S16:128:1:48:M*,N,N,S:   Windows:98::Windows 98
S16:128:1:64:M*,N,W0,N,N,T0,N,N,S: Windows:98::Windows 98
S26:128:1:48:M*,N,N,S:   Windows:98::Windows 98
T30:128:1:48:M*,N,N,S:   Windows:98::Windows 98
32767:128:1:52:M*,N,W0,N,N,S:  Windows:98::Windows 98
60352:128:1:48:M*,N,N,S:  Windows:98::Windows 98
60352:128:1:64:M*,N,W2,N,N,T0,N,N,S: Windows:98::Windows 98

# What's with 1414 on NT?
T31:128:1:44:M1414:   Windows:NT:4.0:Windows NT 4.0 SP6a
64512:128:1:44:M1414:   Windows:NT:4.0:Windows NT 4.0 SP6a
8192:128:1:44:M*:   Windows:NT:4.0:Windows NT 4.0 (older)

# Windows XP and 2000. Most of the signatures that were
# either dubious or non-specific (no service pack data)
# were deleted and replaced with generics at the end.

65535:128:1:48:M*,N,N,S:  Windows:2000:SP4:Windows 2000 SP4, XP SP1
```

```
65535:128:1:48:M*,N,N,S:  Windows:XP:SP1:Windows 2000 SP4, XP SP1
%8192:128:1:48:M*,N,N,S:  Windows:2000:SP2+:Windows
 2000 SP2, XP SP1 (seldom 98 4.10.2222)
%8192:128:1:48:M*,N,N,S:  Windows:XP:SP1:Windows 2000 SP2, XP SP1 (seldom 98 4.10.2222)
S20:128:1:48:M*,N,N,S:   Windows:2000::Windows 2000/XP SP3
S20:128:1:48:M*,N,N,S:   Windows:XP:SP3:Windows 2000/XP SP3
S45:128:1:48:M*,N,N,S:   Windows:2000:SP4:Windows 2000 SP4, XP SP 1
S45:128:1:48:M*,N,N,S:   Windows:XP:SP1:Windows 2000 SP4, XP SP 1
40320:128:1:48:M*,N,N,S:  Windows:2000:SP4:Windows 2000 SP4

S6:128:1:48:M*,N,N,S:   Windows:2000:SP2:Windows XP, 2000 SP2+
S6:128:1:48:M*,N,N,S:   Windows:XP::Windows XP, 2000 SP2+
S12:128:1:48:M*,N,N,S:   Windows:XP:SP1:Windows XP SP1
S44:128:1:48:M*,N,N,S:   Windows:2000:SP3:Windows Pro SP1, 2000 SP3
S44:128:1:48:M*,N,N,S:   Windows:XP:SP1:Windows Pro SP1, 2000 SP3
64512:128:1:48:M*,N,N,S:  Windows:2000:SP3:Windows SP1, 2000 SP3
64512:128:1:48:M*,N,N,S:  Windows:XP:SP1:Windows SP1, 2000 SP3
32767:128:1:48:M*,N,N,S:  Windows:2000:SP4:Windows SP1, 2000 SP4
32767:128:1:48:M*,N,N,S:  Windows:XP:SP1:Windows SP1, 2000
 SP4

8192:128:1:52:M*,N,W2,N,N,S:  Windows:Vista::Windows Vista/7

# Odds, ends, mods:

S52:128:1:48:M1260,N,N,S:  Windows:2000:cisco:Windows XP/2000 via Cisco
S52:128:1:48:M1260,N,N,S:  Windows:XP:cisco:Windows XP/2000 via Cisco
65520:128:1:48:M*,N,N,S:  Windows:XP::Windows XP bare-bone
16384:128:1:52:M536,N,W0,N,N,S:  Windows:2000:ZoneAlarm:Windows 2000 w/ZoneAlarm?
2048:255:0:40:.:   Windows:.NET::Windows .NET Enterprise Server

44620:64:0:48:M*,N,N,S:   Windows:ME::Windows ME no SP (?)
S6:255:1:48:M536,N,N,S:   Windows:95:winsock2:Windows 95 winsock 2
32768:32:1:52:M1460,N,W0,N,N,S:  Windows:2003:AS:Windows 2003 AS



# No need to be more specific, it passes:
# *:128:1:48:M*,N,N,S:U:-Windows:XP/2000 while downloading (leak!) XXX quirk
# there is an equiv similar generic sig w/o the quirk

# ----------------- HP/UX --------------------

32768:64:1:44:M*:   HP-UX:B.10.20::HP-UX B.10.20
32768:64:0:48:M*,W0,N:   HP-UX:11.0::HP-UX 11.0
32768:64:1:48:M*,W0,N:   HP-UX:11.10::HP-UX 11.0
 or 11.11
32768:64:1:48:M*,W0,N:   HP-UX:11.11::HP-UX 11.0 or 11.11
```

```
# Whoa. Hardcore WSS.
0:64:0:48:M*,W0,N:   HP-UX:B.11.00:A:HP-UX B.11.00 A (RFC1323)

# ----------------- RiscOS ------------------

# We don't yet support the ?12 TCP option
#16384:64:1:68:M1460,N,W0,N,N,T,N,N,?12: RISCOS:3.70-4.36::RISC OS 3.70-4.36
12288:32:0:44:M536:    RISC OS:3.70:4.10:RISC OS 3.70 inet 4.10

# XXX quirk
# 4096:64:1:56:M1460,N,N,T:T:   RISC OS:3.70:freenet:RISC OS 3.70 freenet 2.00



# ----------------- BSD/OS ------------------

# Once again, power of two WSS is also shared by MacOS X with DF set
8192:64:1:60:M1460,N,W0,N,N,T:  BSD/OS:3.1::BSD/OS 3.1-4.3 (or MacOS X 10.2 w/DF)
8192:64:1:60:M1460,N,W0,N,N,T:  BSD/OS:4.0-4.3::BSD/OS 3.1-4.3 (or MacOS X 10.2)



# ---------------- NewtonOS ------------------

4096:64:0:44:M1420:  NewtonOS:2.1::NewtonOS 2.1

# ---------------- NeXTSTEP ------------------

S4:64:0:44:M1024:  NeXTSTEP:3.3::NeXTSTEP 3.3
S8:64:0:44:M512:  NeXTSTEP:3.3::NeXTSTEP 3.3

# ------------------
 BeOS --------------------

1024:255:0:48:M*,N,W0:  BeOS:5.0-5.1::BeOS 5.0-5.1
12288:255:0:44:M1402:  BeOS:5.0::BeOS 5.0.x

# ------------------ OS/400 -----------------

8192:64:1:60:M1440,N,W0,N,N,T: OS/400:VR4::OS/400 VR4/R5
8192:64:1:60:M1440,N,W0,N,N,T: OS/400:VR5::OS/400 VR4/R5
4096:64:1:60:M1440,N,W0,N,N,T: OS/400:V4R5:CF67032:OS/400 V4R5 + CF67032

# XXX quirk
# 28672:64:0:44:M1460:A:OS/390:?

# ------------------ ULTRIX -----------------

16384:64:0:40:.:  ULTRIX:4.5::ULTRIX 4.5
```

```
# ------------------- QNX --------------------

S16:64:0:44:M512:  QNX:::QNX demodisk

# ------------------ Novell -----------------

16384:128:1:44:M1460:  Novell:NetWare:5.0:Novel Netware 5.0
6144:128:1:44:M1460:  Novell:IntranetWare:4.11:Novell IntranetWare 4.11
6144:128:1:44:M1368:  Novell:BorderManager::Novell BorderManager ?

6144:128:1:52:M*,W0,N,S,N,N: Novell:Netware:6:Novell Netware 6 SP3


# ----------------- SCO ------------------
S3:64:1:60:M1460,N,W0,N,N,T: SCO:UnixWare:7.1:SCO
 UnixWare 7.1
S17:64:1:60:M1380,N,W0,N,N,T: SCO:UnixWare:7.1:SCO UnixWare 7.1.3 MP3
S23:64:1:44:M1380:  SCO:OpenServer:5.0:SCO OpenServer 5.0

# ------------------- DOS --------------------

2048:255:0:44:M536:  DOS:WATTCP:1.05:DOS Arachne via WATTCP/1.05
T2:255:0:44:M984:  DOS:WATTCP:1.05Arachne:Arachne via WATTCP/1.05 (eepro)

# ------------------ OS/2 -------------------

S56:64:0:44:M512:  OS/2:4::OS/2 4
28672:64:0:44:M1460:  OS/2:4::OS/2 Warp 4.0

# ----------------- TOPS-20 -----------------

# Another hardcore MSS, one of the ACK leakers hunted down.
# XXX QUIRK 0:64:0:44:M1460:A:TOPS-20:version 7
0:64:0:44:M1460:  TOPS-20:7::TOPS-20 version 7

# ----------------- FreeMiNT ----------------

S44:255:0:44:M536:  FreeMiNT:1:16A:FreeMiNT 1 patch 16A (Atari)

# ------------------ AMIGA ------------------

# XXX TCP option 12
# S32:64:1:56:M*,N,N,S,N,N,?12:.:AMIGA:3.9 BB2 with Miami stack

# ------------------ Plan9 ------------------

65535:255:0:48:M1460,W0,N: Plan9:4::Plan9 edition
```

```
# ----------------- AMIGAOS -----------------

16384:64:1:48:M1560,N,N,S: AMIGAOS:3.9::AMIGAOS 3.9 BB2 MiamiDX

##########################################
# Appliance / embedded / other signatures #
##########################################

# ---------- Firewalls / routers ------------

S12:64:1:44:M1460:   @Checkpoint:::Checkpoint (unknown 1)
S12:64:1:48:N,N,S,M1460:  @Checkpoint:::Checkpoint (unknown 2)
4096:32:0:44:M1460:   ExtremeWare:4.x::ExtremeWare 4.x

# XXX TCP option 12
# S32:64:0:68:M512,N,W0,N,N,T,N,N,?12:.:Nokia:IPSO w/Checkpoint NG FP3
# S16:64:0:68:M1024,N,W0,N,N,T,N,N,?12:.:Nokia:IPSO 3.7 build 026

S4:64:1:60:W0,N,S,T,M1460:  FortiNet:FortiGate:50:FortiNet FortiGate 50

8192:64:1:44:M1460:   Eagle:::Eagle Secure Gateway

S52:128:1:48:M1260,N,N,N,N:  LinkSys:WRV54G::LinkSys WRV54G VPN router



# ------- Switches and other stuff ----------

4128:255:0:44:M*:   Cisco:::Cisco Catalyst 3500, 7500 etc
S8:255:0:44:M*:    Cisco:12008::Cisco 12008
60352:128:1:64:M1460,N,W2,N,N,T,N,N,S: Alteon:ACEswitch::Alteon
 ACEswitch
64512:128:1:44:M1370:   Nortel:Contivity Client::Nortel Conectivity Client


# ---------- Caches and whatnots ------------

S4:64:1:52:M1460,N,N,S,N,W0:  AOL:web cache::AOL web cache

32850:64:1:64:N,W1,N,N,T,N,N,S,M*: NetApp:5.x::NetApp Data OnTap 5.x
16384:64:1:64:M1460,N,N,S,N,W0,N: NetApp:5.3:1:NetApp 5.3.1
65535:64:0:64:M1460,N,N,S,N,W*,N,N,T: NetApp:5.3-5.5::NetApp 5.3-5.5
65535:64:0:60:M1460,N,W0,N,N,T:  NetApp:CacheFlow::NetApp CacheFlow
8192:64:1:64:M1460,N,N,S,N,W0,N,N,T: NetApp:5.2:1:NetApp NetCache 5.2.1
20480:64:1:64:M1460,N,N,S,N,W0,N,N,T: NetApp:4.1::NetApp NetCache4.1
```

65535:64:0:60:M1460,N,W0,N,N,T: CacheFlow:4.1::CacheFlow CacheOS 4.1
8192:64:0:60:M1380,N,N,N,N,N,N,T: CacheFlow:1.1::CacheFlow CacheOS 1.1

S4:64:0:48:M1460,N,N,S: Cisco:Content Engine::Cisco Content Engine

27085:128:0:40:.:   Dell:PowerApp cache::Dell PowerApp (Linux-based)

65535:255:1:48:N,W1,M1460: Inktomi:crawler::Inktomi crawler
S1:255:1:60:M1460,S,T,N,W0: LookSmart:ZyBorg::LookSmart
 ZyBorg

16384:255:0:40:.:   Proxyblocker:::Proxyblocker (what's this?)

65535:255:0:48:M*,N,N,S: Redline:::Redline T|X 2200

32696:128:0:40:M1460:   Spirent:Avalanche::Spirent Web Avalanche HTTP benchmarking engine

---------- Embedded systems ----------

S9:255:0:44:M536:   PalmOS:Tungsten:C:PalmOS Tungsten C
S5:255:0:44:M536:   PalmOS:3::PalmOS 3/4
S5:255:0:44:M536:   PalmOS:4::PalmOS 3/4
S4:255:0:44:M536:   PalmOS:3:5:PalmOS 3.5
2948:255:0:44:M536:   PalmOS:3:5:PalmOS 3.5.3 (Handera)
S29:255:0:44:M536:   PalmOS:5::PalmOS 5.0
16384:255:0:44:M1398:   PalmOS:5.2:Clie:PalmOS 5.2 (Clie)
S14:255:0:44:M1350:   PalmOS:5.2:Treo:PalmOS 5.2.1 (Treo)

S23:64:1:64:N,W1,N,N,T,N,N,S,M1460: SymbianOS:7::SymbianOS 7

8192:255:0:44:M1460:   SymbianOS:6048::Symbian OS 6048 (Nokia 7650?)
8192:255:0:44:M536:   SymbianOS:9210::Symbian OS (Nokia 9210?)
S22:64:1:56:M1460,T,S: SymbianOS:P800::Symbian OS ? (SE P800?)
S36:64:1:56:M1360,T,S: SymbianOS:6600::Symbian
 OS 60xx (Nokia 6600?)

Perhaps S4?
5840:64:1:60:M1452,S,T,N,W1: Zaurus:3.10::Zaurus 3.10

32768:128:1:64:M1460,N,W0,N,N,T0,N,N,S: PocketPC:2002::PocketPC 2002

S1:255:0:44:M346:   Contiki:1.1:rc0:Contiki 1.1-rc0

4096:128:0:44:M1460:   Sega:Dreamcast:3.0:Sega Dreamcast Dreamkey 3.0
T5:64:0:44:M536:   Sega:Dreamcast:HKT-3020:Sega Dreamcast HKT-3020 (browser disc 51027)
S22:64:1:44:M1460:   Sony:PS2::Sony Playstation 2 (SOCOM?)

```
S12:64:0:44:M1452:   AXIS:5600:v5.64:AXIS Printer Server 5600 v5.64

3100:32:1:44:M1460:   Windows:CE:2.0:Windows CE 2.0

####################
# Fancy signatures #
####################

1024:64:0:40:.:    *NMAP:syn scan:1:NMAP syn scan (1)
2048:64:0:40:.:    *NMAP:syn scan:2:NMAP syn scan (2)
3072:64:0:40:.:    *NMAP:syn scan:3:NMAP syn scan (3)
4096:64:0:40:.:    *NMAP:syn scan:4:NMAP syn scan (4)

# Requires quirks support
# 1024:64:0:40:.:A:*NMAP:TCP sweep probe (1)
# 2048:64:0:40:.:A:*NMAP:TCP sweep probe (2)
# 3072:64:0:40:.:A:*NMAP:TCP sweep
 probe (3)
# 4096:64:0:40:.:A:*NMAP:TCP sweep probe (4)

1024:64:0:60:W10,N,M265,T:  *NMAP:OS:1:NMAP OS detection probe (1)
2048:64:0:60:W10,N,M265,T:  *NMAP:OS:2:NMAP OS detection probe (2)
3072:64:0:60:W10,N,M265,T:  *NMAP:OS:3:NMAP OS detection probe (3)
4096:64:0:60:W10,N,M265,T:  *NMAP:OS:4:NMAP OS detection probe (4)

32767:64:0:40:.:   *NAST:::NASTsyn scan

# Requires quirks support
# 12345:255:0:40:.:A:-p0f:sendsyn utility


#####################################
# Generic signatures - just in case #
#####################################

#*:64:1:60:M*,N,W*,N,N,T:  @FreeBSD:4.0-4.9::FreeBSD 4.x/5.x
#*:64:1:60:M*,N,W*,N,N,T:  @FreeBSD:5.0-5.1::FreeBSD 4.x/5.x

*:128:1:52:M*,N,W0,N,N,S:  @Windows:XP:RFC1323:Windows XP/2000 (RFC1323 no tstamp)
*:128:1:52:M*,N,W0,N,N,S:  @Windows:2000:RFC1323:Windows XP/2000 (RFC1323 no tstamp)
*:128:1:52:M*,N,W*,N,N,S:  @Windows:XP:RFC1323:Windows XP/2000 (RFC1323 no tstamp)
*:128:1:52:M*,N,W*,N,N,S:  @Windows:2000:RFC1323:Windows XP/2000 (RFC1323
 no tstamp)
*:128:1:64:M*,N,W0,N,N,T0,N,N,S: @Windows:XP:RFC1323:Windows XP/2000 (RFC1323)
*:128:1:64:M*,N,W0,N,N,T0,N,N,S: @Windows:2000:RFC1323:Windows XP/2000 (RFC1323)
*:128:1:64:M*,N,W*,N,N,T0,N,N,S: @Windows:XP:RFC1323:Windows XP (RFC1323, w+)
*:128:1:48:M536,N,N,S:   @Windows:98::Windows 98
*:128:1:48:M*,N,N,S:   @Windows:XP::Windows XP/2000
```

:128:1:48:M,N,N,S: @Windows:2000::Windows XP/2000

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1.136 apr-util 1.6.3

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 misc/unix/getopt.c,
file_io/unix/mktemp.c, strings/apr_strings.c:

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From strings/apr_strnatcmp.c, include/apr_strings.h:

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1.137 zlib 1.2.13

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John R. Hauser
2017 February 10

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creates an executable that is a derivative of the Library (because it
contains portions of the Library), rather than a "work that uses the
library". The executable is therefore covered by this
License.
Section 6 states terms for distribution of such executables.

When a "work that uses the Library" uses material from a header file
that is part of the Library, the object code for the work may be a
derivative work of the Library even though the source code is not.
Whether this is true is especially significant if the work can be
linked without the Library, or if the work is itself a library. The
threshold for this to be true is not precisely defined by law.

If such an object file uses only numerical parameters, data
structure layouts and accessors, and small macros and small inline
functions (ten lines or less in length), then the use of the object
file is unrestricted, regardless of whether it is legally a derivative
work. (Executables containing this object code plus portions of the
Library will still fall under Section 6.)

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distribute the object code for the work under the terms of Section 6.
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containing that work also fall under Section 6,
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6. As an exception to the Sections above, you may also combine or
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(For example, a function in a library to compute square roots has a purpose that is entirely well-defined independent of the application. Therefore, Subsection 2d requires that any application-supplied function or table used by this function must be optional: if the application does not supply it, the square root function must still compute square roots.)

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If such an object file uses only numerical parameters, data structure layouts and accessors, and small macros and small inline functions (ten lines or less in length), then the use of the object file is unrestricted, regardless of whether it is legally a derivative work. (Executables containing this object code plus portions of the Library will still fall under Section 6.)

Otherwise, if the work is a derivative of the Library, you may distribute the object code for the work under the terms of Section 6. Any
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(For example, a function in a library to compute square roots has a purpose that is entirely well-defined independent of the application. Therefore, Subsection 2d requires that any application-supplied function or table used by this function must be optional: if the application does not supply it, the square root function must still compute square roots.)

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b) Use a suitable shared library mechanism for linking with the Library. A suitable mechanism is one that (1) uses at run time a copy of the library already present on the user's computer system, rather than copying library functions into the executable, and (2) will operate properly with a modified version of the library, if the user
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procfs provides functions to retrieve system, kernel and process
metrics from the pseudo-filesystem proc.

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Protocol Buffers for Go with Gadgets

Go support for Protocol Buffers - Google's data interchange format

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1.143 luafilesystem 1.5.0

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LuaFileSystem - File System Library for Lua
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Description

LuaFileSystem is a Lua library developed to complement the set of functions
related to file systems offered by the standard Lua distribution.

LuaFileSystem offers a portable way to access the underlying directory structure and file attributes.
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LuaRocks Installation
----
luarocks install luafilesystem

Documentation

Please check the documentation at doc/us/ for more information.

History

Version 1.5.0 [20/Oct/2009]
* added explicit next and close methods to second return value of lfs.dir (the directory object), for explicit iteration or explicit closing.

* added directory locking via lfs.lock_dir function (see the manual).

Version 1.4.2 [03/Feb/2009]

* fixed bug [#13198] lfs.attributes(filename, 'size') overflow on files > 2 Gb again (bug report and patch by KUBO Takehiro).
* fixed bug [#39794] Compile error on Solaris 10 (bug report and patch by Aaron B).
* fixed compilation problems with Borland C.

Version 1.4.1 [07/May/2008]

* documentation review
* fixed Windows compilation issues
* fixed bug in the Windows tests (patch by Shmuel Zeigerman)
* fixed bug [#2185] lfs.attributes(filename, 'size') overflow on files > 2 Gb

Version 1.4.0 [13/Feb/2008]

* added function lfs.setmode (works only in Windows systems).
* lfs.attributes raises an error if attribute does not exist

Version 1.3.0 [26/Oct/2007]

* added function lfs.symlinkattributes (works only in non Windows systems).

Version 1.2.1 [08/May/2007]

* compatible only with Lua 5.1 (Lua 5.0 support was dropped)

Version 1.2 [15/Mar/2006]

* added optional argument to lfs.attributes
* added function lfs.rmdir
* bug correction on lfs.dir

Version 1.1 [30/May/2005]

* added function lfs.touch.

Version 1.0 [21/Jan/2005]
Version 1.0 Beta [10/Nov/2004]

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1.144 luaposix 5.1.28

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1.145 luuid 1.0

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 http://e2fsprogs.sourceforge.net/
If you're running Linux, libuuid is probably already installed.

To try the library, just edit Makefile to reflect your installation of Lua and
possibily of libuuid. Then run make. This will build the library and run a
simple test. For detailed installation instructions, see
http://www.tecgraf.puc-rio.br/~lhf/ftp/lua/install.html

There is no manual but the library is simple and intuitive; see the summary
below. Read also test.lua, which shows the library in action.

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---

uuid library:
isvalid(s) new([s]) time(s) version

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Found in path(s):
* /tp-luuid-1-051b6bb2c564-zip/CMakeLists.txt
* /tp-luuid-1-051b6bb2c564-zip/cmake/lua.cmake
* /tp-luuid-1-051b6bb2c564-zip/cmake/dist.cmake
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--- This dist file is part of LuaDist project
-- status:

name="luuid"
version="5.1.0.20101118"

desc = "A library for UUID generation"

author = "Luiz Henrique de Figueiredo"
url = "http://www.tecgraf.puc-rio.br/~lhf/ftp/lua/#luuid"
license = "Public domain"
maintainer = "Peter Kapec"

dependencies = {
"lua ~> 5.1",
Linux = {

```
  "uuid-dev >- 2.16"
 }
}
```

Found in path(s):
* /tp-luuid-1-051b6bb2c564-zip/dist.info
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```
/*
* luuid.c
* uuid interface for Lua 5.1
* Luiz Henrique de Figueiredo <lhf@tecgraf.puc-rio.br>
* 18 Nov 2010 19:16:20
* This code is hereby placed in the public domain.
*/
```

Found in path(s):
* /tp-luuid-1-051b6bb2c564-zip/luuid.c
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```
/*
* wuuid.h
*
* Emulation of libuuid.so API functions based on the native Windows
* API. Only those functions actually used by luuid are provided.
* Extending this work to a complete emulation of libuuid would be
* possible, but of unknown value.
*
* Implemented by Ross Berteig <Ross@cheshireeng.com>
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*/
```

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* /tp-luuid-1-051b6bb2c564-zip/wuuid.h
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```
#  BSD license.
```

Found in path(s):
* /tp-luuid-1-051b6bb2c564-zip/cmake/FindUUID.cmake
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```
/*
* wuuid.c
*
* Emulation of libuuid.so API functions based on the native Windows
* API. Only those functions actually used by luuid are provided.
```

* Extending this work to a complete emulation of libuuid would be
* possible, but of unknown value.
*
* Implemented by Ross Berteig <Ross@cheshireeng.com>
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1.146 isof 4.85

1.146.1 Available under license :

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* /lsof-4-85-zip/dialects/darwin/libproc/dstore.c
* /lsof-4-85-zip/dialects/darwin/libproc/dproto.h
* /lsof-4-85-zip/dialects/darwin/libproc/machine.h
* /lsof-4-85-zip/dialects/darwin/libproc/dsock.c
* /lsof-4-85-zip/dialects/darwin/libproc/dmnt.c
* /lsof-4-85-zip/dialects/darwin/libproc/ddev.c
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* /lsof-4-85-zip/dialects/uw/uw7/sys/fs/namenode.h
* /lsof-4-85-zip/dialects/uw/uw7/sys/fs/fifonode.h
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* @(#)netdb.h 5.15 (Berkeley) 4/3/91
*/

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* /lsof-4-85-zip/scripts/list_NULf.perl5
* /lsof-4-85-zip/scripts/shared.perl5
* /lsof-4-85-zip/scripts/list_fields.perl
* /lsof-4-85-zip/scripts/idrlogin.perl
* /lsof-4-85-zip/scripts/list_fields.awk
* /lsof-4-85-zip/scripts/idrlogin.perl5
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* /lsof-4-85-zip/tests/LTlock.c
* /lsof-4-85-zip/tests/LTnlink.c
* /lsof-4-85-zip/tests/LTbigf.c
* /lsof-4-85-zip/tests/LTszoff.c
* /lsof-4-85-zip/tests/LTsock.c
* /lsof-4-85-zip/tests/LTunix.c
* /lsof-4-85-zip/tests/LTnfs.c
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*/
/*
* GetOpt() -- Local get option
*
* Liberally adapted from the public domain AT&T getopt() source,
* distributed at the 1985 UNIFORM conference in Dallas
*
* The modifications allow `?' to be an option character and allow
* the caller to decide that an option that may be followed by a
* value doesn't have one -- e.g., has a default instead.
*/
```

Found in path(s):
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* /lsof-4-85-zip/dialects/aix/dnode1.c
* /lsof-4-85-zip/dialects/uw/dlsof.h
* /lsof-4-85-zip/dialects/uw/dnode2.c
* /lsof-4-85-zip/dialects/uw/dproc.c
* /lsof-4-85-zip/dialects/uw/dstore.c
* /lsof-4-85-zip/dialects/uw/dfile.c
* /lsof-4-85-zip/dialects/uw/dproto.h
* /lsof-4-85-zip/dialects/uw/machine.h
* /lsof-4-85-zip/dialects/n+os/dnode1.c
* /lsof-4-85-zip/dialects/uw/dnode1.c
* /lsof-4-85-zip/dialects/sun/dnode1.c
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* /lsof-4-85-zip/dialects/freebsd/dnode1.c
* /lsof-4-85-zip/dialects/osr/dproc.c
* /lsof-4-85-zip/dialects/n+obsd/dnode1.c
* /lsof-4-85-zip/dialects/osr/dsock.c
* /lsof-4-85-zip/dialects/darwin/kmem/dnode1.c
* /lsof-4-85-zip/dialects/osr/machine.h
* /lsof-4-85-zip/dialects/osr/dlsof.h
* /lsof-4-85-zip/dialects/osr/dproto.h
* /lsof-4-85-zip/dialects/osr/dstore.c
* /lsof-4-85-zip/dialects/osr/dnode.c
* /lsof-4-85-zip/dialects/hpux/kmem/dnode1.c
* /lsof-4-85-zip/dialects/osr/dmnt.c
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* /lsof-4-85-zip/dialects/linux/dproto.h
* /lsof-4-85-zip/lib/ptti.c
* /lsof-4-85-zip/lib/dvch.c
* /lsof-4-85-zip/dialects/linux/dnode.c
* /lsof-4-85-zip/lib/rnch.c
* /lsof-4-85-zip/dialects/linux/dstore.c
* /lsof-4-85-zip/dialects/linux/dfile.c
* /lsof-4-85-zip/dialects/linux/dsock.c
* /lsof-4-85-zip/lib/rmnt.c
* /lsof-4-85-zip/lib/pdvn.c
* /lsof-4-85-zip/dialects/linux/machine.h
* /lsof-4-85-zip/lib/rdev.c
* /lsof-4-85-zip/lib/isfn.c
* /lsof-4-85-zip/lib/prfp.c
* /lsof-4-85-zip/lib/fino.c
* /lsof-4-85-zip/lib/cvfs.c
* /lsof-4-85-zip/lib/rnmh.c
* /lsof-4-85-zip/dialects/sun/dnode2.c
* /lsof-4-85-zip/lib/rnam.c
* /lsof-4-85-zip/lib/lkud.c
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* /lsof-4-85-zip/dialects/aix/dmnt.c
* /lsof-4-85-zip/dialects/sun/dfile.c
* /lsof-4-85-zip/dialects/sun/dmnt.c
* /lsof-4-85-zip/dialects/hpux/kmem/dstore.c
* /lsof-4-85-zip/dialects/aix/dlsof.h
* /lsof-4-85-zip/store.c
* /lsof-4-85-zip/dialects/sun/dproc.c
* /lsof-4-85-zip/dialects/du/dproto.h
* /lsof-4-85-zip/dialects/darwin/kmem/ddev.c
* /lsof-4-85-zip/dialects/n+os/dnode.c
* /lsof-4-85-zip/dialects/n+obsd/dlsof.h
* /lsof-4-85-zip/dialects/du/dlsof.h
* /lsof-4-85-zip/dialects/aix/dfile.c
* /lsof-4-85-zip/dialects/freebsd/dproc.c
* /lsof-4-85-zip/dialects/n+obsd/dstore.c
* /lsof-4-85-zip/dialects/n+os/dlsof.h
* /lsof-4-85-zip/dialects/aix/dnode.c
* /lsof-4-85-zip/dialects/du/dsock.c
* /lsof-4-85-zip/misc.c
* /lsof-4-85-zip/proc.c
* /lsof-4-85-zip/dialects/sun/machine.h
* /lsof-4-85-zip/dialects/darwin/kmem/dsock.c
*
 /lsof-4-85-zip/dialects/du/dproc.c
* /lsof-4-85-zip/dialects/darwin/kmem/machine.h
* /lsof-4-85-zip/dialects/darwin/kmem/dmnt.c
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* /lsof-4-85-zip/dialects/hpux/kmem/dfile.c
* /lsof-4-85-zip/dialects/du/dnode.c
* /lsof-4-85-zip/dialects/hpux/kmem/machine.h
* /lsof-4-85-zip/dialects/freebsd/dmnt.c
* /lsof-4-85-zip/dialects/aix/dsock.c
* /lsof-4-85-zip/lsof_fields.h
* /lsof-4-85-zip/dialects/aix/ddev.c
* /lsof-4-85-zip/dialects/aix/dstore.c
* /lsof-4-85-zip/arg.c
* /lsof-4-85-zip/dialects/hpux/kmem/dproc.c

* /lsof-4-85-zip/dialects/n+os/dstore.c
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* /lsof-4-85-zip/dialects/hpux/kmem/dmnt.c
* /lsof-4-85-zip/dialects/n+os/machine.h
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* /lsof-4-85-zip/dialects/n+os/dsock.c
* /lsof-4-85-zip/dialects/darwin/kmem/dnode.c
* /lsof-4-85-zip/dialects/n+obsd/machine.h
* /lsof-4-85-zip/dialects/n+os/dproto.h
* /lsof-4-85-zip/dialects/aix/machine.h
*
 /lsof-4-85-zip/dialects/freebsd/machine.h
* /lsof-4-85-zip/dialects/du/dstore.c
* /lsof-4-85-zip/dialects/n+obsd/dmnt.c
* /lsof-4-85-zip/node.c
* /lsof-4-85-zip/dialects/hpux/kmem/dlsof.h
* /lsof-4-85-zip/dialects/darwin/kmem/dlsof.h
* /lsof-4-85-zip/dialects/sun/ddev.c
* /lsof-4-85-zip/dialects/freebsd/dnode.c
* /lsof-4-85-zip/dialects/du/dmnt.c
* /lsof-4-85-zip/dialects/sun/dstore.c
* /lsof-4-85-zip/dialects/aix/dproto.h
* /lsof-4-85-zip/dialects/n+obsd/dnode.c
* /lsof-4-85-zip/dialects/sun/dsock.c
* /lsof-4-85-zip/dialects/freebsd/dsock.c
* /lsof-4-85-zip/dialects/freebsd/dstore.c
* /lsof-4-85-zip/dialects/du/machine.h
* /lsof-4-85-zip/dialects/n+os/dproc.c
* /lsof-4-85-zip/dialects/hpux/kmem/dnode.c
* /lsof-4-85-zip/dialects/darwin/kmem/dproc.c
* /lsof-4-85-zip/dialects/du/dfile.c
* /lsof-4-85-zip/proto.h
* /lsof-4-85-zip/dialects/darwin/kmem/dproto.h
* /lsof-4-85-zip/dialects/freebsd/dproto.h
* /lsof-4-85-zip/dialects/hpux/kmem/dsock.c
* /lsof-4-85-zip/dialects/sun/dnode.c
*
 /lsof-4-85-zip/lsof.h
* /lsof-4-85-zip/dialects/hpux/kmem/dproto.h
* /lsof-4-85-zip/dialects/n+obsd/dsock.c
No license file was found, but licenses were detected in source scan.

Notes for the distribution of lsof version 4

****
| The latest release of lsof is always available via anonymous ftp |
| from lsof.itap.purdue.edu. Look in pub/tools/unix/lsof. |

****

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4.85, September 27, 2011

Dialects Supported
==========

Lsof (for LiSt
Open Files) lists files opened by processes on
selected Unix systems. Version 4 is a source reorganization of
version 3, itself a major revision of version 2. Version 4 has
been tested on:

AIX 5.3
Apple Darwin 9 and Mac OS X 10.[56]
FreeBSD 4.9 and 6.4 for x86-based systems
FreeBSD 8.[02] and 9.0 for AMD64-based systems
Linux 2.1.72 and above for x86-based systems
Solaris 9, 10 and 11

(The pub/tools/unix/lsof/contrib directory on lsof.itap.purdue.edu
contains information on other ports.)

If your favorite Unix dialect is not in the list, or if your version
of it is more recent than the ones listed, please contact me at
<abe@purdue.edu>.

Version 3 of lsof was tested on:

AIX 3.2.5, 4.1[.[1234]], and 4.2
BSDI BSD/OS 2.0, 2.0.1, and 2.1 for x86-based systems
DC/OSx 1.1 for Pyramid systems
Digital UNIX (DEC OSF/1) 2.0, 3.0, 3.2, and 4.0
EP/IX 2.1.1 for the CDC 4680

FreeBSD 1.1.5.1, 2.0, 2.0.5, 2.1, 2.1.5 for x86-based
systems
HP-UX 8.x, 9.x, 10.01, 10.10, and 10.20
IRIX
5.2, 5.3, 6.0, 6.0.1, and 6.[124]
Linux through 2.0.27 for x86-based systems
NetBSD 1.0, 1.1, and 1.2 for x86 and SPARC-based
systems
NEXTSTEP 2.1 and 3.[0123]
OpenBSD 1.2 and 2.0 for x86-based systems
Reliant UNIX 5.43 for Pyramid systems
RISC/os 4.52 for MIPS R2000-based systems
SCO OpenServer Release 1.1, 3.0, and 5.0.x for x86-based
systems
SCO UnixWare 2.1 and 2.1.1 for x86-based systems
Sequent PTX 2.1.[1569], 4.0.[23], 4.1.[024], 4.2[.1],
and 4.3
Solaris 2.[12345], 2.5.1, and 2.6-Beta
SunOS 4.1.x
Ultrix 4.2, 4.3, 4.4, and 4.5

Version 3 and its predecessor, version 2, may be found at:

ftp://lsof.itap.purdue.edu/pub/tools/unix/lsof/OLD

How Lsof Works
==============

Using available kernel data access methods -- getproc(), getuser(),
kvm_*(), nlist(), pstat(), read(), readx(), /proc -- lsof reads
process table entries, task table entries, user areas and file
pointers to reach the underlying structures that describe files
opened by processes.

Lsof interprets
most file node structures -- advfsnodes, autonodes,
cnodes, cdrnodes, devnodes, fifonodes, gnodes, hsnodes, inodes,
mfsnodes, pcnodes, procnodes, rnodes, snodes, specnodes, s5inodes,
tmpnodes. It understands NFS connections. It recognizes FIFOs,
multiplexed files, Unix and Internet sockets. It knows about
streams. It understands /proc file systems for some dialects. On
many dialects it recognizes execution text and library references.
It knows about AFS on some Unix dialects.

Lsof Output
===========

The lsof output describes:

* the identification number of the process (PID) that has opened the file;

* the process group identification number (PGID) of the process (optional);

* the process identification number of the parent process (PPID) (optional);

* the command the process is executing;

* the owner of the process;

* for all files in use by the process, including the executing text file and the shared libraries it is using:

  * the file descriptor number of the file, if applicable;

  * the file's access mode;

  * the file's lock status;

  * the file's device numbers;

  * the file's inode number;

  * the file's size or offset;

  * the name of the file system containing the file;

  * any available components of the file's path name;

  * the names of the file's stream components;

  * the file's local and remote network addresses;

  * the TLI network (typically UDP) state of the file;

  * the TCP state, read queue length, and write queue length of the file;

  * the file's TCP window read and write lengths (Solaris only);

  * other file or dialect-specific values.

Getting Started Quickly
==========

If you want to get started using lsof quickly, or see some examples
of how lsof can be used, consult the 00QUICKSTART file of the lsof
distribution.

The 00QUICKSTART file won't help you build or install lsof, but it
will cut
 through the density of the lsof man page, giving you more
readily an idea of what you can do with lsof.

For information on building and installing lsof, consult the 00README
file of the lsof distribution.

Limiting, Filtering, and Selecting Lsof Output
==========

Lsof accepts options to limit, filter, and select its output.
These are the possible criteria:

* Process ID (PID) number -- to list the open files for a given
  process;

* Process Group ID (PGID) -- to list the open files for all
  the processes of a given process group;

* User ID number or login name -- to list the open files for
  all the processes of a given user;

* Internet address -- to list the open files using a given
  Internet address (host name), protocol, or port (number or
  name); or to list all open Internet files;

* command name;

* file descriptor name or number;

* list all open NFS files;

* list all open Unix domain
socket files;

* list all uses of a specific file;

* list all open files on a file system.

Selection options are normally ORed -- i.e., an open file meeting any of the criteria is listed. The selection options may be ANDed so that an open file will be listed only if it meets all the criteria.

In the absence of any selection criteria, lsof lists files open to all processes.

Parsing Lsof Output with Another Program

The lsof -F option directs it to produce "field" output that can easily be parsed by another program. The lsof distribution contains sample awk, perl 4, and perl 5 scripts in its scripts subdirectory that show how to post-process field output.

Repeat Mode

Lsof can be directed to produce output, delay for a specified time, then repeat the output, cycling until stopped by an interrupt or quit signal. This mode is useful for monitoring the status of some file operation -- e.g., an ftp transfer or a tape backup operation.

Repeat mode is more efficient when combined with lsof's selection options, since they limit lsof overhead.

It's possible to use lsof's field output options to supply repeat mode output to another process for its manipulation. The scripts subdirectory of the lsof distribution has sample Perl scripts showing how to consume lsof repeat mode output from a pipe.

Distribution Restrictions

Lsof may be used and distributed freely, subject to these limitations:

1. Neither the author nor Purdue University is responsible for any consequences of the use of this software.

2. The origin of this software must not be misrepresented, either by explicit claim or by omission. Credit to the author and

Purdue University must appear in documentation and sources.

3. Altered versions must be plainly marked as such, and must not
be misrepresented as being the original software.

4. This notice may not be removed from or altered in the lsof source
files.

Cautions
========

Lsof is a tool that is closely tied to the Unix operating system
version. It uses header files that describe kernel structures and
reads kernel structures that typically change from OS version to
OS version.

DON'T TRY TO USE AN LSOF BINARY, COMPILED FOR ONE UNIX OS VERSION,
ON ANOTHER.

On some Unix dialects, notably SunOS and Solaris, lsof versions
may be even more restricted by architecture type. An lsof binary,
compiled for SunOS 4.1.3 on a sun4c machine, for example, won't
work on a sun4m machine.

AN LSOF BINARY, COMPILED FOR ONE SOLARIS 1.X ARCHITECTURE, ISN'T
GUARANTEED TO WORK ON A DIFFERENT SOLARIS 1.X ARCHITECTURE.

Distribution Contents
=====================

The lsof distribution is checked for completeness when it is
constructed and by the Inventory script when you run the Configure
script. (See The Inventory Script section of the 00README file of
this distribution.)

Lsof is organized in these parts:

* The main lsof directory,
containing common sources,
configuration and setup scripts and three subdirectories:
dialects/, lib/, and scripts/.

Lsof is compiled in the main lsof directory after configuration.
The selected dialect sources are copied or linked from the
specified subdirectory. (Symbolic linking is the standard
method.)

Common lsof definitions may be found in lsof.h; common function prototypes, proto.h; and common storage, store.c.

* The dialects/ subdirectory contains subdirectories with sources specific to UNIX dialect implementations -- e.g., the dialects/sun/ subdirectory contains sources for the SunOS (Solaris 1.x) and Solaris (2.x) implementations of lsof. The dialects subdirectories also contain Makefiles and scripts for assisting dialect source configuration.

  Dialect configuration definitions may be found in dlsof.h; other dialect definitions, dlsof.h; dialect prototypes,

dproto.h; and dialect storage, dstore.c.

* The lib/ subdirectory contains sources for common lsof functions. Not all dialects use the functions -- some have their own versions of them. The lib/ functions are enabled and customized with #define's in the dialect machine.h header files.

* The scripts/ subdirectory contains sample scripts for processing lsof field (-F) output. The scripts are written in AWK, Perl 4, and Perl 5.

The 00PORTING file of the lsof distribution has more information on lsof components, configuration, and construction.

Warranty
========

Lsof is provided as-is without any warranty of any kind, either expressed or implied, including, but not limited to, the implied warranties of merchantability and fitness for a particular purpose. The entire risk as to the quality and performance of lsof is with you. Should lsof prove defective, you assume the cost of all necessary servicing, repair, or correction.

Bug
Reports
==========

Now that the obligatory disclaimer is out of the way, let me hasten to add that I accept lsof bug reports and try hard to respond to them. I will also consider and discuss requests for new features,

ports to new dialects, or ports to new OS versions.

PLEASE DON'T SEND A BUG REPORT ABOUT LSOF TO THE UNIX DIALECT VENDOR.

At worst such a bug report will confuse the vendor; at best, the vendor will forward the bug report to me.

Please send all bug reports, requests, etc. to me via email at <abe@purdue.edu>.

The lsof-l Mailing List
==========

Information about lsof, including notices about the availability of new revisions, may be found in mailings of the lsof-l listserv. For more information about it, including instructions on how to subscribe, read the 00LSOF-L file of the lsof distribution.

Version 3 Release Notes
==========

See 00DIST in the last lsof 3 revision 3.88, for its complete set of release notes. Lsof revision 3.88 may be found at:

ftp://lsof.itap.purdue.edu/pub/tools/unix/lsof/OLD

3.0 May 24, 1994
This is the first official release of lsof 3.

...

3.88 February 17, 1997

+=====================================+
| This is the last version 3 revision. |
+=====================================+

Added documentation files -- 00.README.FIRST[_<version>] and 00RELEASE.SUMMARY_<version> -- to the distribution.

What's new in Version 4
==========

The main goal of version 4 was to eliminate the confusing common/
fragment source file technique. Changing the version number also
provided an opportunity to restart the numbering, which at 3.88
had risen to a large value.

The sources that appeared in the dialects/common subdirectory of
version 3 in fragment files have been incorporated into the version
4 liblsof.a library as *.c files. This results in significant
changes to many source files, scripts, and Makefiles of all dialect
versions. It allows elimination of some source
 files -- ddev.c,
dfile.c, dmnt.c -- for dialects now obtaining functions from
liblsof.a that formerly came from making dialect source files by
combining fragment files.

The version 4 liblsof.a sources are stored in the lib/ subdirectory
of the main lsof directory. The liblsof.a functions are activated
and conditioned in their source files by values #define'd in the
dialect dlsof.h and machine.h header files.

Dialects that provide a private version of a library function refrain
from #define'ing the symbol that would activate the library function
code.

Version 4 Release Notes
=======================

4.0 February 24, 1997

 +====================================+
 | This is the first lsof 4 revision. |
 +====================================+

 Reorganized sources: eliminated code fragment files
 and created a library in their place. Modified or
 deleted many dialect source and header files.
 Changed documentation accordingly.

 Added a warning to sgi/Makefile and 00FAQ that
advises
 against using the IRIX C compiler -n32 option when
 compiling lsof. Thanks go to Peter Ilieve
 <peter@memex.co.uk> for bringing this to my attention.

 Dropped IRIX 5.2 in mid-stream, because my 5.2 test
 system was upgraded to 5.3.

4.01 March 3, 1997
Added TFS support for Pyramid dialects.

Added test to Configure and to the IRIX dnode.c
for the different cnode struct that appears in
<cachefs/cachefs_fs.h> on the 6.2 IMPACT distribution.
Heddy Boubaker <boubaker@amfou.cenatls.cena.dgac.fr>
alerted me to the cnode change and helped test this
lsof adjustment.

Shut down the lsof child process before doing a -r
sleep(). A comment from Dan Mercer <dam@mmm.com>
prompted this.

4.02 March 21, 1997

Based on a report from Pasi Kaara <Pasi.Kaara@atk.tpo.fi>,
disabled HP-UX CCIT support in lsof for HP-UX
versions 10 and above. Pasi's report also led to
changes in the HP-UX machine.h to support use of
gcc to compile lsof for HP-UX 10.20 and warnings
against
using `cc -Aa` or `gcc -ansi` to compile
lsof under HP-UX 10.x.

With help from Richard Allen <ra@hp.is> taught
HP-UX 10.x lsof to name file systems better by
using the virtual file system device number. Elias
Halldor Agustsson <elias@rhi.hi.is> provided a test
system.

Changed NEXTSTEP and UNIXWARE Makefiles to use
safer quoting when generating version.h. The change
was suggested by Bob Farmer <ucs_brf@unx1.shsu.edu>.

Added SHELL=/bin/sh string to all Makefiles.

Added support for Linux 2.1.28 on a test system,
kindly provided by Jonathan Sergent <sergent@purdue.edu>.
Configure tests the Linux 2.1.x's C library lseek()
function for proper handling of kernel offsets.
If lseek() appears suspect, Configure activates
the use of a private lseek() function. Changed
the private nlist() function to nlist_private()
and taught it to use the query_module() syscall in
place of the deprecated get_kernel_syms() one.
Added rudimentary AX.25

support for Pierfrancesco
Caci <ik5pvx@infogroup.it> who helped test it.
Updated the old get_kernel_syms() code to recognize
and skip module name entries.

Prompted by Marty Leisner <leisner@sdsp.mc.xerox.com>,
eased the requirement that service name lookup for
the -i option be accompanied by a protocol name. The
name is not needed if both TCP and UDP names yield the
same port number.

Added xusers.awk script from Dan Mercer <damercer@mmm.com>
to the distribution scripts/ subdirectory.

Changed Configure script to use LSOF_VERS for all
UNIX dialect version numbers and to pass LSOF_VERS
to the dialect Mksrc functions. Also added the
ability for a dialect stanza to declare a different
dialect Makefile source. Modified dialect Mksrc
files -- e.g., linux and sun -- accordingly.

Added support for BSD/OS 3.0 with help from Jim
Reid <jim@mpn.cp.philips.com>. Terry Kennedy
<TERRY@spcvxa.spc.edu> kindly provided a test
system. During the port corrected
a bug that
prevented proper handling of revoked files.

4.03 April 7, 1997
At the suggestion of Dan Mercer <damercer@mmm.com>,
made HP-UX building of lsof aware of differences
between the HP-UX bundled and unbundled C compilers.

Added the ability for the lsof builder to define the
default warning message issuance state. By default the
issuance of warning messages is disabled; defining
WARNINGSTATE in machine.h disables it. The Customize
script was updated to handle WARNINGSTATE. Dan Mercer
suggested this.

Eliminated compiler complaint about improperly cast
get_Nl_value() argument in ncache_load() in lib/rnch.c.

Corrected zeromem() argument error in SCO dproc.c.
Sped up parent directory cache lookup slightly.

Updated for PTX 4.4, including additional VxFS (EFS)
file system support.

4.04 April 17, 1997
At the suggestion of Bela Lubkin <belal@sco.COM>
changed device cache handling to be more tolerant
of a device cache file whose [cm]times
are older
than the ones on /dev or /devices. The change
required adding information to Solaris device cache
file clone lines, so the first time lsof 4.04 is
run under Solaris it will complain about a bad
cached clone device in a previous device cache
file, then regenerate it.

Added boot file path detection for SCO OSR 5 and
above, based on information supplied by Bela.

Fixed two bugs in DEC OSF/1 lsof -- an error in
reporting locks and a missing continue statement
in readdev() after a failure to open a directory.
Jan Ole Suhr <josuhr@informatik.tu-clausthal.de>
reported the second bug and supplied a fix.

Fixed XFS problems with IRIX 6.2 by abandoning the
idea that SGI will distribute XFS header files and
defining an lsof-private xfs_inode structure. John
Paul Morrison <John.Paul.Morrison@MultiActive.com>
helped develop and test the 5.3 definition. John
R. Vanderpool <fish@daacdev1.gsfc.nasa.gov> helped
develop and test the 6.2 definition.

Remove
obsolete comments about common/*.frag files.

Updated Linux lsof for Linux version 2.1.35.

4.04 April 18, 1997
Supplement Regenerated the 4.04 distribution to correct a non-
device-cache #define misplacement in the Solaris and
SunOS dlsof.h. Alexandre Oliva <oliva@dcc.unicamp.br>
reported the problem.

4.05 April 24, 1997
Corrected an error in 00DCACHE.

Made sure SCO /etc/ps/booted.systems is closed.

Based on an observation by Bela Lubkin <belal@sco.COM>
that the lsof child had needless file descriptors

open, closed all but the open pipes between the
lsof parent and child.

Decommissioned CDC EP/IX support; I no longer have a
test system.

Based on a suggestion from Patrick Connor
<connor@phreak.csd.sgi.com>, added -xansi to CFLAGS
for IRIX 5.3 and 6.[234].

Also at Patrick's suggestion changed Configure to
propagate exact SunOS 4.1.x version to the main
and library Makefiles. This allowed the sunos413
and sunos413cc Configure abbreviations
to be
shortened to sunos and sunoscc.

Updated obsolete argument uses (-H changed to -n)
in count_pf.perl* and watch_a_file.perl scripts.

Adjusted Solaris 2.6 lsof for Beta_Update with tips
from Casper Dik <casper@holland.Sun.COM>.

Fixed a Solaris 2.4 TCP address reporting bug.

4.06 April 30, 1997
Added a step to the Makefile clean rules that does
a make clean in the lib subdirectory; suggested by
Casper Dik <casper@holland.Sun.COM>. (Configure's
-clean argument already did this.)

Fixed an incorrect awk argument in the sunos*)
Configure stanza, reported by Alexandre Oliva
<oliva@dcc.unicamp.br>.

Added CD9660 (aka ISO) file system support to
FreeBSD, NetBSD, and OpenBSD with mods and help
from Kenneth Stailey <kstailey@disclosure.com>.
(BSDI already had CD9660 support.) While at it,
added file descriptor system support to BSDI and
FreeBSD.

Added /kern file system support to OpenBSD. The
support wasn't extended to BSDI, FreeBSD,
or NetBSD,
because it requires Kenneth Stailey's changes to
/sys/miscfs/kernfs/kernfs.h.

Updated IRIX 6.3 support after getting access to
a test system, provided by John Paul Morrison
<John.Paul.Morrison@MultiActive.com>. Improved
the handling of IRIX 5.1 and greater FIFOs.

4.07 May 12, 1997
Based on AIX problem reports from David Capshaw
<David.Capshaw@SEMATECH.Org>, changed the aix*
Configure script stanza to avoid -bnolibpath for
gcc (which the GNU loader doesn't grok) and AIX
below 4.1.4 (where -bnolibpath hasn't been tested
or is known to be unimplemented), and to refuse to
use gcc for compiling lsof in AIX versions below
4.1 (because of possible structure alignment
problems). Updated 00FAQ appropriately.

Added OpenBSD support for EXT2FS. This support
has yet to be tested.

Tested lsof under OpenBSD 2.1.

Activated /kern file system support for NetBSD when
Configure senses that /sys/miscfs/kernfs/kernfs.h
defines the kern_target
structure. This support
has not been tested under NetBSD, although it has
been tested under OpenBSD.

Made some simple changes to the BSDI machine.h,
suggested by Jeffrey C. Honig <jch@bsdi.com>.

Improved handling of alternate dialect Configure
abbreviations -- aix and aixgcc, hpux and hpuxgcc,
solaris and solariscc, and sunos and sunoscc.

4.08 May 23, 1997
Cleaned up dialect Makefile's, staring with a suggestion
from Christopher Schanzle <chris@cam.nist.gov>.

Improved Configure's -clean processing.

Corrected bugs in Solaris lock reporting.

Changed NetBSD Configure stanza to put -I/usr/include
before -I/sys.

4.09 June 1, 1997
Adjusted for latest FreeBSD 3.0 release. This

required adding a new kernel name cache module for
reading BSD-form hashed kernel name cache entries,
rnmh.c, to the lsof library, and adding a #define
to each machine.h to select it.

Activated rnmh.c for BSDI 2.1, BSDI 3.0, NetBSD
1.2, and OpenBSD 2.1.

4.10 June
8, 1997
Adjusted for Linux 2.1.x (x > 35) kernels with
hashed task structure pointers. Marty Leisner
<leisner@sdsp.mc.xerox.com> and Jonathan Sergent
<sergent@io.com> tested the adjustment.

Replaced readdev() stat() calls with lstat() to
reduce device table and cache entries with the same
device number and inode values. Added code to
remove all remaining duplicates. This fixes a
Linux problem reported by Jonathan Sergent and
makes device node name output predictable.

Corrected a bug in UnixWare stream file handling
that prevented searching for the stream file by
its associated character device name.

Added Pyramid code to determine Reliant UNIX clone
major device number differently from that of DC/OSx.

4.11 June 12, 1997
Changed Configure to sense that the PTX inp_[fl]addr
members of the inpcb structure of <netinet/in_pcb.h>
have a struct type and set HASINADDRSTR for use in
PTX dnode.c and dsock.c tests.

Changed PTX version 4.1.4 tests
to use 4.1.3 instead.
Carson Wilson <carson@mcs.com> reported the need
to do this and tested the change.

Fixed a block device table indexing bug in lib/rdev.c,
reported by Carson Wilson. The same bug was squashed
in pyramid/ddev.c.

Added code to the Pyramid Reliant UNIX kread()
function to compensate for an address boundary
error in the kernel's /dev/kmem driver.

Verified that lsof compiles and works under AIX
4.2.1. Added an AIX test for the presence of NFS
header files, defined HAS_NFS and adjusted AIX
dialect sources accordingly.

Based on a suggestion from Gaylord Holder
<holder@phy.ucsf.EDU>, added DEC OSF/1 code to
auto-detect the booted file, whence kernel symbol
addresses are obtained.

4.12 June 24, 1997
Corrected a device number sign extension problem
in the reading and writing of device cache file.
The problem was reported by Bela Lubkin <belal@sco.com>
and he suggested a fix.

Fixed an SCO stream device lookup problem. The
report
and solution came from Bela Lubkin

Enhanced the Configure script to enable cross-
configuration of lsof, based on suggestions from
Marty Leisner <leisner@sdsp.mc.xerox.com>. A new
documentation file, 00XCONFIG, describes the process.

Made Pyramid OBJFS support conditional on the
presence of supporting header files. Corrected
the Pyramid MkKernOpts script so it generates the
necessary -D's for the Nile/Jolt architecture.
Richard Coley <rcoley@pyra.co.uk> helped.

Added another IRIX xfs_inode variant for 6.2, 32
bits, no XFS rollup patch.

Tested under UnixWare 2.1.2.

4.13 July 9, 1997
Taught Pyramid lsof to grok ttyfs vnodes with help
from Richard Coley <rcoley@pyra.co.uk>. Fixed some
minor bugs in Pyramid FIFO reporting. Eliminated
use of the Pyramid UCB compatibility library at
Richard's suggestion.

Eliminated reporting of "strange" inode numbers
for SCO OSR 3.2v5.0.x HPPS files with help from
Bela Lubkin <belal@sco.com>

Modified

port to service name lookup to use a small
number of getservbyport() calls before reading the
entire map with getservent(). Changed port reporting
to represent a zero as `*' to be consistent with
other prt number reporting tools like netstat.
Casper Dik <casper@holland.Sun.COM> suggested these
changes -- the getserv*() one to improve performance
for large NIS service name maps.

Changed all readdev() functions to make the absence
of block devices a warning instead of a fatal error
after Brian Redman <ber@ms.com> reported his IRIX
6.4 system had no block devices. (It really did
have block devices, but readdev()'s lstat() use
caused it to miss them in a directory symbolically
linked from /dev/dsk->/hw/disk.) Fixed Brian's
real problem by changing the IRIX readdev() to use
stat() on /dev nodes if a Configure test shows /hw
is readable. Extended the potential to do the same
to all readdev() functions.

For consistency and convenience changed some
Configure
abbreviations and dialect subdirectory
names: "decosf" abbreviation and "osf" dialect
subdirectory name to "du"; "netbsd" dialect
subdirectory name to "n+obsd"; "next3" abbreviation
and "next" dialect subdirectory name to "ns"; "sco"
abbreviation and dialect subdirectory name to "osr";
"sgi" dialect subdirectory name to "irix"; and
"unixware" abbreviation and dialect subdirectory
name to "uw".

Added #if/#endif clauses to the AIX rmdupdev()
function to avoid clone processing for AIX versions
less than 4.1.4. The problem was reported by Toralf
Foerster <toralf.foerster@io-warnemuende.de>, who
supplied corrective code.

Added support for new style NetBSD inode with i_ffs
and i_e2fs union members.

Improved Configure and 00FAQ information on Digital
UNIX configuration subdirectory with suggestions
from Brad Krebs <brad@EECS.Berkeley.EDU>.

4.14 July 22, 1997
Reorganized the Solaris handling of the inode

structure header file, ufs_inode.h,
to eliminate
VxFS structure definition conflicts for Solaris
2.4, based on information from Greg Earle
<earle@netbsd4me.jpl.nasa.gov>.

Cleaned up some typos and confusion in Configure's
help output, based on comments from Bela Lubkin
<belal@sco.com>

Added a 00DIALECTS file, containing UNIX dialect
version numbers, that can be used by Configure and
the man page.

4.15 August 15, 1997
Aligned `Configure -help` output better. Removed
Configure's 2.6 Beta test adjustments.

Added improved Solaris VxFS configuration and
handling, based on information from Greg Earle
<earle@netbsd4me.jpl.nasa.gov>.

Added socket state -- TCO or TPI -- for socket
files at the suggestion of Ian Fitchet
<I.D.Fitchet@ftel.co.uk>.

4.16 September 25, 1997
Added reporting of TCP/TPI queue lengths and window
sizes ala netstat to NAME column. Added -T option
to select or de-select TCP/TPI info reporting.
(Window sizes are only reported for Solaris.)
Fixed anomalies
along the way in SIZE/OFF processing
for some dialects.

Fixed service name argument processor to allow
minus signs as part of the name. Consequently this
disallows names with embedded minus signs from
being specified as the start of a range.

Added 00FAQ entries explaining why lsof won't find
a file being edited with vi, why window sizes aren't
reported for all dialects, and what the "no more
information" message means.

Forced Pyramid CC to be /usr/ccs/bin/cc to avoid
accidental use of the BSD variant in /usr/ucb/cc.

Added support for Linux glibc2, including a Configure test; cross-Configure support (00XCONFIG); and much unfortunate and risky sleight-of-hand in lsof Linux dialect header and source files, forced upon lsof by incompatibilities between Linux kernel and glibc2 header files.

Included in scripts/identd.perl5 a Perl 5 implementation of an identd server, using lsof, provided by Kapil Chowksey <kchowksey@hss.hns.com>.

Updated
IRIX 6.4 xfs_inode guess.

4.17 October 14, 1997
Added -V option for verbose search result reporting. Verbose reports are prepared for failure to locate file names, command names, Internet addresses or files, login names, NFS files, PIDs, PGIDs, and UIDs.

Augmented Linux NFS file test to cope with kernels whose NFS code is in a loadable module. Need for the test was pointed out by Jonathan Sergent <sergent@csociety.ecn.purdue.edu>. The change required that Linux have private dmnt.c source,

Completed a Linux 2.1.57 port on a system provided by Jonathan Sergent.

4.18 October 25, 1997
Eliminated memory leaks in alloc_lfile(), lkup_port(), and NEXTSTEP's process_text() function.

Added recognition of OpenBSD 2.2 in Configure, supplied by Kenneth Stailey <kstailey@disclosure.com>.

Consolidated print_file() functions to use the one in lib/prtf.c. Made it configurable and changed it to size print columns dynamically.

!!! WARNING !!!

WITH
DYNAMICALLY SIZED PRINT COLUMNS LSOF 4.18
PRODUCES OUTPUT SIGNIFICANTLY DIFFERENT FROM THAT
OF PREVIOUS REVISIONS. LINES ARE GENERALLY SHORTER
AND THERE IS GENERALLY LESS BLANK SPACE BETWEEN
COLUMNS AND THE ITEMS IN THEM. THERE ARE NO LONGER

ANY SPACES BETWEEN DEVICE NUMBER ELEMENTS, ONLY
COMMAS.

!!! WARNING !!!

Added special types and print specification modifiers
for file size and offset to handle UNIX dialects
with 64 bit sizes and offsets. Paul Eggert
<eggert@twinsun.com> reported the need for this
addition.

With Paul Eggert's help picked lint from the lsof
library, the main level lsof sources, and the Sun
dialect sources.

Added documentation, including the file 00LSOF-L,
about the lsof-l LISTSERV.

Added support for Reliant UNIX on the RM600. Bob
Passarella <rmpassar@pyramid.com> supplied the
changes. Kevin Smith <kevin@pyramid.com> helped
arrange test systems. While incorporating Bob's
changes, modified lib/rnch.c to handle kernel
ncache
structs whose name is accessed via a char *, rather
than in a char array.

Changed #include order of <sys/socketvar.h> for
Solaris 2.x. W. Richard Stevens <rstevens@kohala.com>
pointed out the need to do this.

4.19 October 30, 1997
Changed Pyramid Reliant RM600 proc scan to skip
SSYS (p_flag) processes, since they don't seem to
have a readable u_cdir vnode.

Enabled Pyramid Reliant UNIX kread() work-around
for DC/OSx, too, since its read(/dev/kmem) kernel
driver seems to share the page boundary bug this
work-around circumvents.

Changed SzOffFtm_d and SzOffFtm_dv (new formats at
4.18 to print size and offset) from signed to
unsigned. Setting them signed at 4.18 was an
oversight.

Plugged a memory leak that caused the loss of 130
bytes per repeat-mode pass. Fixed it with a simple

work-around in main(). Lionel Cons <Lionel.Cons@cern.ch>
reported the leak.

4.20 November 11, 1997
Tested under BSDI 3.1.

Added support for Reliant
UNIX Mesh IPC files with
help from Billy Ho <bho@pyramid.com>.

Added support to Digital UNIX lsof that uses the
libmsfs tag_to_path() function (when it exists) to
look up AdvFS path names. The idea and sample code
came from Dean Brock <brock@cs.unca.edu>. Converted
Dean's code into more general purpose support for
private name cache lookups via the HASPRIVNMCACHE
#define in the dialect machine.h file and code
conditional on it in the printname() function.

Taught Digital UNIX lsof to recognize NFS3 file
systems. Corrected Digital UNIX lsof DEVICE column
alignment.

4.21 December 1, 1997
Squashed bug, introduced at revision 4.18, that
resulted in double reporting of each selected PID
when terse mode (-t) was specified.

Corrected minor bug, also introduced at 4.18, that
might cause an extra print_proc() pass when one
PID has been specified.

Added -R to lsof options in scripts/idrlogin.perl*.
The option should have been there -- it was supposed
to
be mandatory for PGID reporting -- but a bug,
corrected in revision 4.18, previously made -R
unnecessary.

Enabled configuring for BSDI BSD/OS 4.0 per a
suggestion from Jeff Honig <jch@bsdi.com>.

Enabled replacement of scoff_t with off64_t (scoff_t
is used to type r_size and r_localsize in the rnode
struct) for IRIX 5.3 systems that have the NFS
kernel rollup patch (1477). This compensates for
SGI's failure to distribute an updated <sys/fs/rnode.h>
with their patch.

Validated under Linux 2.0.3[12], Linux 2.1.64, and NetBSD 1.3.

Added FreeBSD root directory reporting, courtesy of Dan Nelson <dnelson@emsphone.com>.

4.22 December 15, 1997

Made adjustments for Linux 2.1.7[02].

Improved NAME information for Linux UNIX domain sockets.

Added option +|-M to control the reporting of portmapper registration information in square brackets after the TCP or UDP port or service name. Kenneth Stailey <kstailey@disclosure.com> suggested the feature and provided sample code from OpenBSD. Reporting is disabled by default in the distribution and may be enabled with +M; if lsof is compiled with HASPMAPENABLED (e.g., from machine.h), reporting will be enabled by default and can be disabled with -M.

Changed the -w option to +|-w to match the syntax of the +|-M option and to eliminate any options that flip meaning when a symbol is defined at compile time. For both +|-M and +|-w, specifying `-' when the default state is disabled or specifying `+' when the default state is enabled causes no problems.

!!!WARNING The -w option has changed in lsof 4.22. WARNING!!!

Made the +|- prefix legal for most options, but didn't document it in the man page or help panel. Most options that disable something -- e.g., -b, -C, -n, -P -- now disable when the prefix is `-' and enable when it is `+'. Since the states these options disable are enabled by default, I chose to avoid documentation complexity and confusion by not mentioning that they can be used with the `+' prefix.

Condensed the help panel.

Made sure Digital UNIX Configure stanza puts normal
include path (e.g., /usr/include) before system
include paths.

Added IPX socket information reporting to Linux
with help from Jonathan Sergent <sergent@purdue.edu>.

4.23 January 16, 1998
Fixed conflict arising from the quondam replacement
of the Sun Solaris <netdb.h> with a BIND/BSD version.

With help from Jonathan Sergent <sergent@purdue.edu>
developed a /proc file system based Linux lsof.
It needs some Linux 2.1.x release to work -- I'm
not sure which, but I tested under 2.1.72, 2.1.76,
and 2.1.79. The Configure script selects special
sources for this lsof, so the full lsof distribution
now contains both /dev/kmem and /proc based sources
for Linux lsof. An optional kernel mod, written
by Jonathan, enhances the /proc-based lsof ability
to recognize IPX socket files. Reorganized and
augmented
the Linux sections in 00FAQ to explain
the two types of Linux lsof.

Defined DOSTAT_FUNCTION for dostat() in misc.c to
select the function, stat() or lstat(), it will use.
DOSTAT_FUNCTION is normally undefined, defaults to
lstat(), and is only defined for the /proc-based
Linux lsof in its dlsof.h.

Made conditional on the presence of IRIX 6.4 XFS
rollup patch #6 an XFS node change introduced in
revision 4.16. Identified the patch with help
from John R. Vanderpool <fish@daacdev1.gsfc.nasa.gov>.

Added NFS node compensation for NetBSD 1.3. The
code and suggestion for it was supplied by Jean-Luc
Richier <richier@imag.fr>.

Added diagnostic messages to the /dev/kmem-based
Linux Mksrc script to report errors during the
construction of the kernel name cache header file,
kncache.h. Added 00FAQ information on kncache.h.

Added a new Linux test host, running 2.0.33 and
GlibC, provided by Steve Logue <stevel@mail.cdsnet.net>.

Ported to PTX 4.1.3
and 4.4.2. Adjusted lib/rnch.c
for 4.4.2 to allow customization f additional ncache
struct element names.

4.24 January 28, 1998
Changed /proc-based Linux lsof offset test to use "/"
instead of "/etc/passwd".

To assist Jim Mintha <jim@geog.ubc.ca> with the
packaging of lsof for Debian Linux, added a
DEBIAN_LINUX_LSOF #define to trigger the activation
of special system map file location code in the
/dev/kmem-based dproc.c.

Applied modification to dialects/bsdi/dlsof.h from
Ingimar Robertson <iar@skyrr.is>, enabling lsof to
compile for BSDI BSD/OS 2.0.

Corrected a documentation error in 00DCACHE, pointed
out by Thomas Anders <anders@hmi.de>. The error was
created when the -V option was added at lsof 4.17.

Made IRIX 5.3 through 6.3 lsof aware of IRIX SCSI
tape devices (e.g., /dev/tape). Dave Olson of SGI
and Randolph J. Herber of FNAL provided valuable
advice, and Igor Schein <ischein@air-boston.com>
helped test.

Added a machine.h symbol
(NEVER_HASDCACHE) that
prevents Customize from offering to change HASDCACHE.
The symbol may appear anywhere in machine.h --
e.g., in a comment. Included the symbol in a
comment of the HASDCACHE section of the /proc-based
Linux lsof machine.h, and accompanied it with
warnings against #define'ing HASDCACHE. Did the
same thing for WARNDEVACCESS (NEVER_WARNDEVACCESS
is the suppressant.)

4.25 February 7, 1998
Corrected an IRIX mis-cast of file offset (position).
Igor Schein <ischein@air-boston.com> reported the
problem. This was offered as a patch to 4.24.
Picked some lint Igor pointed out.

At Igor's suggestion added an optional decimal
digit size argument to the -o option. This argument

specifies how many file offset decimal digits can
follow "0t" before lsof switches to a "0x..." form.
The argument size specification doesn't count the
two characters of the "0t". A size of 0 means
unlimited. The default is OFFDECDIG (8), preserving
compatibility
with existing lsof output; it can be
changed by the lsof builder. When size is specified
with -o it does not force offset display; -o without
a size still must be used to do that.

Added an IRIX 6.2, 32 bit system, XFS node patch,
courtesy of Ulrich Bernhard <rzubu@rzu.unizh.ch>.

For my own convenience enabled Configure to use
/usr/local/bin/gcc for NEXTSTEP. This allows
circumvention of a gcc 2.8.0 ranlib problem on
my test 3.1 `040 cube.

Added flags recommended by the RISC/os and Ultrix
compilers for the updated (and longer) main.c.

Updated FreeBSD cd9660_node.h Configure test.

4.26 February 17, 1998
Added shared process group processing for IRIX 5.3,
and IRIX 6.1 and above, based on investigation of
a bug report from Igor Schein <ischein@air-boston.com>.
Igor helped test this addition.

Improved handling of file system name arguments.
It's now done in a manner similar to fuser. The
-f argument forces path names to be considered as
simple
files, rather than as file system names.
The +f flag forces them to be considered as file
system names. Normally path arguments are considered
file system names when they match a mounted-on
directory in the system's mount table, or when they
match a mounted file system's block device. Igor
Schein helped test this change.

Igor also suggests that the proper compilation of
the IRIX 6.4 proc structure after patch 2536 has
been installed may need -DPIOMEMOPS. So lsof's
MkKernOpts script was updated to propagate that
option from CCOPTS in /var/sysgen/system/irix.sm,
even though patch 2536 doesn't add -DPIOMEMOPS to

it. Added a 00FAQ item on this patch.

Added a fatal warning message about names forced
to be file system names (with +f) that have no
match in the mount table.

Improved the -V message for files and file systems
for which no open files were found. Added reporting
of /proc file and file system search failures.

Did some code
reorganization to combine the multiple
ck_file_arg() functions into one. Moved the new
function from the library to the top level and put
it in arg.c; moved the usage function from arg.c
to a new top-level source file, usage.c, to balance
top-level source file size. The new usage.c depends
on version.h; arg.c no longer does.

Added flag recommended by the DU compiler for the
updated (and longer) main.c.

4.27 March 6, 1998
At the request of Igor Schein <ischein@air-boston.com>
added a conditional repeat mode option, using the
`+' prefix to the `r' option. +r operates as does
-r with the exception that it exits the first time
no open files have been listed during a cycle.
The exit code will be zero when any open files have
been listed; one, if none were ever listed.

Ported lsof to HP-UX 11.0 with the help of Richard
Allen. This port hasn't been tested on a 64 bit
kernel; I'm sure it won't work there without more
mods. It may not work on PA 2
architectures; I've
only tested it under PA 1 and a separate, busy
tester reported PA 2 problems that I've been unable
to investigate.

In anticipation of getting access to a 64 bit HP-UX
kernel and the pending start of the Solaris 2.7
Beta test (It will have 64 bit kernel addressing.),
started adding support for 64 bit kernel pointers.
This includes: ubiquitous use of the KA_T cast
for kernel pointers; a format to print them,
KA_T_FMT_X; a function to print them, print_kptr();
and modifications to most kernel-related functions

-- e.g., process_file(), process_node(),
process_socket(), readvfs() -- to process kernel
addresses as KA_T types.

Fixed minor bug in handling path name arguments
that end with a `/'.

Removed support for RISC/os; its test system is no
longer available.

Made modifications to insure that lsof output
doesn't contain non-printable characters. All such
characters are now printed in the printf form
"\x%02x". Several new
common functions were
installed in misc.c to support "safe" printing.
This second major modification in 4.27 to common
and dialect code could have introduced bugs not
yet detected.

4.28 March 10, 1998
Refined unprintable format to use \b, \f, \r, \n,
\t, and ^* (for CTRL) forms. Corrected omission
of safestrprt() use for field output command name.
These changes were offered as patches to 4.27.

Made space an unprintable character (\x20) in the
COMMAND column; printable elsewhere, including the
NAME column, field output, and error messages.

Made sure FD column is parseable as a single entity
-- i.e., has no embedded space. Thus, if the access
mode is unknown but there is a known lock mode, (a
very rare case) the access mode will be printed as
`-'.

Picked lint with gcc 2.8.0 under Solaris 2.6.

With the help of Dave Olson of SGI identified a
proc struct element that should have been added to
<sys/proc.h> by IRIX 6.4 patch 2536. Added a
work-around
for it to the lsof Configure script.
Igor Schein <ischein@air-boston.com> identified
that the patch caused a proc structure length
complaint from lsof. Removed an obsolete 00FAQ
item on the patch, installed at lsof 4.26, explaining
that no solution was yet available.

Added a 00FAQ item on how BIND installs its own header files, including <netdb.h>, which may cause the rpcent struct definition to vanish. Solaris has an automatic lsof work-around, but that hasn't been (and probably can't be) propagated to all dialects supported by lsof. The 00FAQ item recommends re-installation of the vendor header files that BIND has replaced. (Others include <rpcent.h>, <sys/bitypes.h>, and <sys/ctypes.h>.)

Made AIX AFS fixes.

4.29 March 26, 1998

Corrected bug in Internet address matching. The matching formerly stopped if the foreign address matched, thus failing to check the local address for a match. That led to a possible false "Internet address not located" warning (i.e., in response to -V) about the local address, when both foreign and local addresses were specified with -i. This correction was offered as a patch to 4.28.

Changed readmnt() usage in an attempt to defer mount readlink() and stat() delays until they are necessary.

Corrected two bugs in the Digital UNIX readdev() function. Made the correction available as a patch to 4.28 and regenerated the 4.28 DU binaries.

Added a missing argument to a print-kptr() call in the HP-UX dsock.c. The missing argument causes a fatal gcc error. The problem was reported by Eyal Shaynis <eyal.shaynis@telrad.co.il>. The fix was offered as a 4.28 patch.

Adjusted for Digital UNIX 4.0D; the spec_node structure is now defined in <sys/specdev.h>. Kris Chandrasekhar <Kris.Chandrasekhar@digital.com> identified the need for the adjustment.

Incorporated a bug fix from Brian McAllister <mcallister@mit.edu> to the DU readmnt() function. This fix was offered as a patch to 4.28.

Added "safe" printing to a SunOS clone device error message.

Corrected bug in tabling of Linux /proc-based lock info.

Corrected bug in handling of SunOS TLI streams. Dan Farmer <zen@trouble.org> reported the problem.

Added a Solaris 2.6 work-around to keep the BIND <sys/bitypes.h> from colliding with the Solaris <sys/int_types.h>.

Strengthened the Configure test for /proc-based Linux lsof, based on a report from Marty Leisner <leisner@sdsp.mc.xerox.com>.

Tested on OpenBSD 2.3.

Made AIX changes that allow use with 3.2.5. The changes were suggested and tested by Brett Hogden <hogden@rge.com>.

Added Solaris 2.6 AFS support. Disabled reporting of some node numbers for Solaris 2.5 and above open AFS files. The node number computation algorithms used for SunOS 4.1.x and Solaris less than 2.5 no longer always work under Solaris 2.5 and above.

4.30 April 9, 1998

Corrected a pid structure member naming error for UnixWare < 2.1.2. The problem was reported by Richard van Meurs <vanmeurs.anva@atriserv.nl>. He supplied the correction. This was offered as a patch to 4.29.

Had a report from Igor Schein <ischein@air-boston.com> that IRIX 6.4 patch 2839 is another SGI kernel patch, along with 2536, that changes the size of the proc structure in the kernel without changing the proc structure in <sys/proc.h>. Upon further investigation found that the effect of these patches on the proc structure is not consistent. Therefore, dropped the Configure patch test for IRIX 6.4 and made the code in irix/dproc.c slightly more tolerant of proc structure size differences for IRIX 6.4. Igor help test the change.

Corrected Solaris >= 2.5 AFS inode number generation.
Craig Everhart <Craig_Everhart@transarc.com> helped
find the cause of the problem. This was offered as
a patch to 4.29.

Refined the Linux /dev/kmem-based glibc evasion
for the timeval structure
to make it work with
glibc version 2.0.7. This required defining a new
global symbol, TIMEVAL_LSOF, default timeval, that
the /dev/kmem-based Linux lsof can set to its
private glibc timeval name, distinct from the kernel
timeval name.

Added support for Alpha to the /dev/kmem-based
Linux lsof. Alexandre Oliva <oliva@dcc.unicamp.br>
provided a test system. Added an item to 00FAQ
about lsof, the Alpha processor, and Linux.

Added a 00FAQ item about lsof year 2000 compliance.
Basically it says lsof is probably compliant,
because its only date or time computations are done
with time_t values, but I haven't done any specific
Y2K validation. I don't have plans to do any.

Added support for UnixWare 7. Chris Daniels
<chrisd@dlpco.com> provided a test system and Don
Draper <dond@sco.COM> provided technical information.
Added BFS and SFS file system support to lsof for
UW 2.1.[12] and 7.

Updated Solaris VxFS support for VxFS 3.2.1. Greg
Earle
<earle@netbsd4me.jpl.nasa.gov> reported the
need for the update. Greg and Roger Klorese
<rogerk@veritas.com> provided technical information.
Scott McClung <mcclung@primenet.com> tested.

Changed IRIX XFS patch detection in anticipation of
learning there are multiple XFS patches for IRIX 6.4
that require different versions of the lsof-invented
xfs_inode structure.

4.31 April 21, 1998
Added a VxFS #if/#endif wrap to a section of the
HP-UX dnode.c that wasn't properly protected. The
problem was reported by Peter Klosky <PKlosky@bdm.com>.

This was offered as a patch to 4.30.

Added support for Solaris 2.7 (first Beta release).
Mike Sullivan <Mike.Sullivan@Eng.Sun.COM> provided
technical advice and helped test. Charles Stephens
<cfs@jurassic.eng.Sun.COM> also helped test.

Fixed bug in /proc-based Linux that caused it to
access /proc/mounts excessively. Marty Leisner
<leisner@sdsp.mc.xerox.com> provided a syscall
trace that identified the bug.
The fix was offered
as a patch to 4.30.

Adjusted the IRIX 6.4 private structure definition
for the XFS node to accommodate patch 2970. Igor
Schein <ischein@air-boston.com> identified the
patch and the required adjustment.

4.32 May 11, 1998
Corrected Solaris 2.7 code for reporting PCFS
(floppy disk) node numbers. Casper Dik
<casper@holland.sun.com> supplied the fix. The
fix was offered as a patch to 4.31.

Corrected a bug in conditional repeat mode handling
pointed out by Igor Schein <ischein@air-boston.com>.
This was offered as a patch to 4.31.

Improved reporting of AIX open(/dev/memory device)
errors.

Corrected a Solaris < 2.5 KA_T declaration error,
pointed out by Robert Kiessling <robert@easynet.de>.
Changed KA_T from a #define to a typedef for all
dialects to prevent future problems of this kind.

Changed the sample Perl 5 script big_brother.perl5
to report a four digit year from localtime().

Added support for AIX 4.3[.1]. Bill
Pemberton
<wfp5p@tigger.itc.virginia.edu> provided a test
system. Andrew Kephart <akephart@austin.ibm.com>
and Tom Weaver <tvweaver@austin.ibm.com> provided
technical assistance. Niklas Edmundsson
<nikke@ing.umu.se> did 4.3.1 testing.

Added -qmaxmem option to CFLAGs for an AIX compilation with an xlc version 4.x compiler.

Adjusted Linux socket handling for changes in the AX25 members of the sock struct. Richard Green <rtg@tir.com> pointed out the problem. Tested /dev/kmem-based lsof under Linux 2.0.34.

4.33 May 22, 1998

Added generic IPv6 support to common lsof sources and specific IPv6 support to AIX sources. Andrew Kephart <akephart@austin.ibm.com> supplied the additions and helped with testing. Bill Pemberton <wfp5p@tigger.itc.virginia.edu> provided a test system. The modification affected sources for every dialect, whether it supports IPv6 or not, by changing the interfaces to the common Internet address function ent_inaddr().

Added support for the NetBSD UVM virtual memory system. Paul Kranenburg <pk@cs.few.eur.nl> supplied technical details.

Bracketed HP-UX 11 use of <sys/spinlock.h> with #if/#endif _KERNEL.

Corrected printing of PCB address in DEVICE column for IRIX.

4.34 June 26, 1998

Updated 00FAQ to discuss TCP and UDP ports private to the AIX kernel and 00README to describe how ACLs can be used to give lsof permission to read the kernel memory devices. Add information to 00FAQ and 00README about other OpenBSD architectures where lsof is reported to compile and run. Added section to 00FAQ discussing how an incorrect loader path environment variable value can prevent lsof from loading correctly.

Improved Solaris namefs and doorfs support so that it is now possible to search for an open VDOOR file by the path name of its fattached file system object. Igor Schein <igor@txc.com> requested the ability to do such a search. Even with the change, lsof can't always

identify path names for open
VDOOR files.

Also at Igor's request, improved reporting of
information on open Solaris VCHR files that share
a common vnode, and Solaris UNIX domain socket
files.

Corrected print_kptr() argument error in PTX dnode.c,
reported by Mark Price <mprice@sequent.com>.
Compensated for ncache element naming differences,
introduced at PTX 4.4.2; Kurtis D. Rader
<krader@sequent.com> reported the problem.

Changed output column title from INODE to NODE to
better reflect the column's contents of node IDs
for more than just inodes.

Improved Configuration and processing for Solaris
AFS. Corrected AIX AFS 3.4 afs_rwlock_t simulation.

Corrected a cast problem with two AIX knlist()
calls, thus quieting an AIX 4.2.1 compiler argument
type warning. Jon Champlin <champlin@us.ibm.com>
reported the problem.

Added support to most dialect versions (exception:
/proc-based Linux) to warn when the identity of
the kernel where lsof
was compiled doesn't match
the running identity. The warning can be suppressed
with -w. Note: determining AIX state requires
calling oslevel, a potentially slow operation.
Jon Champlin <champlin@us.ibm.com> suggested this
addition.

!!!! WARNING !!!! !!!! WARNING !!!! !!!! WARNING !!!!

Those using the lsof cross-configuration capability
(see 00XCONFIG), should be aware that the kernel
identity test feature introduces two new basic
cross configuration environment variables, LSOF_ARCH
and LSOF_VSTR.

!!!! WARNING !!!! !!!! WARNING !!!! !!!! WARNING !!!!

Identified a situation where a Solaris UNIX domain
socket name is known and can be searched for by

name; added the necessary code.

4.35 July 17, 1998
Made the kernel identity check an option with the HASKERNIDCK #define in machine.h. Enabled altering of HASKERNIDCK with the Customize script. Added a clause to the help output that indicates the build-time HASKERNIDCK status.

Added more information to the NAME column for Solaris UNIX domain sockets. Made them searchable by their clone device path name. Igor Schein <igor@txc.com> requested this.

Completed the HP-UX 11 port with support for its optional 64 bit kernel. Rich Rauenzahn <rrauenza@cup.hp.com> provided a test system. Corrected errors with HP-UX 11 lock reporting and private kernel structure and type definitions. Added support for HP-UX NFS3 files.

Limited mount table warnings -- e.g., when -b is used -- to one set per mount point.

Fixed some mount table scanning and usage bugs, including one in Solaris, reported by Kjetil Torgrim Homme <kjetilho@ifi.uio.no>.

4.36 August 4, 1998
Made corrections and additions to IPv6 support and to AF_ROUTE socket handling, supplied by Jean-Luc Richier <Jean-Luc.Richier@imag.fr>. Jean-Luc's additions provide IPv6 support for the Inria IPv6 implementations on FreeBSD and NetBSD.

Fixed two Solaris 2.5, 2.5.1, 2.6 and 2.7 TCP and UDP host name or IP address reporting bugs, reported by James Mathiesen <James-Mathiesen@deshaw.com>. This fix was offered as a patch to 4.35.

Updated the Customize script to cause ENTER to use all defaults. Amir J. Katz <amir@ndsoft.com> suggested this and helped test the changes.

Updated Solaris ICMP and IP stream handling, based on a report from Igor Schein <igor@txc.com>.

Fixed a bug in the Digital UNIX mount table handling,
reported by Bob Ward <bward@thehartford.com>.
While working on the bug, found and updated some
obsolete AdvFS code. This fix was offered as a
patch to 4.35.

4.37 September 15, 1998
Deactivated SGI IRIX support and archived revision
4.36 sources and binaries in pub/tools/unix/lsof/OLD.

Improved performance of FD searching. This was
offered as a patch to 4.36.

Amir J. Katz <amir@ndsoft.com> pointed out that
ranlib isn't needed for AIX or Solaris. Made
appropriate Configure script changes.

Fixed a file
offset reporting bug for HP-UX VCHR
and VBLK device nodes located on a VxFS root. Doug
Siebert <douglas-siebert@iowa.edu> reported the
bug. The fix was offered as a patch to 4.36.

Resolved an HP-UX root device name reporting bug,
partly caused by an out-dated local copy of the
<sys/mount.h> mount structure, by generating a
local header file with the structure that can be
compiled without needing _KERNEL defined. Doug
Siebert also reported this bug.

Changed some dialect source code -- Digital UNIX,
Solaris, SunOS, and UnixWare -- to make more
consistent with ps the user ID lsof reports in the
USER column. Added a 00FAQ entry about it. Igor
Schein <igor@txc.com> reported the Solaris and
SunOS lsof inconsistencies with what ps(1) reports.

Ported lsof to Pyramid ReliantUNIX 5.44.

Added brackets as comments to case, do, done, else,
endif, esac, if, and while statements in Configure
to assist in navigating its clauses.

Added more Linux 2.0.x
glibc work-arounds.

Added support for UnixWare 7.0.1.

Ralph Forsythe <ralph@contact-paging.com> provided
a new FreeBSD test system.

4.38 November 25, 1998
Added support for recent FreeBSD 3.0 distributions.
A 3.0 test system was provided by David O'Brien
<obrien@NUXI.com>. This was offered as a patch
to 4.37.

Updated the scripts/idrlogin.perl* files to look
for sshd processes in addition to rlogind and
telnetd ones.

Added support for DU 5.0 Beta. Berkley Shands
<berkley@cs.wustl.edu> provided a test system.

Added support for OpenBSD 2.4 with changes supplied
by Kenneth Stailey <kstailey@disclosure.com>.

Changed the Solaris 2.7 tests and documentation to
Solaris 7.

Made some changes to the header files for NEXTSTEP
3.3 and added support for OPENSTEP 4.x with help
from Michael A. Hovan III <mhovan@BLaCKSMITH.com>
and Carl Lindberg <Carl_Lindberg@BLaCKSMITH.com>.
The combined dialect subdirectory is named n+os.
One of Carl's changes
propagates RC_CFLAGS to the
library Makefile. Timothy J. Luoma <luomat@peak.org>
helped test under NEXTSTEP 3.3 and OPENSTEP 4.2.

Made UW 7.x version sensitive to the presence of
ptf7038. Added peer PCB address to Unix domain
socket Name column, even when a path name has been
located. Information for these changes was supplied
by Francis Le Bourse <flebourse@intelcom.fr>. Lee
Penn <lee@dlpco.com> provided a test system.

Tested lsof under OSR 5.0.5 on a test system also
provided by Lee Penn.

Made path name argument processing more tolerant
of errors per a suggestion from Julian Gordon
<julian@cadence.com>.

Acquired a new UnixWare 2.x test system, generously

provided by Computer Classroom, Inc. -- Matthew Thurmaier <matt@compclass.com>, Ken Laing <ken@compclass.com>, and Andrew Merril <andrew@compclass.com>. Updated Configure to accept a UnixWare version of 2.1.3.

Updated kmem-based lsof for Linux 2.0.36.

Updated NetBSD sources for a change in a UVM virtual mapping header file.

Corrected a cache allocation bug in Sun format kernel name cache handling. The bug only shows up when the kernel name cache is inaccessible.

4.39 December 29, 1998

Corrected problems with large device number handling for 64 bit Solaris 7. The problems were reported by Steve Bellenot <bellenot@math.fsu.edu>. Steve helped test the fixes. The fixes were offered as two patches to lsof 4.38.

Improved FreeBSD Configure operations for header files that must be obtained from the kernel source tree, based on a suggestion from David O'Brien <obrien@NUXI.com>.

For Bela Lubkin <filbo@deepthought.armory.com> made optional with +f[cfn] the display of file structure address, shared use count, and node structure address. /proc-based Linux doesn't implement this feature, because it doesn't read kernel structures from kernel memory. Modified the PTX -X option to take advantage of the new file structure display option.
Added shared.perl5 to the scripts/ subdirectory to provide an example of how +f[fn] might be used to track shared file descriptors and files.

Added more /dev/kmem-based Linux glibc evasions, provided by Jeff Johnson <jbj@redhat.com> and Maciej Lesniewski <nimir@kis.p.lodz.pl>. Jeff helped test them on various Linux architectures.

Tested on AIX 4.3.2; no changes were required. Doug Crabill <dgc@purdue.edu> provided a test

system.

Fixed -c option to detect missing command name when
following option begins with `+'.

4.40 January 25, 1999
Added support for using the CDS compiler for Reliant
Unix 5.44 and above. Made Reliant Unix MIPC support
optional, dependent on the presence of <sys/mipc.h>.

Based on a report from Michael Schmitz <MSchmitz@lbl.gov>
that /dev/kmem-based lsof misbehaves on a Linux
2.0.x m68k kernel without module support, made the
absence of query_module() or get_kernel_syms()
Linux kernel support a fatal error.
Updated relevant
sections of 00FAQ to reflect the change.

Added the ability to force the Linux Configure
stanza to use the /proc or /dev/kmem source base
via a LINUX_BASE environment variable specification.
This is a cross-configuration assist.

Added "+D <dir>" and "+d <dir>" options for directory
searching. +D searches the entire tree, starting
at <dir>, including <dir>, its contents, and its
subdirectory branches; +d searches only <dir> and
its contents, but not its subdirectory branches.
Improved lsof's searching of the specified name
list to compensate for anticipated long lists from
+d and +D.

Made an egrep in the Solaris Configure stanza usable
by the standard and XPG4 egrep's. Kenneth Stailey
<kstailey@disclosure.com> pointed out the improvement.

Fixed bugs in /dev/kmem-based Linux and UnixWare
Unix domain socket name searching.

Changed a Linux Alpha #include to be conditional
on the presence of its named header file, so that
lsof
will compile on Red Hat 5.1 and 5.2 (Linux
kernel 2.0.35) where the header file is absent.
The problem was reported by Alexandre Oliva
<oliva@dcc.unicamp.br>.

Fixed an AIX 4.3+ bug in procinfo struct space

allocation, reported by Jeff Stewart <jws@purdue.edu>.
This was offered as a patch to 4.39.

Added an lstatsafely() function to offer the same
isolation for lstat() calls that statsafely() offers
for stat() calls. This made DOSTAT_FUNCTION no
longer necessary, so deleted it.

With help from Laurent P. Montaron <lpm@sequent.com>
ported lsof to PTX 4.4.4. Laurent did a monumental
job of identifying TCP/IP changes by their TCP
version, rather than by their PTX (With mix 'n
match PTX and TCP/IP versions, the PTX version
often has no bearing on the TCP/IP version.), and
changed the Configure script and pre-processor
#if/#else/#endif blocks to match. He also updated
Unix domain socket handling for PTX TCP/IP versions
4.5 and above.

Updated CLIENT
handle acquisition of fill_portmap()
in print.c to use the more modern RPC function
clnt_create() in place of clnttcp_create() where
possible. PTX 4.4.4 requires clnt_create().

4.41 February 27, 1999
Added FreeBSD 3.1 and and 4.0 support with help
from Sheldon Hearn <axl@iafrica.com>, David O'Brien
<obrien@NUXI.com>, and John Polstra <jdp@polstra.com>.

Corrected bungled AIX 4.3+ patch that went into
lsof 4.40.

Reorganized the Configure script to improve Makefile
construction. A specific impetus for this was to
allow FreeBSD system-wide make flags to be propagated
to the lsof Makefiles, but other goals were to make
sure that the DEBUG= make entry can over-ride
standard CFLAGS values, and to better manage the
identification of compilers and their versions.
Two compiler-related values may now be supplied in
environment variables: 1) the compiler path in
LSOF_CC; and 2) the compiler version in LSOF_CCV.
00XCONFIG documents them.

Added support
for Pyramid Reliant Unix bsdsfs,
msockfs, and sockfs file systems.

Added an optional LSOF_CINFO string to Configure,
producing a CINFO string in selected Makefiles,
producing a #define LSOF_CINFO in selected version.h
header files. The purpose of this is to allow
Configure the option to propagate information to
the lsof -v output. It is now used for Linux to
identify the code base, and for HP-UX 10.30 and
11.0 and Solaris 7 to identify the kernel bit size.

Added system information to NEXTSTEP and OPENSTEP
-v output, from the second line of hostinfo's
output.

Fixed a login name buffer overflow problem in the
processing of -u option values. This was offered
as a patch to 4.40. !!!THIS IS A SERIOUS STACK
OVERFLOW BUG; A LINUX EXPLOIT EXISTS FOR IT THAT
OPENS A BASH SHELL WITH LSOF'S AUTHORITY -- E.G,
SETGID(KMEM) POWER!!!

Improved the Solaris mount table filter so the
volume manager's fake mount point, "/vol", is
ignored and doesn't supplant
"/" in NAME column
path assemblies. Igor Schein <igor@txc.com> reported
this bug and provided important help in finding
it. This was offered as a patch to 4.40.

Changed the Linux /dev/kmem-based lock ownership
test to answer a problem reported by Tom Christiansen
<tchrist@jhereg.perl.com>. This was offered as a
patch to 4.40.

Installed an HP-UX 11 patch, suggested by Kevin
Vajk <kvajk@cup.hp.com>, that adjusts a private
lsof kernel header file, derived via Q4, to correspond
to an HP-UX patch bundle.

Made NetBSD 1.3I sockproto structure adjustment.

4.42 March 30, 1999
Fixed a typo in the HP-UX dfile.c that caused +fF
and +fN output controls to swap effect.

Enabled for OpenBSD 2.5 per notice from Kenneth
Stailey <kstailey@kstailey.tzo.com>

Made more VM accommodations for FreeBSD 4.0.

Improved file system search reporting to include path name components when they're available, instead of mindlessly reporting the file system name in the NAME column. Guy Dallaire <gdallair@geocities.com> brought the need for this change to my attention.

Updated Solaris 2.6 VxFS for Veritas Oracle Database Edition 2.0, VxFS version 3.3, and VxVm version 2.5.4, based on a report from Chris Kordish <chris.kordish@East.Sun.COM>. Chris kindly provided a test system.

Improved HP-UX ipc_s patch detection in Configure, response in .../dialects/hpux/hpux11/ipc_s.h, and documentation in 00FAQ, Kevin Vajk <kvajk@cup.hp.com> helped test.

Added to Customize the option to suppress HASKERNIDCK selection for specified dialects. Suppressed it for /proc-based Linux lsof, and removed its test and code from there. Tin Le <tin@netimages.com> alerted me to the need for this update.

Ported to official Digital UNIX 5.0 release.

Changed DU lsof to use the knlist(3) function when no kernel file has been specified with -k. This change was suggested by Erich Wimmer <Erich.Wimmer@digital.com>.

Updated Configure for latest NetBSD (1.3I?) with UVM support the default.

4.43 May 11, 1999

Corrected a typo in the Solaris gcc discussion in 00FAQ. Made changes to the Solaris 2.5[.1] private tcp_s structure. Both changes were done in response to reports from Igor Schein <igor@txc.com>, who tested the Solaris 2.5 change.

Made more IPv6 adjustments to lsof for Tru64 UNIX (Digital UNIX) 5.0, based on information obtained from Compaq by Berkley Shands <berkley@cs.wustl.edu>.

Corrected HP-UX error message about HP-UX 11 q4 usage.
Amir Katz <amir@ndsoft.com> reported the correction.

Fixed a GlibC 2.1 conflict in /proc-based Linux lsof.

Fixed a man page typo reported by Vlad Harchev
<hvv@hippo.ru>.

Changed some Solaris 2.7 references to Solaris 7
in Configure and 00XPORTING.

Added a Solaris example to the echo statements that
are the install rule in the SunOS/Solaris Makefile.

Added a field to the file structure output --
FILE-FLAG (file structure open
flags, f_flag[s],
and process file flags, typically u_pofile)) --
enabled with +f[gG]. Its field output character
is 'G'.

Figured out another piece of the HP-UX 11 patched
ipc_s structure puzzle with the help of Keith Kalet
<KEITH_KALET@HP-USA-om41.om.hp.com>.

Fixed a PTX real vnode to real inode interpretation
bug.

Added link count to lsof output. Eric Dumazet
<dumazet@risgw.ris.fr> requested and helped test
it. The new +L option enables and filters it.
Its field output character is `k'.

Updated Configure script to recognize NetBSD 1.4.

Updated AFSConfig to handle default answers to
questions.

Incorporated patch from Jonathan Sergent <sergent@io.com>
that enables /proc-based Linux lsof to run on both
32 and 64 bit kernels.

Updated Configure script with a patch from David
O'Brien <obrien@NUXI.com> that recognizes FreeBSD 3.2.

4.44 June 24, 1999
Corrected use of nlink member of hsnode for SunOS
4.1.x High Sierra File System files.

John Dzubera
<zube@tlaloc.stat.colostate.edu> reported the
problem and helped test the fix. Also fixed a
SunOS segmentation fault bug. These fixes were
offered as a patch to 4.43.

Improved handling of /proc-based Linux UNIX PCB
address.

Fixed a NEXTSTEP and OPENSTEP bug that made repeat
option (-r) processing malfunction. This fix was
offered as a patch to 4.43.

Fixed Configure so it doesn't use -O in the Cflags
for the bundled HP-UX C compiler. Jim Ankenbrandt
<jankenbrandt@penton.com> reported the problem.

Corrected output ordering of parent PID and process
group ID when both -R and -g are specified.

Enhanced the pdev.c and pdvn.c library modules for
wider use. These dialect versions use the new
library modules: DEC OSF/1, Digital UNIX, and Tru64
UNIX; Pyramid DC/OSx and Reliant UNIX; SCO OSR and
UnixWare; and Sequent PTX.

Added basic clone device support to /dev/kmem-based
HP-UX lsof for HP-UX 10.30 and higher.

Added raw socket
support to /proc-based Linux lsof.

Changed NODE-ADDR column title to NODE-ID in
anticipation of using more general identification
information in the column.

Ported to UnixWare 7.1, using a test system kindly
provided by Matt Thurmaier <matt@compclass.com>
and Don Draper <dond@sco.com>.

Updated for NetBSD 1.4C VM changes, and a new
current and root working directory structure.

Made minor adjustment for latest Tru64 UNIX 5.0
Beta release.

4.45 July 30, 1999
Fixed quoting problem in DEC OSF/1, Digital Unix,

and Tru64 UNIX Makefile's install rule. The problem
was reported by Berkley Shands <berkley@cs.wustl.edu>.
Fixed bug in Tru64 UNIX 4 lsof that caused FDs to
be skipped. These fixes were offered in a patch
to 4.44.

Fixed a repeat-mode /proc-based Linux lsof bug,
reported by Sami Farin <sfarin@ratol.fi>. This
was offered as a patch to 4.44.

Picked lint, some reported by Sami Farin.

Corrected a 00DCACHE documentation error in a sample
shell
script. The problem was reported by Chad R.
Larson <chad@larsons.org>. Changed commented-out
entries in machine.h files so they require more
thought and work when the comments are removed,
based on a remark by Chad.

Compensated for the practice of Solaris 7 and above
to record the dev= value in /etc/mnttab in 32 bit
mode, even on 64 bit systems. This was offered as
a patch to 4.44.

Added a C library test for /proc-based Linux lsof,
so that the #include files can be adjusted for a
non-GlibC environment. The need for this was
reported by Andrew Hill <andrewh@tirin.openworld.co.uk>.
This was offered as a patch to 4.44.

Added support for Auspex LFS 1.8.1 and 1.9.2 to
SunOS 4.1.4 lsof. The support was requested by
Quentin Fennessy <quentin@dvorak.amd.com>, who
provided information and did testing.

Enabled IPv6 support code for NetBSD and OpenBSD,
conditional on Configure script tests. Wolfgang
Rupprecht <wolfgang@wsrcc.com> supplied
the NetBSD
code and tested it. The OpenBSD code I constructed
has been compiled but not tested.

Updated the identd Perl 5 script, based on a report
from Wendy Lin <af5@taiyang.cc.purdue.edu> that
the space in its response line in front of the user
name violates RFC 1413.

Added IPv6 support to /proc-based Linux lsof. Jonathan Sergent <sergent@ETLA.NET> and Andrew Thomas Sydelko <sydelko@ecn.purdue.edu> kindly provided a test system.

Updated man page description of AIX multiplexed files to indicate that they might be /dev/ptc or /dev/pts, depending on the AIX version. The correction was suggested by Onno van der Linden <onno@simplex.nl>.

Sylvain Robitaille <syl@alcor.concordia.ca> reports lsof passes his Y2K tests.

4.46 October 23, 1999

Corrected /proc-based Linux lsof to detect that an IPv6 address is a mapped IPv4 address. The problem was reported and analyzed by Arkadiusz Miskiewicz <misiek@misiek.eu.org>, who also tested the fix.

Added a libc5 library /dev/kmem-based Linux lsof circumvention, supplied by Jason Lingohr <lingman@lucid.net.au>.

Corrected a bug in -t (terse) AIX output, reported by Wendy Lin <af5@taiyang.cc.purdue.edu>. I introduced the bug at revision 4.43 when adding FILE_FLAG reporting. This was offered as a patch to 4.45.

Added a work-around for a problem in the OpenBSD 2.3 <sys/pipe.h> header file. Volker Borchert <bt@teknon.de> provided and tested it.

Improved description of cross-building lsof for a 64 bit Solaris 7 system on a 32 bit system with suggestions from Phillip Edwards <Philip.Edwards@sn.wpafb.af.mil>.

Fixed a gawk POSIX-mode pattern error in the Linux /dev/kmem-based Mksrc script, based on a tip from Ambrose C. Li <acli@mingpaoxpress.com>.

Fixed a bug in the Tru64 UNIX IPv6 handling, courtesy of a report from Casper Dik <casper@holland.sun.com>.

Enabled support for OpenBSD 2.6.

Enabled support for BSDI BSD/OS 4.1, based on a report
from Jeffrey C Honig <jch@bsdi.com> that only a Configure script change is necessary.

Enabled Configure script to use gcc for building lsof for a 64 bit Solaris 7 and 8 kernels, if the gcc version is 2.95 or above.

Improved -i option handling for systems with IPv6 support so that it will search for a host name in both IPv4 and IPv6 families, when that is possible. As a companion modification, changed -V processing to report a single error when a multiple host name match is requested. Casper Dik <casper@holland.Sun.COM> helped test.

Fixed a DEC OSF/1, Digital UNIX, Tru64 UNIX repeat mode bug, reported by Mayer Ilovitz <mayer@cooper.edu>. Mayer helped test the fix. The fix was offered as a patch to 4.45.

Changed Solaris socket file recognition scheme, so it is (nearly) the same through Solaris 8, where the previous clone device scheme no longer works.

With significant assistance from Casper Dik, added support for Solaris 8 Beta and
Beta refresh. The IPv6 support in Solaris 8 is still in some flux, so there are temporary compensations for the differences between Beta IPv6 support and Beta refresh IPv6 support. Casper and I hope those differences disappear by FCS.

Improved the delivery of information on Solaris 2.5.1, 2.6, 7, and 8 door files.

Fixed a repeat mode bug that surfaces when /etc/passwd changes between cycles. The bug report and diagnostic help were supplied by Igor Schein <igor@txc.com>. The fix was offered as a patch to 4.45.

Added support for INRIA IPv6 to NetBSD. Jean-Luc Richier <Jean-Luc.Richier@imag.fr> provided patches and a test system on which to verify them.

Added support for AIX 4.3.3. Jeff W. Stewart <jws@anaconda.cc.purdue.edu> provided a test system.

Made adjustments for FreeBSD 4.0-current.

Improved reporting of information for AIX sockets that lack protocol control blocks.

4.47 November 29, 1999

Based on a query from Jean-Pierre Radley <jpr@jpr.com>, changed the lsof top-level Makefile to propagate CFGF to the library Makefile. (DEBUG was already being propagated.) Added osrgcc and scogcc Configure abbreviations (to use gcc) for Jean-Pierre.

In response to a query from Igor Schein <igor@txc.com>, improved the Configure script test for Solaris 7 and 8 that decides if the compiler can produce 64 bit executables.

Made an ugly hack, based on making a private rnode structure definition from q4 output, to compensate for HP-UX 10.20 and lower recent NFS3 patches. HP didn't supply an updated <nfs/rnode.h> with the patches. The problem was reported by Will Partain <partain@mekb2.sps.mot.com>. Elias Halldor Agustsson <elias@hi.is> helped identify the patches as PHNE_18173, PHNE_19426, PHNE_19937, and PHNE_20091, and provided a test system.

Switched BSDI test system from 2.1 and 3.1 to 4.0.1, courtesy of Terry Kennedy <terry@tmk.com>.

Added some more dev_t hacks for Alpha FreeBSD 4.0.

Added support for IPv6 on BSD 4.x. The support hasn't yet been tested, just compiled.

Added support for the mnt file system (mntfs or /etc/mnttab) on Solaris 8. Tested on Solaris 8 BETA-Refresh.

Made selection of optional fields (e.g., PPID with -FR) in a field output specification select the optional field, too, so that the option selector for the field (e.g., -R) isn't also required. This

change was made in response to an inquiry from John DuBois <spcecdt@armory.com>. This may require some revision to scripts that parse all field output; two scripts in the lsof distribution's scripts/ subdirectory had to be updated.

Corrected handling of Linux IPv4 addresses mapped in IPv6 addresses.

Tested under OpenBSD 2.6.

4.48 January 14, 2000

Modified -i argument processing of colon-separated IPv6 addresses to recognize an IPv4 address mapped in an IPv6 address and handle it as an IPv4 address. This was offered as a patch to 4.47.

Added a defined symbol (NOWARNBLKDEV) to control (inhibit) the issuance of a warning when no block devices are found. This was done anticipating its need in FreeBSD 4.x, but that dialect version no longer has any block devices, so HASBLKDEV was disabled for it instead. NOWARNBLKDEV was left in place for possible use in the future.

Enabled KAME IPv6 Configure support for FreeBSD when <netinet6/in6.h> is found.

Disabled use of gcc to compile lsof for 64 bit HP-UX 11.

Updated Configure to recognized FreeBSD 3.4.

Based on suggestions from Bernt Christandl <beb@MPA-Garching.MPG.DE> improved AFS configuration for AIX and Solaris, and updated AIX AFS 3.5 support. Johannes Tax <tax@bluedog.oit.unc.edu>, Hung T. Pham <hung_pham@unc.edu>, and Curt Freeland <curt@grumpy.cse.nd.edu> provided test systems.

Updated lsof's private rnode definition for AIX 4.3.3, since IBM still doesn't ship the <oncplus/nfs/rnode.h> header file and the rnode structure definition in <nfs/rnode.h> doesn't match what the kernel uses. This was offered as a patch to 4.47.

Weakened the test in the Linux /proc-based lsof of
the field count of data lines in /proc/net/{tcp,udp}.
It appears that recent 2.3.x Linux kernels have
added untitled fields to these files. The bug
report came from Gabor Liptak <gaborliptak@usa.net>.

Adjusted for a FreeBSD 4.0 change in the definition
of [_]KERNEL. David O'Brien <obrien@NUXI.com> reported
the problem and provided a test system.

Removed the HASPPID bracket from Fppid (the -R
option state variable) so that the field select
table will compile even when HASPPID is not defined.
This problem was introduced at revision 4.47 with
code that causes some field output characters to
set option states. The problem was reported by
David Bacon <bacon@birch.eecs.lehigh.edu>.

4.49 April 3, 2000
Made clearer in man page that "Lxx" FDs are AIX
loader table references. Also updated the 00FAQ
discussion
of the Stale Segment ID bug to include
AIX 4.3.x.

Modified support for NetBSD 1.4Q to include the
<sys/buf.h> header file to cope with an MFS change.

Added support for OpenBSD UVM virtual memory.

Added support for AIX systems with > 2GB of memory.
Chris Sylvain <csylvain@itg.ummc.umaryland.edu>
reported the problem and provided the solution.
Chris also supplied some minor code cleanup. This
was offered as a patch to 4.48.

Based on new information from Igor Schein <igor@txc.com>
made additional compensation in Configure script
for 64 bit Solaris 7 and 8 gcc.

Added some 00FAQ info on the effect ordering of
the +fg and -FG options has on output format.

Improved NetBSD IPv6 configuration, based on a
suggestion from Thomas Klausner
<wiz@danbala.ifoer.tuwien.ac.at>. Added code to
convert IPv4-mapped-in-IPv6 addresses to IPv4

addresses.

Updated the information in 00FAQ and the HP-UX 11
binary directory README files on the HP-UX 11
ipis_s
patch with new information supplied by Eric McWhorter
<emcwhorter@xsis.xerox.com>.

Added documentation on changes to HASFSTYPE and
HASNCACHE, and the new HASPRIVPRIPP.

Adjusted Configure for FreeBSD 5.0. Made additional,
necessary changes to Configure and the BSDI sources
to eliminate load errors.

Added KAME IPv6 support to FreeBSD at the request
of Ollivier Robert <roberto@eurocontrol.fr>, who
provided a test system.

Corrected the script that generates the CHECKSUMS
files for binaries to correctly name the detached
PGP certificate. The documentation bug was reported
by Michael Hennecke <hennecke@rz.uni-karlsruhe.de>.

4.50 June 29, 2000
Added a NetBSD alpha test host, courtesy of Ray
Phillips <r.phillips@mailbox.uq.edu.au>. An lsof
4.49 binary, built on Ray's 1.4.1 system was made
available prior to the 3.50 release.

Upgraded the system map file tests in /dev/kmem-based
Linux lsof, making the use of DEBIAN_LINUX_LSOF
unnecessary.
Tested the changes on a system made
available by Vincent Kujala <kujala@geog.ubc.ca>
and Jim Mintha <jim@ic.uva.nl>.

Forced AIX to use the large-file-enabled versions
of lstat (lstat64) and stat (stat64) if <sys/stat.h>
contains stat64. This should allow lsof to stat()
AIX files > 2GB even when the builder has not
defined the "large file enabled programming
environment." Configure tests <sys/stat.h> and
puts -DHASSTAT64 in the Makefile's CFLAGS to make
this happen. Fernando A.B. Whitaker
<whitaker@cenapad.unicamp.br> reported the problem.
This was offered as a patch to 4.48.

Enabled Configure script to handle OpenBSD 2.7.
Angelos D. Keromytis <angelos@dsl.cis.upenn.edu>
reported the availability of OpenBSD 2.7 and supplied
the Configure script patch.

Improved handling of DOOR and fattach()'d files in
Solaris.

Changed message about missing kernel symbol file
from "not yet determined" to "none found".

Updated FreeBSD, NetBSD, NEXTSTEP,
OpenBSD, and
OPENSTEP support to report "no PCB" and the values
of the SO_CANTSENDMORE and SO_CANTRCVMORE state
flags when a socket structure has no inpcb pointer.
This modification was made to AIX lsof at revision
4.46. Added an entry to 00FAQ about sockets that
have no inpcb pointer.

Upgraded support for FreeBSD 5.0-CURRENT. Ben
Smithurst <ben@scientia.demon.co.uk> supplied
patches and did testing. David O'Brien <obrien@NUXI.com>
supplied a test system. The update included dropping
the Fctty part of file descriptor file system
support, conditional on a Configure script test.
I propagated those changes to BSDI, NetBSD, and
OpenBSD in anticipation of their having the
modification in the future. David also arranged
with Michael Haro <mharo@area51.fremont.ca.us> for
a FreeBSD 3.4 test system.

In response to an lsof 3.72 bug report from Jim Mewes
<jim@corp.phone.com>, added more kernel address
filtering to the lsof function, kread(), that
reads
Solaris kernel data.

In response to a report from Marc Duponcheel
<marc@offline.be>, added tests to the /proc-based
Linux lsof to ignore file systems of types "autofs"
and "pipfs".

Based on a report and information supplied by Casper
Dik <casper@holland.Sun.COM>, updated the ncache_load()
function in lib/rnch.c with new code that deals
with a post Solaris 8 change in kernel name cache
(DNLC) handling. Casper tested the update, which

should be invisible to Solaris versions without
the new DNLC code.

Added support for Solaris VxFS QIO files, based on
a report from Kieran Broadfoot <kieran.broadfoot@gs.com>.
Kieran help test the support.

Added support for PTX 4.4.6 and 4.5[.1] with help
from the usual cast of good people at Sequent.

Added support for 64 bit file sizes and offsets on
BSDI, FreeBSD, NetBSD, and OpenBSD, based on a
report from Dan Nelson <dnelson@emsphone.com>.
Dan supplied a patch and did FreeBSD testing.

Added Configure
script recognition of NetBSD 1.5,
based on a report from Andrew Brown <atatat@atatdot.net>.
Thomas Klausner <wiz@danbala.ifoer.tuwien.ac.at> updated
the NetBSD port package to use a pre-release of this
addition.

At the last minute saw a notice via deja.com's
UseNet search service that FreeBSD 3.5 had been
released and lsof didn't grok it. Added recognition
of 3.5 to lsof's Configure script, but didn't have
the opportunity to test lsof on 3.5.

4.51 August 21, 2000
Added Configure script support for the upcoming
Solaris 9 release based on suggestions from Casper
Dik <Casper.Dik@holland.sun.com>.

Changed sample Perl scripts to assume that
/usr/local/bin/perl is Perl 5 and Perl 4 may be
found in /usr/local/bin/perl4.

Updated Configure to recognize FreeBSD 4.1 and made
a FreeBSD pre-release distribution available.

Bela Lubkin <belal@sco.COM> tested lsof on the
upcoming SCO OSR 5.0.6 release and reports that
lsof appears to work properly.

Updated
the AIX compiler test in Configure to
recognize its version 5.

Updated AIX 4.3.3 support with automatic recognition
of the proper rnode structure, based on machine
bit width. Also added code to detect when processing
the -X option that lsof has been compiled with the
"other" AIX 4.3.3 user structure and to apply
compensations. When a compensation method works,
it's applied during subsequent -X processing; when
none works, further -X processing is disabled.

Added Tru64 UNIX 5.1 support. Updated Tru64 UNIX
library text file support to recognize new kernel
support for AdvFS library files. Berkley Shands
<berkley@cs.wustl.edu> and Klaus Saggerer USG
[saggerer@zk3.dec.com> helped put me in contact
with Chang Song <song@zk3.dec.com>, the developer
of 5.1's new kernel name cache and he helped me
develop new code in lsof to access it.

Corrected reporting of PTX fattach()'d address.

Changed Configure and dlsof.h for NetBSD and OpenBSD
to
use /usr/include/uvm header files when available.
Andrew Brown <atatat@atatdot.net>, Thomas Klausner
<wiz@danbala.ifoer.tuwien.ac.at>, and Wolfgang
Rupprecht <wolfgang@wsrcc.com> pointed out the need
to do this for NetBSD. Andrew provided access to
a NetBSD 1.5 system for verifying the changes.

Installed snprintf() support, including a private
version in the lsof library for those UNIX dialects
without the function. Changed all sources to use
it instead of sprintf() and strcpy().

Fixed a memory leak in the readvfs() functions of
BSDI, DEC/OSF1, Digital UNIX, FreeBSD, NetBSD,
OpenBSD, and Tru64 UNIX.

Tested on Linux 2.4.

Modified the Pyramid MkKernOpts script to compensate
for `uname -s` configuration alternatives. Robert
Dahlem <Robert.Dahlem@ffm2.siemens.de> supplied
the modification.

Obtained access to an FCS Solaris 8 64 bit system
and built lsof on it, using Sun Workshop C 5.0 and
gcc 2.96 20000814 (experimental). Both compilers

produce
a working lsof.

4.52 November 8, 2000
Completed work on an HP-UX 11.11 port that uses a
pstat(2) interface provided by HP. To distinguish
it from its predecessors for HP-UX, this lsof
version is called PSTAT-based and the predecessor
versions are now called /dev/kmem-based. I am
indebted to the far-sightedness and support of
these good people at HP for making PSTAT-based lsof
possible: Carl Davidson, Louis Huemiller, Rich
Rauenzahn, and Sailu Yallapragada. The PSTAT-based
sources are in lsof_4.52/dialects/hpux/pstat, the
/dev/kmem-based ones in lsof_4.52/dialects/hpux/kmem.

Ported to IBM Monterey for Merced|Itanium, aka AIX
5L. It configures via the Configure script's "aix"
abbreviation and has been tested on AIX 5L Beta 3.
Jay Beck, Steve Dibbell, Loc Le, Nasser Momtaheni,
and Malcom Zung of IBM provided generous support.
Since AIX 5L is still in Beta testing, this port
can't be considered complete.

Added Configure support for OpenBSD
2.8. David
Mazieres <dm@cs.nyu.edu> provided a test system.

Based on a report from Marc Christensen
<marc@mecworks.com> added sockfs to the mount scan
exemption list for /proc-based Linux lsof.

Added large file, CDFS, and DOSFS for UnixWare 7.x.
Added UnixWare device memory mapping support. All
UnixWare changes were supplied by Eric Dumazet
<edumazet@cosmosbay.com> Eric also supplied some
miscellaneous bug fixes.

Deferred name cache loading until printname() needs
to use the name cache.

Terminated Pyramid, SunOS 4.1.x, and Ultrix support,
because test systems are no longer available.
Final Pyramid and Ultrix source code distributions
for lsof revision 4.51 may be found on lsof.itap.purdue.edu
in pub/tools/unix/lsof/OLD/src. The no longer
supported SunOS 4.1.x source code is still distributed

with the Solaris source code.

Added code to set Solaris node address to real vnode address, when applicable.

John Speno <speno@lopan.isc-net.upenn.edu> provided information that enabled me to update the Tru64 AdvFS (MSFS) node definition for AdvFS version 5.

Added Tru64 5.x CFS support with help from Kris Chandrasekhar <Kris.Chandrasekhar@compaq.com>, Diane Lebel <lebel@zk3.dec.com>, and John Speno. The support only provides information about cached file attributes.

Installed a Configure patch for HP-UX 11 supplied by Kenneth Stailey <kstailey@disclosure.com> that adds another command to q4 input.

Tested on FreeBSD 4.2.

Will Day <willday@rom.oit.gatech.edu> and Frank Winkler <frank.winkler@germany.sun.com> graciously supplied Solaris 8 binaries.

Added Solaris 9 text file support, supplied by Casper Dik <Casper.Dik@holland.sun.com>.

4.53 December 6, 2000

Added the AIX 5L j2_lock.h to the distribution with a Configure script step to use it when it's missing from /usr/include/j2.

Removed SunOS 4.1.x support.

Removed Linux 2.0.x /dev/kmem support.

Fixed VBLK and VCHR special device file reporting to handle /dev information more accurately.

Added a Apple Darwin / Mac OS X 1.2 port, provided by Allan Nathanson <ajn@apple.com>. Allan also arranged for a test system so I can maintain this port. An additional test system was provided by Dale Talcott.

Dropped claims of support for all UnixWare versions
except 7.1.0, since that is the only version on
which I can test lsof. Even though lsof 4.53 is
deprecated for UnixWare 2.1.3, installed a patch
for it with testing done by A. Channing Clark
<clark.channing@heb.com>.

Dropped claims of support for all SCO OpenServer
versions except 5.0.5, since that is the only
version on which I can test lsof.

4.54 January 19, 2001
Added compensation for a change that made the
FreeBSD mount structure invisible. I can only test
back to 3.2 and the compensation works there, so
it's been #ifdef'd for 3.2 and above. David O'Brien
<obrien@FreeBSD.org> provided the necessary clue.

Based
on a report from Valdis Kletnieks
<Valdis.Kletnieks@vt.edu>, changed all IPv6 support
to report a TYPE of IPv6 for sockets with IPv4
addresses mapped in IPv6 addresses. The previous
lsof behavior was to report their TYPE as IPv4.

Restored the Linux GlibC test to Configure, removed
at revision 4.53, based on a report from John Dzubera
<zube@cs.colostate.edu>, that RedHat Linux 6.0 still
needs the test.

Made setting of link count for Solaris more selective.

Limited Readlink() recursion to MAXSYMLINKS. The bug
was reported by Jan Dvorak <johnydog@go.cz>.

Dropped the *claim* that lsof runs on Solaris 2.5.1.
It may well do so, but I no longer have access to a
test system.

Fixed an #endif comment typo, reported by Igor Schein.

Fixed a typo in a cast for a Tru64 UNIX 5.1 function
and updated Configure for Tru64 UNIX 5.0 and 5.1 with
information from Jesse Perry <jesse.perry@compaq.com>.

Corrected non-fatal typos in the AdvFS support in
dnode.c

for Tru64 UNIX.

Added msdos file system support for NetBSD and OpenBSD. Andrew Brown <atatat@atatdot.net> requested and helped test it.

4.55 February 15, 2001

Based on a report from Bernd Eckenfels <ecki@lina.inka.de> added support in lsof for files in /proc/<PID>/maps that have been deleted.

Changed PGRP output title to PGID, conforming to the most common current abbreviation for Process Group ID (PGID). While some systems continue to use *pgrp for internal kernel variable names, most systems that support the display of PGID via ps(1) now title it PGID. The lsof -g and -Fg options operations are unchanged in function; only titles and descriptions have changed. Also changed internal variable names from *PGRP and *pgrp to *PGID and *pgid where possible.

Dropped the *claim* that lsof runs on HP-UX 9.x. It may well do so, but I no longer have access to a test system.

In response to a suggestion from Jeff Howie <jeff.howie@federated.ca> added support for command name selection by regular expression. A new form of the -c option value is use to identify and specify a regular expression.

Restore the *claim* that lsof works on UnixWare 7.0, since I re-acquired a test system.

4.56 May 3, 2001

Corrected some problems Amir Katz <Amir_Katz@bmc.com> found with Insure++, one in lib/dvch.c, the rest in Solaris sources. Amir's report also helped me find an error in an snpf() call that caused (the unsupported) Solaris 2.5.1 lsof to crash. Wally Winzer, Jr. <wally.winzer@ChampUSA.COM> helped test.

Added support for UnixWare 7.1.1 and above in-kernel UNIX sockets. John Hughes <john@Calva.COM> kindly provided code and access to a test system. John also provided a test system and advice for adding

UnixWare 7.1.1 NonStop Cluster and CFS support.
More help with that effort came from Kurt Gollhardt
(SCO), Barbara Howe (SCO), Bela Lubkin (SCO), and
Dewan Rashid <Dewan.Rashid@ir.com>.

Archived
a set of compilation hints (patches) from
Bill Melvin <Bill.Melvin@esc.edu> that make it
possible to compile the old, unsupported lsof 3.08
sources on UnixWare 1.x without NFS or CDFS support.

Installed support supplied by Allan Nathanson
<ajn@apple.com> for the Darwin "Gold Master" release,
Mac OS X 10.0 (aka Darwin 1.3 in its public source
version). Added Allan's CVS repository suggestions
to the script that gets additional header files
from an open source repository.

Tested an HP-UX 11.11 kernel patch from Sailu
Yallapragada that enables reporting of TCP/IP
information for telnetd processes that use the
telnet multiplexor. I don't yet know the kernel
patch ID.

Made the Solaris inclusion of <inet/mi.h> conditional
on the Solaris version. (It's apparently not needed
at 2.6 and above.) Bill Watson <bill.watson@uk.sun.com>
brought this to my attention.

Added alternate Linux 2.4.x lock extent test, supplied
by Jim Mintha <jim@ic.uva.nl>.

Rearranged
the lines and pre-processor tests in
regex.h, lib/regex.c, and lib/snpf.c so that unifdef
can be used to eliminate copyright and GPL statements
when the files aren't being used for a particular
dialect. (USE_LIB_* definitions in a dialect's
machine.h header file determine if one or more of
those three files are to be used.)

Added preliminary support for Solaris 8 with VxFS
3.4. This support will be refined as I get
information from Veritas about how they will
distribute the kernel header files lsof needs.
Those header files were omitted from the standard
VxFS 3.4 distribution. Technical assistance and
testing were provided by Calle Dybedahl <cdy@algonet.se>,

Gary Millen <gary.millen@veritas.com>, Rainer Orth
<ro@TechFak.Uni-Bielefeld.DE>, Peter C. Vernam
<pvernam@draper.com>, and Donna Yobs
<Donna.Yobs@veritas.com>

Tested on FreeBSD 4.3-STABLE.

Dropped the *claim* that lsof works on UNIX dialects
where I no longer have test
systems: BSDI 2.1,
3.[01] and 4.0; DEC OSF/1, Digital UNIX and True
64 UNIX 2.0 and 3.2; FreeBSD 2.1.[67], 2.2[.x],
3.[012345] and 4.[01]; HP-UX 10.20; NetBSD 1.[234];
SCO OpenServer 5.0.5; and SCO UnixWare 7.0

Tested on Solaris 9 BETA, s81_36.

4.57 July 19, 2001
Help (-h) and version (-v) output now have URLs
for the newly created and timeliest lsof FAQ
(00FAQ in the lsof distribution) at:

ftp://lsof.itap.purdue.edu/pub/tools/unix/lsof/FAQ

and the man page for the current lsof distribution
at:

ftp://lsof.itap.purdue.edu/pub/tools/unix/lsof/lsof_man

Based on a report from Steve Laubscher
<slaubs@woodward.com>, modified dlsof.h for PTX
4.6[.1] to avoid a temporary dnlc_t definition
needed at PTX 4.5.1.

Corrected test for old Linux kernels in Configure.
Henri Karrenbeld <ishtar@cal044202.student.utwente.nl>
brought the error to my attention. Limited Linux
claims to 2.1.72 and above in the documentation.

Improved HP-UX 11 Configure
stanza and stream socket
handling.

Constructed a work-around for the HP-UX 11 optional
OnlineJFS package. The work-around sadly requires
lsof to have a private version of the vx_inode
structure, since the OnlineJFS package doesn't
update <sys/fs/vx_inode.h>. Troyan Krastev

<Troyan.Krastev@ricoh-usa.com> brought the bug to
my attention and Michael Bracewell
<michael@ra.TSS.PeachNet.EDU> provided a test system
where I developed the work-around.

Added locale support to lsof's isprint() test,
based on a suggestion from Dan Mercer <damercer@mmm.com>.
Lsof will use setlocale(), when that function and
its supporting <locale.h> header file are available.

Added OpenBSD 2.9 support.

Based on a report from Aaron Rhodes <arhodes@psionic.com>
and with testing help from Aaron, made the lsof
4.56 revision compile and work on OpenBSD 2.6.
While that OpenBSD version is no longer supported,
Aaron's report exposed a Configure script bug
affecting OpenBSD versions
lsof does support.

Updated for FreeBSD 5.0-CURRENT. Szilveszter Adam
<sziszi@petra.hos.u-szeged.hu> help test. The lsof
FreeBSD ports packager, David O'Brien <obrien@FreeBSD.org>,
assisted.

Tested on AIX 5.1. Loc Le and Nasser Momtaheni of
IBM provided test systems.

4.58 September 13, 2001
Added options to safestrprt() and safestrprtn() to
surround the string with "" and to suppress the
printing of an ending '\n'. Use of these functions
in device cache file error message reporting answers
a suggestion for better error reporting from John
Jackson <jrj@purdue.edu>.

Fixed a Solaris 2.6 and above problem related to
searching for "large" (O_LARGEFILE) files by name;
lsof was using the wrong version of [l]stat(2).
The bug was reported by Daniel Trinkle
<trinkle@cs.purdue.edu>.

Added AIX 4.1.4 and above XTI socket support.

Added OSR Xenix Shared Data and Semaphore file type
support with modifications supplied by Bela Lubkin.

Updated

OPENSTEP support with modifications from Carl
E. Lindberg <lindberg@clindberg.org>. The changes
enable the correct reporting of executable and
library open files ("txt" type).

Limited claims of OpenServer support to the versions
where I currently test, 5.0.4 and 5.0.6. (Lsof
probably works on 5.0.5.)

Enabled processing of -C option for PSTAT-based HP-UX
lsof.

Enabled and tested on FreeBSD 4.4.

Corrected a file system test example in 00QUICKSTART,
based on a report from Jun Biao WANG <wangjunb@cn.ibm.com>.

Made available for re-distribution a user-contributed
port of lsof 4.51 to Reliant UNIX 5.45. Thomas
Mauterer <Thomas.Mauterer@philosys.de> contributed
the port.

4.59 October 20, 2001
With the closing of the Sequent Synergy Links Lab
by IBM, terminated lsof support for PTX. The last
tested PTX lsof revision, 4.58, is available on
lsof.itap.purdue.edu in .../lsof/OLD/src.

Adjusted for FreeBSD 5.0-CURRENT NFS header file
changes, based
on a report from Jos Backus
<josb@cncdsl.com>.

Corrected a bug in the way Linux lsof identifies
the owner of a process. Lionel Cons <lionel.cons@cern.ch>
reported the problem and tested the fix. Added
code to avoid stat(2) calls on regular Linux files
whenever possible. Lionel reported the need to do
this (AFS files) and tested the new code.

Added new output field for raw device number in
hex. The field is identified with 'r'. This field
is NOT selected when -F or -F0 is specified so that
its appearance won't disturb existing scripts that
process field output.

Added support for OpenUNIX 8. A test system was
provided by Larry Rosenman <ler@lerctr.org>.

Matthew Thurmaier <matt@compclass.com> and many
people from Caldera provided technical assistance.

Added an additional UVM test to the NetBSD Configure
stanza. Andrew Brown <atatat@atatdot.net> supplied
the test; it recognizes NetBSD 1.5Y UVM changes to
the vnode structure recently committed
by Chuck
Silvers.

Applied Configure and get-xnu-headers.sh script
changes suppled by Allan Nathanson <ajn@apple.com>
for Darwin 1.4.

Added for Bela Lubkin <belal@mammoth.ca.caldera.com>
OSR-specific environment variables to supply values
to the Configure script. The variables are described
in 00XCONFIG.

Added an IP version selector to the -i option
parameters.

4.60 November 9, 2001
Added special handling to and corrected bugs in
the matching of IPv4 in IPv6 addresses to -i6:<...>
selectors.

Made 00FAQ corrections and updates, based on
discussions with Igor Schein <igor@txc.com>.

Modified Configure script to detect a 64 bit capable
gcc compiler and permit it to be used to build 64
bit (PA-RISC 2) lsof for HP-UX 11.00. Tested with
HP's gcc package, which Rich Rauenzahn of HP kindly
installed on a test system at HP. Stefan Marquardt
<stefan.marquardt@hagebau.de> helped test.

Made lsof's method of killing its child process
more
robust, based on a suggestion from Bela Lubkin
<belal@caldera.com>.

Modified all dialect Makefile segments to accept
select -v #define's from the environment -- a
builder's comment, host, logname, system information
and user name. This was done for Bela Lubkin, so
he can "tune" the -v output when he packages lsof
in the upcoming Caldera OSR 5.0.7 release.

Changed Perl scripts in scripts/ to put the lsof
path consistently in $LSOF. Also added a fix from
Bela Lubkin to scripts/big_brother.perl5 that allows
it to tolerate SCO OSR "ago" clauses in open UDP
file information. Strengthened emphasis in
scripts/00README that the scripts are examples that
shouldn't be expected to run on all UNIX dialects
without modification.

At Bela Lubkin's suggestion changed the device
cache file format examples in 00DCACHE and 00FAQ
to avoid "%U%". That's an SCCS escape sequence.

Added support for OpenBSD 3.0.

Added +DAportable to CFLAGS for 32 bit HP-UX 11.
Amir
Katz <Amir_Katz@bmc.com> suggested the addition.

4.61 January 22, 2002
Updated field output example Perl scripts in the
scripts/ subdirectory to discover the lsof path,
starting at .. and proceeding through the PATH
environment variable's directories.

Added minor OSR Configure script fixes, provided
by Bela Lubkin <belal@caldera.com>.

In response to a report from Joshua Wright
<Joshua.Wright@jwu.edu> modified NetBSD and OpenBSD
Configure stanzas and sources so that lsof can be
built when there is no system source tree (e.g.,
/usr/src/sys).

In response to a report from Peter Valchev
<pvalchev@openbsd.org> improved the UVM test in
the OpenBSD Configure stanza.

Updated Configure script to recognize FreeBSD 4.5.
Updated for FreeBSD 5.0 procfs and pseudofs changes.

Updated HP-UX stanza to see if the compiler named
in the LSOF_CC environment variable is the bundled
compiler. If it is, "-O" is omitted from the
compiler flags.

Updated

Digital UNIX 4.x and Tru64 UNIX error message
related to kernel name list failures. Added an FAQ
section about how a kloadsrv daemon failure can cause
knlist(3) to fail. The condition was reported by
Douglas B. Jones <douglas@gpc.peachnet.edu>

Based on a report from Mark W. Eichin <eichin@thok.org>
made Linux lsof capable of handling and reporting
file sizes greater than 32 bits.

Tested on Solaris 9 BETA-Refresh.

Corrected a bug in the matching of IPv4 addresses,
mapped in IPv6 addresses, to an IPv4 parameter to
an -i option.

Ported to 64 bit Power AIX 5.1 kernel with advice
from David Clissold <cliss@austin.ibm.com> and Marc
Stephenson <marc@austin.ibm.com>, and on a test
system provided by Loc Le <lple@us.ibm.com>.

4.62 March 7, 2002
Updated 00README to reflect the usefulness of gcc
for building AIX lsof. Documented a report from
Brian L. Gentry <BGentry@nationsrent.com> of success
on AIX 4.3.3. I documented my success on 32 bit
Power
AIX 5.1 and my lack of success on ia64 AIX
5.1 and 64 bit Power AIX 5.1.

Improved UnixWare >=7.1.1 reporting of UNIX socket
NAME field information for NonStop Cluster systems
with a patch provided by John Hughes <john@Calva.COM>.
Offered John's improvement as a patch to lsof 4.61.

Corrected bugs in handling of open files on block
devices by OSR lsof. The bugs were reported by
Bela Lubkin <filbo@deepthought.armory.com>.

Fixed bug in writing >32 bit device numbers for
block devices to the device cache file.

Added support for reporting block special nodes
not in /dev (or /devices). That required "like
device special" be changed to "like block special"
and "like character special". (00FAQ was updated.)

Based on a report from Peter Valchev <pvalchev@openbsd.org>

improved the definition of the source for NetBSD
and OpenBSD kernel symbols (the nlist() source
file). NetBSD now defaults to getbootfile(3) if
it is available, /netbsd otherwise. OpenBSD
now
defaults to /dev/ksyms if it is available, /bsd
otherwise.

Made possible compilation under BSD/OS (BSDI) 5.0
with changes to Configure, dialects/bsdi/dlsof,
dialects/bsdi/dproc.c and lib/rnmh.c. The changes
were suggested by Steven Hinkle <hinkle@bsdi.com>.
Note that these changes do not substantiate a claim
that lsof works on BSDI 5.0, because I haven't
tested it there.

Updated OpenUNIX private <sys/fs/memfs_mnode.h>,
based on a report from Larry Rosenman <ler@lerctr.org>
that it had been updated by Caldera patch OU800PK3.
Unfortunately the patch only corrects some of the
problems with the header file, so it is still
necessary to distribute a private patched version
of it with the lsof sources.

Applied a man page correction reported by Frederic
Delanoy <max_ok@yahoo.com>.

Corrected cast bugs related to using the HP-UX
bundled C compiler on HP-UX 11.11.

4.63 April 23, 2002
Added HPUX_BOOTFILE environment variable for use
by
the Configure script in determining HP-UX kernel
configuration information -- e.g., the state of
the ipis_s structure in the HP-UX 11 kernel. The
change was suggested by Marc Bejarano <beej@alum.mit.edu>.
Marc also suggested some changes to the HP-UX
section in 00FAQ that discusses Configure's use of
q4 for HP-UX 11.

Fixed a bug in the Solaris lsof file system matching
code. It was not reporting that VCHR files in
/devices were in / when /devices was in /, too.

Corrected bugs in device number, file size, file
offset, and raw device number field output generation.

Added recognition of OpenBSD 3.1 to the Configure
script with a suggestion from Peter Valchev
<pvalchev@sightly.net>. Note that this change does
not constitute a claim that lsof works on OpenBSD
3.1, because I haven't tested it there.

Built an automated test suite. (See 00TEST and
the tests/ sub-directory of the lsof main directory).
Bela Lubkin requested it. Dale Talcott, John
Hughes,
and Larry Rosenman helped me validate it
on their systems.

During the development of the test suite I discovered
the following lsof bugs or missing features, and
corrected or supplied them.

* Corrected the reporting of locks for:
  o Digital UNIX 4.0d and Tru64 Unix 5.[01];
  o HP-UX 10.30 and 11.00;
  o OpenUNIX 8;
  o UnixWare 7.1.1.

* Enabled HP-UX 10.30 and 11.00 to report open NFS
  file link counts.

* Corrected the reporting of UNIX domain socket
  names for Apple Darwin, FreeBSD 4.5 and above,
  NetBSD 1.4.1 and above, and for OpenBSD 3.0 and
  above.

* Enabled HP-UX 11.11 to stat(2) large files.

* Fixed handling of combination 32 and 64 bit
  device numbers in AIX 64 bit architectures.

Updated the AIX 4.3.3 NFS rnode recognition code,
first installed at revision 4.51. It looks like
some IBM update has restored a single rnode structure
independent of the machine bit width.

Updated the NetBSD and OpenBSD sources so NetBSD
can
process DTYPE_PIPE files, as OpenBSD was already
able to do.

Updated Darwin get-xnu-headers.sh script to reflect
information about a recent reorganization of the

Darwin CVS hierarchy, supplied by Allan Nathanson
<ajn@apple.com>.

Added defense against the standard I/O descriptor
attack.

4.64 June 26, 2002
Corrected some FreeBSD pre-processor directives.
David O'Brien <obrien@NUXI.com> pointed them out.

Updated lsof's main() function to: 1) close all
open file descriptors above 2 before starting; and
2) to set a non-interfering umask. Moved GET_MAX_FD
test from misc.c to proto.h, so that main() could
use it. Added multiple-include protection to
proto.h.

Moved FAQ's test suite Q's & A's to a more appropriate
section. Added a Q&A on HASSECURITY option and
its affect on searching for open files. (That was
already in the man page.)

Updated hpux/kmem/dnode.c for HP-UX < 11 compilation
with information from John Dzubera <Zube@CS.ColoState.EDU>.
While
lsof doesn't support HP-UX < 11 any more, I
try to avoid disabling it there when possible, and
a locking fix for HP-UX >= 11 in lsof 4.63
inadvertently disabled compilation of lsof for
HP-UX < 11. Fixed long-standing bug in HP-UX 10.20
lock reporting.

Removed language from the test suite programs that
requires an ANSI-C compiler. This allowed the test
suite to be validated with cc and gcc on the un-
supported HP-UX 10.20.

At the suggestion of Manuel Bouyer <bouyer@antioche.eu.org>
switched NetBSD and OpenBSD lsof from using nlist()
to using kvm_nlist(). Made the same change for
BSDI, Darwin, and FreeBSD.

Validated test suite on OPENSTEP 4.2.

In response to a suggestion from Jeff Stoner
<jstoner@blackboard.com> enhanced support for the
FD list of the -d option to allow it to be either
an exclusion or inclusion list, using the '^' prefix

to denote exclusions.

Made adjustments for FreeBSD 4.6 and 5.0-CURRENT.
Fixed a
FreeBSD /etc/make.conf CFLAGS extraction
bug, reported by Kris Kennaway <kris@obsecurity.org>,
and new a bug in the fix, reported by Eric Cronin
<ecronin@eecs.umich.edu>

Added nullfs support for FreeBSD, NetBSD, and OpenBSD
at the request of Andrew Brown <atatat@atatdot.net>.

Modified all readmnt() functions to ignore mounted-on
directory names that don't begin with '/'.

Tested on NetBSD 1.6A and OpenBSD 3.1.

Upgraded to Solaris 9 FCS with two changes to the
BETA-Refresh support: 1) an adjustment to dnode.c
for a change in the so_so (sonode) structure; and
2) addition of Solaris 9 FCS specific DNLC code.
David Comay <David.Comay@Eng.Sun.COM> sent me the
dnode.c change and Casper Dik <Casper.Dik@sun.com>
helped with the new DNLC support code.

Applied OpenUNIX changes that permit lsof to compile
and run on the upcoming 8.0.1 release. The changes
were supplied by Robert Lipe <robertl@caldera.com>.
Larry Rosenman <ler@lerctr.org> provided a test
system.

Added
Solaris fd file system support.

4.65 October 10, 2002
Adjusted for change in FreeBSD 5.0-CURRENT inode
structure, reported by David O'Brien <obrien@NUXI.com>.
Adjusted for changes in FreeBSD 5.0-CURRENT <sys/vnode.h>.
One change was reported by Anders Nordby
<anders@FreeBSD.org>. Adjusted for FreeBSD 5.0-CURRENT
on sparc64 architecture.

Enhanced the error reporting of Solaris lsof when
it detects a kvm_open() failure, and added a 00FAQ
entry on the cause, based on a report from Peter
J. Bertoncini <pjb@anl.gov>.

Enabled compiling of lsof for NetBSD 1.5 with the

NULL file system, using a patch from Andrew Brown
<atatat@atatdot.net>.

Removed a hack in the LTbigf test program that was
once needed when it was compiled on Solaris 9 BETA-
Refresh with gcc. The hack isn't needed on Solaris
9 FCS. Janet Hempstead <jan@library.carleton.ca>
brought the need for this change to my attention.

Applied a patch, supplied by Andrew Brown
<atatat@atatdot.net>,
that updates lsof for NetBSD
version 1.6F. Corrected handling of the NetBSD
nullfs.

Updated to BSDI BSD/OS 4.3 on a test system kindly
provided by Terry Kennedy <terry@tmk.com>.

Updated to FreeBSD 4.7.

Updated to Apple Darwin 1.5, 5.x and 6.x with
patches supplied by Allan Nathanson <ajn@apple.com>.
The patches include IPv6 support.

Updated Configure to use the -bnolibpath loader
option when building lsof on a PowerPC, running
AIX 5 or greater. Valdis Kletnieks
<Valdis.Kletnieks@vt.edu> informed me this was
needed. Lsof for AIX 5.x was initially developed
on the IA64, where -bnolibpath can't be used and
I didn't think to restore it to PowerPC loads when
AIX 5.x became available for that architecture.

Updated to UnixWare 7.1.3 on a test system provided
by Larry Rosenman <ler@lerctr.org>. Removed claims
that lsof works on OpenUNIX 8.0.1, because UnixWare
7.1.3 is the release name of OpenUNIX 8.0.1.

Based on a comment
that his e-mail address was
wrong in the lsof distribution from Kenneth Stailey
<kstailey@disclosure.com>, removed all e-mail
addresses from lsof documentation files except this
one, 00DIST. The addresses in 00DIST are used to
send revision release notices to those who contributed
to a revision, but the addresses in this file for
previous revisions and in other documentation files
sometimes grow stale and are never validated.

4.66 December 22, 2002
Acquired Solaris 7 and 8 test systems, courtesy of
John Dzubera <Zube@CS.ColoState.EDU>. Updated
00TEST and tests/TestDB accordingly.

Clarified FreeBSD 5.0 architecture claims at the
suggestion of David O'Brien <obrien@NUXI.com>.
Also implemented David's suggestion to change
Intel to x86.

Installed changes to DNLC handling in OSR lsof in
preparation for handling changes in the OSR 5.0.7
DNLC cache. Information about the changes and
patches to handle them were supplied by Bela Lubkin
<filbo@deepthought.armory.com>.

Upgraded
True 64 UNIX support to the 5.1B release
on a test system provided by Berkley Shands
<berkley@cse.wustl.edu> Had to used relaxed ANSI
compilation because of an error in a system header
file and other lsof source usages.

Implemented the HASNOSOCKSECURITY compile-time
option. When it and HASSECURITY are defined, lsof
will be built to list only the user's open files,
but will also list anyone else's open socket files,
provided the "-i" option selects their listing.
Updated the Customize script to ask about setting
HASNOSOCKSECURITY. Left it undefined in all dialect
machine.h header files. This change was requested
by Kenneth Stailey <kstailey@speakeasy.net> for
use with ntop.

Added support for OpenBSD 3.2 and its kernel trace
file.

Improved lsof help (-h) and version (-v) information
reporting.

Fixed a FreeBSD 4.7 and above off-by-two UNIX domain
socket path termination bug, reported by Ken Stailey
<kstailey@speakeasy.net>

4.67 March
27, 2003
Began the transition of the lsof ftp server host

name from vic.cc.purdue.edu to lsof.itap.purdue.edu.
That reflects Purdue organizational changes. This
first step makes the new name an alias to the old
one. The old name, vic.cc.purdue.edu, will remain
usable for an extended period.

Corrected a revision number reference in section
17.17 of 00FAQ on the appearance of Solaris negative
DNLC caching handing.

Updated 00FAQ discussion of compilers for 64 bit
Solaris.

Validated test suite for 64 bit Solaris 8 and gcc.

At the request of Alek O. Komarnitsky <alek@komar.org>
added the "+c <width>" option to enable optional
changing of the COMMAND column output maximum width
from the default to <width>. The default maximum
width remains CMDL, as defined in lsof.h.

Fixed three AIX kernel bit size detection bugs,
one in the AIX Configure script stanza, the second
and third in the AIX dproc.c get_kernel_access()
function.
The bugs were reported by Pierre-Yves
Fontaniere <pyf@cc.in2p3.fr>, who tested the fixes.

Added kernel event queue file support for FreeBSD,
NetBSD and OpenBSD. Andrew Brown <atatat@atatdot.net>
supplied the code.

Updated to AIX 5.2 on a test system provided by
Dale Talcott <dtalcott@purdue.edu>. Had to build
work-arounds for two missing AIX 5.2 header files,
<j2/j2_snapshot> and <proc/proc_public.h>. Corrected
an off-by-one UNIX socket addressing bug. Taught
AIX lsof to handle both jfs and jfs2 files at the
same time. Adjusted for an IBM mistake in the
sizing of the fdsinfo structure in <procinfo.h>
Toshiya Nakamura <TOSHIYAN@jp.ibm.com> helped test,

Updated to FreeBSD 4.8. Corrected another bug in
FreeBSD UNIX domain socket name handling.

Corrected gcc build problems on HP-UX 11i, reported
by Yuliy Minchev <yuliy@mobiltel.bg>.

Updated BSDI BSD/OS support to 4.3.1.

Augmented a lock ID test on NetBSD to check if the
ID
is an LWP pointer.

4.68 June 18, 2003
Enhanced Configure script's cleanup operations.

Added support for OpenBSD 3.3, based on a report
from Peter Valchev <pvalchev@sightly.net>.

Improved the description of the detached PGP
signature certificate file in the main lsof README
file, based on a suggestion from Diana Stockdale
<diana@mpl.ucsd.edu>.

Installed a work-around for FreeBSD 5.0-CURRENT on
Alpha to avoid a compiler register use complaint.

Corrected a 'c' option error message. Gnele
<blaadeleng@yahoo.com> reported the problem.

Upgraded EXT2FS and UFS support for NetBSD and
OpenBSD to handle new inode information, and the
fast UFS1 and UFS2 file systems.

With the help of Andrew Brown <atatat@atatdot.net>
determined the NetBSD snapshot (1.6F) at which
<sys/mount.h> could be included under _KERNEL, thus
eliminating the lsof netexport.h hack. The same
change applies to OpenBSD versions 3.3 and above.

Applied a patch from Armin Gruner
<ag@muc.de> that
corrects the use of the HASPROCFS definition in the
FreeBSD dialect sources.

Corrected spelling errors in 00FAQ and in the
generated 00.README.FIRST_<version> file of the
distribution archive. John Jackson <jrj@purdue.edu>
and Ray Phillips <r.phillips@jkmrc.uq.edu.au>
spotted and reported the errors.

Corrected a spelling error in a comment and incorrect
use of an alarm function in the LTsock test program.

At the suggestion of Stuart Anderson <sba@srl.caltech.edu>

added preliminary (and incomplete) SAM-FS file system
support to Solaris lsof. Completion awaits availability
of SAM-FS internals.

Fixed a Solaris device name printing bug, reported by
Ric Anderson <ric@tick.Telcom.Arizona.EDU>, only
visible when HASDCACHE is not defined. Ric helped
test the fix.

Fixed an AIX kernel bit size handling bug related
to the NFS node (rnode) structure.

Corrected a print_kptr() function call error in the AIX
AFS code, reported by David
Steiner
<david.r.steiner@Dartmouth.EDU>. Upon further reflection
and because I no longer have appropriate AIX AFS test
systems, disabled AIX AFS support in the Configure script
for AIX versions above 4.3.3.0 or AIX AFS versions above 3.5.

Added support for FreeBSD 5.1.

With advice from Allan Nathanson <ajn@apple.com> adjusted
the Darwin get-xnu-headers.sh script to access the kernel
header files needed by lsof from a new form of the Apple
open source repository.

Installed Linux and lsof library bug fixes and
improvements, supplied by Marian Jancar <mjancar@suse.cz>.
One Linux improvement handles mount strings that
have octal escapes in them, eg., \040 for embedded
blanks. Marian tested the changes.

4.69 October 16, 2003
Received and applied an OpenBSD patch from Peter Valchev
<pvalchev@sightly.net> that replaces a ctob() call with
a sysconf() call. Peter claims sysconf() is needed for
OpenBSD on SPARC. (It is not needed for NetBSD on SPARC.)

With
the upgrade of my only Solaris 7 test system
to, Solaris 8, dropped the *claim* that lsof works
on Solaris 7. That doesn't mean it won't work
there, so those who want lsof for Solaris 7 probably
should be able to build it there and it probably
will work there.

Revised lsof's DNLC handling for BSD derivatives,

including: BSDI; Darwin, DEC OSF/1, Digital UNIX
and Tru64 UNIX; FreeBSD; NetBSD; and OpenBSD. The
latest NetBSD distribution's dropping of the vnode
capability ID (v_id) required the revision.

Adjusted to the latest FreeBSD 5.1-CURRENT.

Added NetBSD support for using kvm_getproc2().

Added a patch from Andrew Brown <atatat@atatdot.net>
to handle NetBSD enum conflicts and changes in the
<miscfs/kernfs/kernfs.h> and <miscfs/procfs/procfs.h>
header files.

Added a "#define _KERNEL" to the AIX dnode2.c source
file for compatibility with a new <j2/j2_inode.h>
AIX 5.2 header file version. The addition was
supplied by Dick Dunbar
<Dick.Dunbar@Siebel.com>
and was offered as a patch to lsof 4.68/

Added support for a second type of Solaris SAMFS.
Stuart Anderson <sba@srl.caltech.edu> provided the
support. SAMFS support in lsof SOLARIS remains
scanty, because Sun won't release any details on
its kernel structures.

Dropped the *claim* that lsof works on AIX 4.3.3,
because I was unable to test it there. That doesn't
mean it won't work there, so those who want lsof
for AIX 4.3.3 probably should be able to build it
there and it probably will work there.

Updated for Solaris 10 on test systems provided by
Mike Miscevic <miscevic@hotpop.com>. Casper Dik
<casper@holland.sun.com> provided significant help.
During the Solaris 10 port found and fixed an lofs
handling bug that prevented reporting of open lofs
file lock status.

Updated the DNLC test, LTdnlc, to provide a possible
explanation about file systems on which the test
might fail.

Modified the procedure for obtaining
missing Darwin
XNU kernel header files. The new one requires more
manual intervention, but is the best that can be

done with the way Apple open sources are now organized. 00FAQ explains the new procedures for those not used to downloading Apple open source files.

Added support for Apple Darwin 7.0 (Mac OS X 10.3) with patches supplied by Allan Nathanson <ajn@apple.com>. Dropped the *claim* that lsof builds and works on Apple Darwin below 6.0.

Validated lsof on FreeBSD 4.9, using a test system provided by Ben Lewis <bl@purdue.edu>.

Validated lsof on FreeBSD 5.1-CURRENT for Amd64. David O'Brien <obrien@FreeBSD.org> provided a test system.

Changed the NetBSD Configure stanza to do header file searches in /usr/include by default. The LSOF_INCLUDE and NETBSD_SYS environment variables may still be used to specify other search paths. Discussions with Andrew Brown and Wolfgang S. Rupprecht <wolfgang@wsrcc.com> led to the change.

4.70 January 16, 2004

Improved shell-portability of the linux stanza of the Configure script with a patch from Paul Jarc <prj@po.cwru.edu>.

Added a "silent" rule to tests/Makefile for Paul. Updated, extended and clarified the test suite documentation in 00FAQ and 00TEST.

Fixed Solaris 10 dlsof.h typo, reported by Mike Miscevic <miscevic@hotpop.com>. The typo prevents lsof from loading cleanly in Solaris 10 builds past 40.

Fixed a Solaris HSFS node number reporting bug and added a structure definition work-around for Solaris 10.

Converted PGP signing to GPG. My previous PGP key can be used, but the gpg "--allow-non-selfsigned-uid" option may have to be used when it is imported into a GPG key ring.

Added bz2 compression.

Updated for OpenBSD 3.4.

Added a work-around for a missing header file in the s10_44 Solaris 10 build.

Added support for FreeBSD 5.2-BETA and 5.2-CURRENT.

Updated Linux AX25 support with modifications supplied by Lutz Poetschulat <dl9cu@db0zwi.de>.

Added raw IPv6 support to Linux lsof.

Improved handling of parameters after "-i@".

Improved file name test in LTdnlc.c.

Added loop count controls to the reading of Solaris lock chains. The change was implemented as a result of a report from Steve Gonczi <steve@relicore.com>.

Based on a report from John Jackson <jrj@purdue.edu>, enabled a Solaris 10 <sys/lgrp.h> work-around for Solaris 9, too. (Patch 112233 installs an lgrp.h on Solaris 9 that needs the work-around.)

With help from Andrew Brown <atatat@atatdot.net> and John Heasley <heas@netbsd.org> added log-structured file system (LFS) support for NetBSD and OpenBSD.

Added AMD64 to the list of FreeBSD 5.x-CURRENT supported architectures. FreeBSD.org provides a test system, courtesy of (I believe) David O'Brien <obrien@FreeBSD.org>.

Added a cast to lseek() in the HP-UX /dev/kmem-based kread() function to make it work properly with the bundled HP C compiler.

4.71 March 11, 2004

Added text file support to Apple Darwin lsof and enabled the lsof executable portion of the LTbasic test. Added support for Darwin kernel queue, POSIX semaphore and POSIX shared memory files. Tested on Darwin 7.2 (aka Mac OS 10.3.2).

Added process_kqueue() function prototypes for FreeBSD, NetBSD and OpenBSD.

Picked some lint in AIX sources, lib/rnmh.c and tests/LTsock.c.

Added "-x [fl]" cross-over option, which enables +d and +D processing to cross over symbolic links and|or file system mount points. Discussion with Johan Lindquist <johan@smilfinken.net> and Eric Williams (aka The Ghost In The Machine) <ewill3@earthlink.net> on Linux news groups revealed the need for the option.

Updated support for UnixWare 7.1.4.

Added support for the optional reporting of socket options, socket states and TCP flags for most currently supported dialects. John Smith <lbalbalba@hotmail.com> and Tristan Nefzger <tn@bhtrader.com> requested the information.
The dialects and their versions for which this feature has become available include:

AIX 4.3.2 and 5.[12]
Apple Darwin 7.2
BSDI BSD/OS 4.3.1
Digital UNIX and Tru64 UNIX 4.0
FreeBSD 4.9 and 5.2
HP-UX 11 and 11.11 (aka 11i)
NetBSD 1.6ZH
OpenBSD 3.4
OPENSTEP 4.2
OpenUNIX 8
SCO OpenServer Release 5.0.6
Solaris 2.6, 8, 9 and 10
UnixWare 7.1.[134]

Modified the Configure stanza for HP-UX 11 with better q4 detection. Steve Bonds <3vhmxxm02@sneakemail.com> supplied the modification.

Applied a patch from Mike Miscevic <miscevic@hotpop.com> to enable lsof to compile with the zone support in the Solaris 10 s10_b51 release. Added information on lsof zone behavior to 00FAQ.

Added a "-z [z]" option to Solaris 10 lsof. It enables the listing of zone name and can also be used to select

the listing of processes and their files from specified
zones.

4.72 July 13, 2004
Corrected
Solaris 10 ZONE column title display bug with
a patch from Joep Vesseur <Joep.Vesseur@Sun.COM>. Joep's
fix was offered as a patch to 4.71.

Based on a report from Jean-Pierre Radley <jpr@jpr.com>
about an unexpected GNU uname Configure interaction on
OSR, and working from information received from Bela
Lubkin, changed the OSR Configure stanza to use
/bin/uname instead of uname. Added an FAQ entry about
Configure version detection problems.

Added the +m and "+m m" options in response to a dialog
with Robert T. Brown <rbrown@netmentor.com>. The
options allow the creation of a mount table supplement
file which can be used on selected dialects to get
device numbers when stat(2) and lstat(2) can't deliver
them. (That's generally the result of an inaccessible
NFS server.) Currently the new options are supported
only on Linux.

Made cpumask_t typedef _KERNEL compensation for FreeBSD
5.2-CURRENT. Refined it for 5.2.1-RELEASE with testing
help from
Scott Ellentuch <tuc@ttsg.com>.

Added support for FreeBSD 4.10. Larry Rosenmann
<ler@lerctr.org> kindly provided a test system.

Added support for NetBSD 2.0 with patches supplied by
Andrew Brown <atatat@atatdot.net>. Andrew also
provided two test systems.

Made handling of Linux maps file more robust, based on
a report from Jan Blunck <J.Blunck@tu-harburg.de>. As
a side benefit, made handling of generated stat(2)
information more flexible.

As a result of a discussion with Jason Fortezzo
<fortezza@mechanicalism.net>, adjusted lsof for Solaris
to obtain the maximum user name length from ut_name of
the utmpx structure, if <utmpx.h> exists.

Tested under OpenBSD 3.5.

Updated 00README information about using gcc (via the
Configure aixgcc abbrevisiation) to compile lsof on
AIX. Ann Janssen <ajanssen@nebook.com> made me aware
the information was out of date.

Added an AIX SIGDANGER handler and some 00FAQ sections
on lsof memory usage after a discussion
with Tom Qin
<tom.qin@citigroup.com> about lsof memory usage.

Added scripts/sort_res.perl5, contributed by Fabian
Frederick <fabian.frederick@gmx.fr>. The script
displays lsof output sorted by size and path name.

Improved handling of files on Linux NFS mount points
that use the root_squash option, based on discussions
with Paul Szabo <psz@maths.usyd.edu.au>.

Updated FreeBSD 5.2-CURRENT support, based on a problem
report from Filippo Natali <filippo@widestore.net>.

Corrected improper FreeeBSD 5.x-CURRENT #if condition,
reported by Kim Culhan <kimc@kim.net>.

Added a Configure script work-around for AIX 5.2 lsof
with JFS2, compiled by gcc >= 3.3. The work-around
was supplied by Florian M. Weps <fmw@hactrn.ch>.

4.73 October 21, 2004
Added an __XPG4_CHAR_CLASS__ #define before
#include'ing <ctype.h> on Solaris to restore lsof's
ability to display special characters such as acute-e.

Added wide-character (e.g., UTF-8) support where
possible,
prompted by a request from Kyungjoon Lee
<kjoonlee@gmail.com>. Some older dialects -- e.g.,
NetBSD 1.4.1 -- don't support wide characters, so the
wide character support is enabled by definitions in
each dialect's machine.h. Dialects with wide-
character support are listed in 00FAQ.

Make a FreeBSD 5.2-CURRENT adjustment for <sys/pipe.h>,
supplied by Sergey A. Osokin <osa@FreeBSD.ORG>.

Implemented a Linux feature request made by Jakub
Jelinek <jakub@redhat.com> that enhances lsof's ability

to locate UNIX domain sockets whose paths are named as arguments. Jakub supplied suggested code.

Dropped *claims* that lsof works on AIX below 5.1, SCO
Dropped *claims* that lsof works on AIX below 5.1, SCO
Openserver 5.0.4, Tru64 UNIX 5.0, and UnixWare below 7.1.4. Lsof will probably build and work on those UNIX dialect versions, but I no longer have any way to test lsof on them.

Added support for FreeBSD 5.3 and 6.0. The FreeBSD 5.3 support hasn't
been tested.

Added FD test code that will allow dialect versions to test FD option selections. Used the new code in the PSTAT-based HP-UX lsof to enable it to avoid scanning the mount table when its information is not needed. The addition was made in response to a query from Harvey Garner <Harvey.Garner@championusa.com> about lsof performance in a busy NFS environment.

Upgraded lsof's AIX support level to AIX 5.3, based on a report from Dick Dunbar <Dick.Dunbar@Siebel.com>. (I have not tested lsof under AIX 5.3.) Based on Dick's recommendation and local testing changed the C for AIX version 6 and higher -qmaxmem option value to -1.

Made LSOF_AR environment variable more useful and documented it in 00XCONFIG.

Corrected the use of sum(1) to generate signatures for the lsof distribution and binaries to match the documentation that claims it is sum -r output. Jin Guojun <jin@george.lbl.gov> noticed and reported the problem.

Tested under OpenBSD
3.6.

Added checksum and GPG certificate files for the bz2, gz and Z lsof distribution archives. The new files reside with the distribution archives and supplement the signature information already inside the archives.

Validated on Solaris 10, i8xpc, build s10_63.

4.74 January 17, 2005

Fixed a Solaris segment fault bug on systems that lack
a /dev/allkmem device. Offered the fix as a patch to
lsof 4.73. The bug was reported by Donald Zoch
<donald.zoch@amd.com>.

Updated lsof for FreeBSD 6.0 and higher for a change in
<sys/vnode.h>, based on a report from Sergey A. Osokin
<osa@FreeBSD.ORG>. Made the update available in a 4.74
'A' edition pre-release.

Filed an HP bug report about missing pstat(2) CWD info
for LOFS on HP-UX 11.11 and higher. The missing CWD
info was noticed by Ermin Borovac <e.borovac@bom.gov.au>.
Added info to 00FAQ about the problem, which can cause
the lsof test suite's LTbasic test to fail.

Updated the q4-generated tcp_s.h
in the lsof
distribution and added socket option support for HP-UX
11.00. Erwin Reyns <ereyns@europarl.eu.int> helped
test.

Updated for Solaris 10, build s10_69, with a patch
supplied by Mike Miscevic <miscevic@hotpop.com>.

Added v_path support to Solaris 10 lsof. That relieves
it of having to read and decode the kernel DNLC, and
delivers full paths more reliably.

Added specialized NFS4 support to Solaris 10 lsof.

Applied Solaris 10 patches to lsof supplied by Casper
Dik <casper@holland.sun.com>.

Updated lsof for NetBSD 2.99.10 and tested it on a
system provided by Andrew Brown <atatat@atatdot.net>.

Added support for the FreeBSD 6.0-CURRENT f_vnode
pointer in the file structure.

Added BSDI, FreeBSD, NetBSD and OpenBSD support for the
*effnlink member of the inode structure. This makes
the lsof LTnlink test run faster on all modified
dialects and correctly on OpenBSD.

Added ptyfs support for NetBSD, using modifications
provided

by Andrew Brown.

Changed the netbsd Configure stanza to look by default for system header files in both /usr/include and /usr/src. (The NETBSD_SYS environment variable can still be used to select an alternate for /usr/src.)

Corrects two FreeBSD 4.10 RPC/XDR type definitions.

Added an FAQ Q&A about setuid and setgid restrictions in HP-UX 11.11. The information in the answer was supplied by Frank Sanders <frank.sanders@siemens.com>.

Added abbreviations for AXI FCIO and FSNAPSHOT file flags. Holger VanKoll <Holger.VanKoll@swisscom.com> reported the missing FCIO.

Adjusted lsof's private AIX 64 bit rnode structure for 64 bit AIX 5.2 systems. (IBM doesn't distribute a correct <nfs/rnode.h> for it.)

Corrected a Linux socket inode printing bug reported by Igor Schein <igor@txc.com>.

Updated for FreeBSD 4.11. The support compiles but hasn't been tested.

Back-ported a FreeBSD 6.0-CURRENT fix to FreeBSD 5.3-RELEASE-p1. That was done to solve a compilation problem reported by Radko Keves <rado@daemon.sk>.

4.75 May 16, 2005

Dropped the *claim* that lsof works on DEC OSF/1 and Digital UNIX, since my last 4.0 test system has been removed. The last tested distribution of lsof on DEC OSF/1 and Digital UNIX was revision 4.74. It has been archived on lsof.itap.purdue.edu in pub/tools/unix/lsof/OLD/src.

Added negation forms to the values in the -g (PGID) and -p (PID) lists. Negated PGID and PID values, like negated UID or login name values, are applied without ORing or ANDing and take effect before any other selection criteria are applied.

At the request of Marcin Gozdalik <gozdal@gmail.com> added a -X option for Linux. The option inhibits the reading of the /proc/net/tcp* and /proc/net/udp*

files.

Based on a report from David Gutierrez
<davegu1@hotmail.com> changed DEC OSF/1 process table
allocation to request memory in smaller increments.

Based on a report from jayjwa <jayjwa@atr2.ath.cx>
updated
the Customize script to use "tail -n 1" where
possible.

Enabled support for FreeBSD 5.4.

Improved the BSDI, FreeBSD, NetBSD, OpenBSD and Solaris
kvm_open() and kvm_openfiles() error messages.

Enabled support for NetBSD 2.99.12.

Improved HP-UX Configure stanza with help from Piet
Starreveld <pstarrev@csc.com>. Picked some lint Piet
found.

Enabled IPv6 support for HP-UX > 11. Piet Starreveld
helped test it on 11.23, among others.

Updated for HP-UX 11.23 on the ia64 architecture.

Updated to latest FreeBSD 6.0-CURRENT, using a test
system provided by Andrzej Tobola <ato@iem.pw.edu.pl>.

Added support for SCO OSR 6.0.0 and UnixWare 7.1.4 with
help from Richard at SCO.

Corrected a Linux bug in NFS handling, reported by Karel Zak
<kzak@redhat.com>. Karel supplied a patch.

Improved the code for accessing an AIX 3.2 and higher
sockaddr_un structure, thus eliminating a segmentation
fault possibility.

Updated for AIX 5.3.

Added
preliminary (DEBUG) support for the AIX SANFS
file system.

Fixed a bug in the Solaris 10 processing of the vnode's
v_path pointer with code supplied by Edward Jajko

<ejajko@portal.com>. The fix was offered as a patch to 4.74.

Dropped support for OpenUNIX 8, since a test system is no longer available. Archived an OpenUNIX-only distribution of the last revision (4.74) tested on OpenUNIX in pub/tools/unix/lsof/OLD/src.

Tested under Openbsd 3.7.

Tested under Darwin 7.7.0.

Enabled building on amd64 Solaris 10 with hints from Marc Aurele La France <tsi@ualberta.ca>. Marc provided a test system.

Supplied a missing quote in the FreeBSD Configure stanza. Carl Cook <Info@quantum-sci.com> reported the problem.

Removed "-O" option from tests/Makefile so that the HP-UX bundled compiler won't complain.

4.76 August 30, 2005

Corrected an example and spelling errors in man page.

Updated for Apple Darwin 8.x with changes supplied by Allan Nathanson <ajn@apple.com>. Allan also provided a test system.

Completed documentation of CLRLFILEADD in all machine.h files.

At the request of Chris Markle <cmarkle@sendmail.com> added partial listen queue length to socket options displayed when -Tf is specified. Partial queue length is not reported for all dialects. (00FAQ lists the ones where it is reported.)

Updated for FreeBSD 7.0 with information supplied by Andrzej Tobola <ato@iem.pw.edu.pl>.

Updated Solaris VxFS support for VxFS versions 4 and above with technical advice from Craig Harmer <craig_harmer@symantec.com>, Gary Millen <gary_millen@symantec.com> and Chuck Silvers <charles_silvers@symantec.com>. Testing help was

provided by Michael Antlitz <mantlitz@prophasys.com>,
Steve Ginsberg <steve@dhapdigital.com> and Kenneth
Stailey <kstailey@yahoo.com>.

Fixed a Solaris address space map processing bug.
Janardhan Molumuri <mjanardhan@gmail.com> reported the
bug and help me identify
it. Made the fix available as
a patch to 4.75.

Added support for Solaris 10 port and CTFS files. The
CTFS support is imcomplete, because I don't know how
to get inode number, size and link count. (There's
a new 00FAQ entry about that.)

Investigated a report from Christopher J Warweg
<warwegc@GAO.GOV> that the CHECKSUMS for the lsof 4.75
binary for 64 bit Solaris 8 was incorrect. It was my
packaging error. I rebuilt and repackaged the binary.

Enabled support for Linux map file names with embedded
spaces.

4.77 April 10, 2006
Added -X option support for Solaris 10 and above. When
-X is specified lsof will report cached v_node path
names for unlinked files, followed by "(deleted)".
Improved cached vnode path name handling by adding
"(?)" to the end of path names of questionable accuracy.
Updated 00FAQ to reflect these changes.

Updated for FreeBSD 7.0-CURRENT.

Fixed name addition spacing bug, reported by Stuart
Anderson <anderson@ligo.caltech.edu>.
Also updated
Solaris 10 SAMFS support at Stuart's request.

Added missing "break;" and another HASSTATVFS test to
the NetBSD and OpenBSD dnode.c. Bill Behr
<bbehr@networkstoragecorp.com> reported those needs.

Fixed an HP-UX 11 file descriptor "chunk" size problem,
reported by Per Allansson <per@appgate.com>. Per helped
devise the fix and tested it. This fix was offered as
a patch to lsof 4.76.

Updated for FreeBSD 6.0-STABLE and FreeBSD

6.1-PRERELEASE.

Updated scripts/sort_res.perl5 with changes supplied by
Frederick Fabian <fabian.frederick@skynet.be>, the
author of the script.

Corrected +|-M man page documentation error, reported
by Roger Cornelius <rac@tenzing.org>.

Improved FreeBSD user device random seed generation in
response to a problem report from Danny Braniss
<danny@cs.huji.ac.il>.

Eliminated three syntax error bugs and other compiler
complaints from the PSTAT-based lsof. H. Merijn Brand
<h.m.brand@xs4all.nl>
reported the problems and tested
the fixes.

Eliminated compiler complaints in the test suite.

Investigated problems with the building of lsof on
PA-RISC HP-UX 11.23, based on a report from John
Orndorff <John.Orndorff@sungard.com>. Found that
neither the HP bundled C compiler nor gcc would build
lsof, but the the HP unbundled ANSI C compiler would.
Concluded that HP bundled C compiler can't handle
<gssapi/gssapi.h>. Devised a work-around to gcc's
omission of the rpcent structure definition of
<netdb.h> that allows it to compile lsof's print.c, but
the resulting binary doesn't run reliably. Documented
the situation in 00FAQ.

Changed reporting of unknown file types. The number of
an unknown type is now reported as four octets. The
change was made in response to a Linux lsof bug report
from Karel Zak <kzak@redhat.com>.

Dropped the *claim* that lsof works on BSDI BSD/OS
since my last test system has been removed. The last
tested distribution
of lsof for BSDI BSD/OS was
revision 4.76. It has been archived on
lsof.itap.purdue.edu in pub/tools/unix/lsof/OLD/src.

As a result of discussing the lsof source tar's MD5
checksum with Andrew Bell <andrew.bell.ia@gmail.com>,
changed the description of a suitable MD5 tool in the

lsof distribution's documentation to name the openssl "dgst" command.

Enabled compilation on Solaris 10 1/06 with a fix sent by Jason Fortezzo <fortezza@mechanicalism.net>. Made the fix available as a patch to 4.76.

Adjusted to FreeBSD 5.5-PRERELEASE.

Corrected a bug in the lsof library's process_file() function to enable the locating of AIX XTI sockets by their TCP/IP address values. The bug was reported by Michel Dubois <Dubois@sears.ca>.

Based on a bug report from Karel Zak <kzak@redhat.com> added command name length checking to as many dialects as possible (Linux for Karel) for the "-c c" option.

Updated for OpenBSD 3.[89]. Tested the 3.9 update on a system
provided by David Mazieres. I have not tested on OpenBSD 3.8, but David reports lsof 4.76 worked there.

Ended regression testing of lsof on 32 bit Solaris 8 with the ending of access to a test system. Lsof continues to be tested on 64 bit Solaris 8.

4.78 April 24, 2007

Added more information to the lsof FAQ about missing link counts and sizes on Linux files.

Simplified Linux stat() and lstat() usage.

Relocated #define's that prevent OpenBSD compilation on systems without a /proc file system. Pieter Bowman <bowman@math.utah.edu> reported the problem.

Added code to avoid processing Linux /proc/<PID>/maps file entries with zero device and node numbers. Some such entries now have names associated with them that are not path names -- e.g., "[heap]", "[stack]" or "[vdso]". Scott Worley <sworley@chkno.net> reported lsof's mishandling of such entries.

Added SELinux security context support, provided by James Antill <james.antill@redhat.com>.

I have not
tested this, but James and Karel Zak <kzak@redhat.com>
have.

Added the #include of <sys/types.h> to Solaris lsof to
enabled compilation on Solaris 10 6/06. Peter Harvey
Peter.Harvey@Sun.COM diagnosed the problem and supplied
a patch.

Added better support for JFS2 on AIX 5.2 and 5.3, based
on bug reports and help from Thomas Braunbeck
<BRAUNBEC@de.ibm.com> and Tom Whitty <TWHITTY@cerner.com>.

Documented that lsof supports AIX 5.3 only up through
maintenance level 1 (ML1).

Enabled Solaris lsof to locate the AFS vnode operation
address for OpenAFS 1.4.1. The fix was supplied by
Robert Jelinek <Robert.Jelinek@MorganStanley.com>.

Enabled support for Solaris 10 ZFS. If the necessary
ZFS header files aren't found, lsof offers the option
to drop ZFS support, to use internal, possibly
inaccurate structure definitions, or to supply a path
to the missing header files. Horst Scheuermann
<Horst.Scheuermann@uni-trier.de> provided a development
system
and helped test the support.

Corrected a typo in the man page, reported by Eric S.
Raymond <esr@thyrsus.com>.

Changed the spelling of macroes to macros in lsof
source and documentations files, based on a suggestion
from Josh Soref <timeless@gmail.com> and verification
with the OED.

The following dialects are no longer supported: 32 bit
AIX 5.2, HP-UX 11, OpenStep 4.2, Solaris 2.6, Solaris
8, True Unix 64 and UnixWare 7.1.4. Lsof may work on
them, but I no longer have test systems for them.
Support for OpenBSD ends at its version 3.9 for lack of
interest in the port.

4.79 April 15, 2008

********** IMPORTANT NOTE **********
* *

```
* Lsof support has been reduced to the following *
* dialects: AIX, FreeBSD, Linux and Solaris, and *
* only in selected versions of those dialects.   *
* The selected versions are listed in this file  *
* and in other lsof documentation.
      *
*                                  *
* I have made this move because of retirement    *
* and because I no longer have many test systems *
* available to me.                         *
*                                  *
* Vic Abell                              *
*                                  *
************************************************
```

Fixed a Solaris VXFS permission problem when accessing the VXFS inode offsets. The bug was reported by Gregory A. Ivanov <ivga@mts.ru>. Gregory tested the fix.

Moved an #include <string.h> later in FreeBSD dlsof.h to enable compilation on recent FreeBSD releases. The change was supplied by Roy Marples <uberlord@gentoo.org>.

Improved Linux /proc file stream reading speed by applying an expanded version of a patch from Eric Dumazet <dada1@cosmosbay.com> that allocates a page size buffer to each stream. Improved TCP, TCP6, UDP and UDP6 hashing
by determining the hash bucket count from the /proc/net sockstat and sockstat6 files. The improvement was suggested by Eric and he provided sample code. Eric also tested both improvements.

Modified Configure script to build lsof on FreeBSD 6.2. Tested it on a system provided by Larry Rosenman <ler@lerctr.org>.

Fixed a Linux maps file processing bug that prevented path names from having an embedded colon. James Lingard <jchl@arastra.com> reported the bug and helped with its fix.

Based on reports from Eric Dumazet and Samuel Thibault <samuel.thibault@ens-lyon.org> added support for the Linux 2.6.22 kernel's /proc/<PID>/fdinfo files -- i.e., file offset and flags. Samuel Thibault provided a test system.

Fixed a Linux UNIX socket memory leak, reported by
Philip Shin <pshin@xceedium.com>. Phillip supplied the
fix.

With generous assistance from HP added support for an HP-UX
11.23 patch that makes TLI/XTI socket address information
available.

Fixed
a header file problem for FreeBSD 6.2 on the Alpha
architecture. The problem was reported by Pekka Honkanen
<phonkane@cc.hut.fi>. Pekka tested the fix.

Based on a report and using suggested fixes from Karel Zak
<kzak@redhat.com>, made these changes to Linux lsof: corrected
a getpidcon() error message; insured that inode numbers are
handled correctly for their unsigned long long type; and
improved SELinux handling. At the request of Alon Bar-Lev
<alonbl@gentoo.org> added the LINUX_HASSELINUX environment
variable to enable or inhibit SElinux support unconditionally.

Updated Configure for FreeBSD 8.0-CURRENT and tested lsof on
AMD64 there.

Added a patch provided by Oles Hnatkevych
<don_oles@able.com.ua> for FreeBSD systems where the root
file system is on a CD9660 device.

Added compensation for the disappearance of FMARK and FDEFER
from the FreeBSD 8.0-CURRENT <sys/file.h>.

Updated FreeBSD lsof with ZFS support. Larry Rosenman
<ler@lerctr.org>,
Erwin Lansing <erwin@FreeBSD.org>, Wesley
Shields <wxs@atarininja.org> and Dmitry Morozovsky
<marck@rinet.ru> provided test systems.

Fixed a socket file identification problem reported by
Pavol Rusnak <stick@gk2.sk>. Pavol also reported the
cause of the problem.

Added the ability to format the repeat mode marker line
with strftime(3), where the dialect supports the
localtime(3) and strftime(3) C library functions. The
addition was suggested by Mike Depot <mdepot@comcast.net>,
who also tested it. The addition required creating a new
main lsof source module, util.c, that contains functions

whose compilation conflicts with the general header file
tree defined by lsof.h and dlsof.h.

Based on reports from Andrei V. Lavreniyuk
<andy.lavr@reactor-xg.kiev.ua> and Pav Lucistnik
<pav@FreeBSD.org> updated the FreeBSD 7.0 and above
file lock handling to use new locking structures. The
update requires a terrible hack to get a definition
for
the lock owner structure from a kernel source module
into a local lsof header file.

4.80 May 12, 2008
Updated for a FreeBSD 7.0 and above byte level locking
change. The problem was reported by Conrad J. Sabatier
<conrads@cox.net>, who helped test the update. Wesley
Shields <wxs@FreeBSD.org> provided an 8.0-CURRENT test
system.

Propagated the FreeBSD 7.0 and above locking changes to
FreeBSD 6.x, based on a report from Edwin Groothuis
<edwin@FreeBSD.org>.

Added warnings for unsupported dialects or versions.

Added Linux support for the UDPLITE protocol. Eric
Dumazet <dada1@cosmosbay.com> supplied a patch.

Added a missing quote to the Configure script's
FreeBSD stanza.

Added a usage.o rule to the HP-UX PSTAT-based
Makefile. I mistakenly deleted the rule at revision
4.79. The missing rule was reported by Kawaljeet Kaur
<kawaljeet.malviya@gmail.com> who tested the corrected
Makefile.

4.81 October 21, 2008
Updated the Darwin libproc
sources with changes from
Allan Nathanson <ajn@apple.com>. Tested them on a iMac
mini, provided by Apple Inc.

Changed dummy declarations in library source files to
eliminate complaints about unused variables and empty
object files. This change may not work on dialects I
can no longer test; it has been tested on some versions
of AIX, Darwin, FreeBSD, Linux and Solaris.

At the request of Hal Brooks <hal@uga.edu> added support
for Linux /proc/net/packet files. Hal tested it.

Added socket file only performance enhancements to Linux
and PSTAT-based HPUX lsof.

Added htonl call around improper usage of INADDR_LOOPBACK;
report from an Apple engineer forwarded by Allan Nathanson
<ajn@apple.com>.

Adjusted for FreeBSD-8.0 change in device number handling.
The adjustment should work for FreeBSD 5 and above, should
the 8.0 change be propagated downward. The problem was
reported by Pav Lucistnik <pav@FreeBSD.org>. An updated
test system was provided
by Erwin Lansing <erwin@FreeBSD.org>.

Reduced AIX support to version 5.3, since test systems with
older versions are no longer available to me.

At the request of Marjo F. Mercado <mmercado@xceedium.com>
and Phil Shin <pshin@xceedium.com> applied some speed
improvements to lsof, particularly when the files of
interest are /Internet files -- i.e., selected with lsof's
-i" option. Added a two new options to assist the
improvements: 1) "-c^<command>" to tell lsof to exclude the
named command(s); and 2) "-stcp|ud>:[^]state' to tell lsof
to include in its reporting or exclude ('^') from its
reporting Internet files in the named states (e.g., LISTEN,
^CLOSE_WAIT, IDLE, etc.) For the most part these changes
apply only to AIX, Darwin, FreeBSD, PSTAT-based HP-UX, Linux
and Solaris, since those are the only places I could test
them. They are controlled by the HASTCPUDPSTATE definition
in each dialect's machine.h header file. Marjo and Phil
provided HP-UX
11.23 and 11.31 test systems.

Fixed a stat(2) problem on HP-UX 11.31 while testing the
speed improvements.

Adjusted for kernel header file changes in FreeBSD
8.0-CURRENT. Larry Rosenman <ler@lerctr.org> provided
a test system.

Added a warning for Solaris systems where VxFS node info
can't be obtained from the VxFS utility library. The
warning was requested by Tom Matthews <Tom.MATTHEWS@rbs.com>.

Corrected mishandling of file system path name arguments
that have trailing slashes, except, of course, the root
file system, "/". Allan Nathanson <ajn@apple.com> reported
the bug.

4.82 March 25, 2009
Corrected an over-zealous exclusion test that caused
lsof to report nothing when it was given no arguments
and built with HASSECURITY and HASNOSOCKSECURITY enabled.
Joshua Kinard <kumba@gentoo.org> reported the bug and
supplied information for reproducing it.

Based on a report from Dan Trinkle <trinkle@cs.purdue.edu>
corrected use of <sys/utsname.h>
for 32 bit Solaris 10
and above compilations. Simultaneously eliminated a
casting complaint in arg.c and updated Configure to use
the appropriate 64 bit compilation option (-xarch=v9 or
-m64) with the Solaris Sun C compiler.

Updated for FreeBSD 7.1-PRERELEASE with information
supplied by Larry Rosenman <ler@lerctr.org>.

Updated the Darwin libproc sources with changes from
Allan Nathanson <ajn@apple.com>. Tested them on a iMac
mini, provided by Apple Inc. Allan also provided man
page corrections.

Updated the FreeBSD Makefile to use the ${MAKE} variable
for ZFS dnode2.c module compilation, based on a suggestion
from Alexis Ballier <aballier@gentoo.org>.

Improved the Solaris VxFS library location test, based on a
suggestion from Jason Fortezzo <fortezza@mechanicalism.net>.
Jason tested the change.

Updated Solaris 10 ZFS support for ZFS version 4 and ZFS
pool version 10, using a test system kindly provided by
Vladislav Nespor <vladislav.nespor@id.ethz.ch>.
Renata
Maria Dart <renata@slac.stanford.edu> tested on ZFS
version 4, verifying that the update works there, too.
(ZFS pool version 10 is apparently the ZFS version shipped
with the 10/08 update to Solaris. The original ZFS
support targeted ZFS version 3.)

I still consider ZFS support in Solaris lsof a hack,

because it depends on a znode structure definition that
I developed using dbx. Sun is remiss in not distributing
the ZFS header files used to build the distributed kernel.

Because of the znode structure definition hack, I can't
guarantee that lsof ZFS support will work for any other
versions of ZFS.

Solaris 10: adjusted to a change in the way devices are
stored in the kernel; fixed a problem in zone handling;
and added rudimentary sharedfs support. Carson Gaspar
<carson@taltos.org> reported the device number problem,
provided a test system, and tested the changes. Peter
Vines <psv2b@eservices.virginia.edu> reported the zone
handling
problem and tested the fix.

Adapted to FreeBSD 8.0-CURRENT changes in device number
computation. Problem was reported by Erwin Lansing
<erwin@FreeBSD.org>. Larry Rosenman <ler@lerctr.org>
provided a test system.

Corrected Solaris Configure test for appropriate VxFS
library when using gcc to compile lsof.

Updated for loss of KAME IPv6 FreeBSD accommodations.

Adapted to FreeBSD 7.2. Made Configure script recognized
FreeBSD 6.3.

4.83 January 18, 2010
Converted Solaris 10 and above ZFS support to use the CTF
debugger library, libctf. Code was supplied by Robert
Byrnes <Robert.Byrnes@deshaw.com>.

Corrected a typo in the testing of the LINUX_HASSELINUX
environment variable in the Configure script. The error
was reported by Mike Frysinger <vapier@gentoo.org>.
At Mike's request made Configure script accept LSOF_RANLIB
(ranlib command), LSOF_CFGF (additional configuration flags)
and LSOF_CFGL (additional library specifications) from the
environment.

Enabled
complilation of Solaris 10 lsof after a recent Sun
patch which changed the PC file system's structure. Peter
Vernam <pvernam@draper.com> reported the problem and helped
with the fix.

Made the sort of configuration CFLAGS in the CkTestDB
script impervious to locale settings.

Ported to Solaris 11, using a test system kindly provided
by David Day <dday76@gmail.com>.

Adjusted to the disappearance of <nfs/rpcv2.h> in FreeBSD
8.0-BETA1.

Changed Solaris node type lookup to a hashed method and
added some ability for it to handle duplicate vnodeop names
in /dev/ksyms.

Updated for FreeBSD 9.0-CURRENT. Andrzej Tobola
<ato@iem.pw.edu.pl> provided a test system. Extends the
fix to FreeBSD 6.0 and above via a Configure test and a
compile-time definition. The need for the extension was
reported by Erik Trulsson <ertr1013@student.uu.se>>

Made corrections to FAQ typographical errors, suggested
by Josh Soref <timeless@gmail.com>.

Added
__UCLIBC__ test to Linux dlsof.h so lsof would compile
on an Intel ARM XScale processor. The addition was provided
by Doug Kehn <rdkehn@yahoo.com>.

Added test for <utmpx.h> to FreeBSD configuration. Improved
its use in lsof.h. The changes were supplied by Martin Wilke
<miwi@FreeBSD.org>.

4.84 July 29, 2010
Fixed a man page nroff command error with a correction
supplied by Josh Soref <timeless@gmail.com>.

Made Configure script recognize FreeBSD 7.3. Larry Rosenman
<ler@lerctr.org> provided a test system.

Improved task support, initially for Linux only, with help
provided by Jerome Marchand <jmarchan@redhat.com> and
Miklos Szeredi <mszeredi@suse.cz>. The support includes a
new compile-time definition, HASTASKS, and a new run time
option, "-K" to select task reporting.

While adding help output support for "-K", reorganized the
printing of help columns to make it much easier to add a new
option description.

Updated the Solaris PC
file system structure patch in
revision 4.83 so it will compile with gcc.

Disabled the Solaris lgrp_root work-around in the Solaris
machine.h so it won't cause compilation problems on Solaris
11. It no longer causes compilation problems on my Solaris
9 and 10 test systems, but some older Solaris 9 and 10
versions may still need it, so the work-around was left in
the Sun machine.h and a FAQ entry was created about it.

Updated for Solaris 11 b134, using a test system kindly
provided by Carson Gaspar <carson@taltos.org>. Made
provisions for the next ZFS version. Added info about
the failure of the LTnlink test on ZFS file systems.

Corrected typo in Configure script, reported by Dmitry
Berezin <dmitryb@oit.rutgers.edu>.

4.85 September 27, 2011
John Dzubera <Zube@CS.ColoState.EDU> kindly provided a patched
Solaris 9 test system with the lgrp_root conflict and I was
able to devise an automatic work-around for the conflict. The
special note in .../dialects/sun/machine.h
was removed and
the 17.28.1 FAQ entry was modified to reflect the update.

Added a Solaris 11 work-around for a typedef problem with
<sys/mutex.h>. Carson Gaspar <carson@taltos.org> reported
the problem and supplied the work-around.

Added support for FreeBSD 7.4 and 8.2; tested on systems
provided by Larry Rosenman <ler@lerctr.org>.

Added support for 32 bit Solaris 11 lsof with mods supplied
by Jan Wortelboer <J.H.P.Wortelboer@uva.nl>.

Added Solaris 11 support for using an alternate genunix
location. Bill Goodridge <bill@its.brooklyn.cuny.edu>
reported the alternate location.

Added further Linux cross configuration support to lsof's
Configure script. The additional support was supplied by
Grant Erickson <erick205@umn.edu>. See the descriptions of
the LINUX_* environmen variables in 00XCONFIG for more
information. Tested lsof on Linux kernel 2.6.32 and picked
some lint that surfaced during the test.

Added fixes and changes
for Apple Mac OS X 10.6, provided by
Allan Nathanson <ajn@apple.com>. Allan also provided a test
system.

Tested on FreeBSD 6.4 i386, using a test system provided by
Terry Kennedy <TERRY@tmk.com>. Updated for recent FreeBSD ZFS
changes on an 8.2 amd64 test system also provided by Terry.

Changed documentation to indicate FreeBSD 7.x is no longer
supported, since I no longer have a test system.

Made some changes to the lsof man page, suggested by Navid
<evi1m4chine@googlemail.com>.

Added compensation for Solaris 10 systems that have patch
144488-10. The patch requires that the new header file
<sys/socket_proto.h> be included while _KERNEL is defined.
Brett Bartick <Brett.bartick@nomura.com> reported the problem
first, followed by Stuart Anderson <anderson@ligo.caltech.edu>.
Michael Hocke <michael.hocke@nyu.edu> suggested a work-around
which I refined to limit it to the specific Solaris 10 instance
and then tested on a system provided by Charles
Stephens
<cfs@cowlabs.com>

Added the +|-e option for Linux. It exempts file systems
named by path from function calls that might block in the
kernel -- i.e., stat(2) and lstat(2), and when the +e form
is used, readlink (2). The new packager of lsof for the
Linux Fedora and RHEL distributions, Peter Schiffer
<pschiffe@redhat.com>, asked for the feature so it could
be used with Clearcase file systems, whose implementation
can block stat(2) calls. I consider this feature very risky
and easy to misuse -- e.g., specifying the file system as
'/' would exempt all file systems. I don't intend to
propagate this option to any other UNIX dialect that lsof
currently supports.

Made FreeBSD 9 adjustment.

Fixed a Linux bug that prevented the display of paths for
abstact UNIX sockets. Masatake Yamato <yamato@redhat.com>
reported the bug and supplied a patch.

Added compensation for the removal of RPC header files from
GlibC 2.14 for Linux. Marek Behun <kabel@blackhole.sk>

reported
the problem and supplied a patch.

Added support for Linux Netlink protocol. Masatake Yamato
requested the support and supplied a patch. Peter Schiffer
<pschiffe@redhat.com> provided a test system.

Corrected Linux UDP6-lite path. The error was reported by
Masatake Yamato and he also supplied a patch.

Vic Abell <abe@purdue.edu>
September 27, 2011

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Frequently Asked Questions about lsof

****
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| location. |

****

This file contains frequently asked questions about lsof and answers
to them.

Vic Abell <abe@purdue.edu>
September 27, 2011

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17.5 Where are the Solaris header files?
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17.7 Why does Solaris lsof say ``can't read proc table''?
17.8 Why does Solaris lsof complain about a bad cached clone device?
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17.10 Why does lsof report some Solaris 2.3 and 2.4 lock types as `N'?
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17.12.2 Why does Solaris 7, 8 or 9 lsof say "FATAL: lsof was compiled
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17.12.3 How do I build lsof for a 64 bit Solaris kernel under a 32
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17.12.4 How do I install lsof for Solaris 7, 8 or 9?
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17.15 Why does lsof say, "kvm_open(namelist=default, core=default):
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17.18.2 Why does lsof report "vx_inode: vxfsu_get_ioffsets error"

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17.18.3 Why does Solaris Configure claim there is no VxFS library?
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17.25.2 Why does Solaris 10 lsof sometimes report only the mounted-on directory and device?
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17.27.2 Why do -h and -v output warn about possibly inaccurate ZFS structure definitions?
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18.2.1 What's the risk with a perverted device cache file?
18.2.2 How do I put the full host name in a personal device cache file path?
18.2.3 How do I put the personal device cache file in /tmp?
18.3 Why doesn't lsof know about AFS files on my favorite dialect?
18.3.1 Why doesn't lsof report node numbers for all AFS volume files, or how do I reveal dynamic module addresses to lsof?

1.0 General Concepts

1.1 Lsof -- what is it?

Lsof is a UNIX-specific tool. Its name stands for LiSt Open Files, and it does just that. It lists information about files that are open by the processes running on a UNIX system.

See the lsof man page, the 00DIST file, the 00QUICKSTART file, and the 00README file of the lsof distribution for more information.

1.2 Where do I get lsof?

Lsof
is available via anonymous ftp from lsof.itap.purdue.edu.
Look in the pub/tools/unix/lsof sub-directory.

ftp://lsof.itap.purdue.edu/pub/tools/unix/lsof

Bzip2'd, compressed and gzip'd tar files with GPG certificates are available.

1.2.1 Are there mirror sites?

On April 28, 2009 these sites appeared to have the lastest lsof revision:

ftp://ftp.fu-berlin.de/pub/unix/tools/lsof
ftp://sunsite.ualberta.ca/pub/Mirror/lsof

1.2.2 Are lsof executables available?

Some lsof executables are available in the subdirectory tree pub/tools/unix/lsof/binaries These are neither guaranteed to be current nor cover every dialect and machine architecture.

I don't recommend you use pre-compiled lsof binaries; I
recommend you obtain the sources and build your own binary.
Even if you're a Sun user without a Sun C compiler, you
can use gcc to compile lsof.

If you must use a binary file, please be conscious of the
security and configuration implications in using an executable
of
unknown or different origin. The lsof binaries are
accompanied by GPG certificates. Please use them!

Three additional cautions apply to executables:

1. Don't try to use an lsof executable, compiled for one
    version of a UNIX dialect, on another. Patches can
    make the dialect version different.

2. If you want to use an lsof binary on multiple systems,
    they must be running the same dialect OS version and
    have the same patches and feature support.

1.2.3 How do I check the validity of an lsof distribution?

There are two ways to check the validity of an lsof
distribution:

1. Follow the instructions in the CHECKSUMS_<revision>
    file found with the lsof distribution.

    Checking with GPG is the best method.

2. Follow the instructions in the "Security" section of the
    README.lsof_<revision> file found inside the lsof
    distribution.

    Again, checking with GPG is the best method.

1.2.4 Why can't I get the sum(1) result reported
in
README.lsof_<revision>?

The "Security" section of the README.lsof_<revision> file found
inside the lsof distribution gives md5, sum, and GPG certificate
information.

The simplest, the sum(1) signature, seems to be the trickiest.
That's because there are different sum(1) methods, BSD systems

usually have cksum(1) instead of sum(1), and different systems
compute the block size value differently.

First, the lsof sum results are computed with the old,
"alternate" algorithm. On newer systems, you can use sum's
"-r" option to get that computation result.

Second, on BSD systems you usually must use cksum(1) instead
of sum(1), because they have no sum(1). To tell cksum(1)
to use the old, "alternate" algorithm, use its "-o1" option.

Third, the second value that sum reports, the block count, may
be computed differently on different systems -- usually block
size is considered to be 512 or 1,024. The lsof block counts
were computed on a system with a sum(1) option that
considers
block size to be 512. The BSD system cksum(1) -o1 option
considers block size to be 1,024. If your sum(1) or cksum(1)
doesn't report a block count that matches the sum(1) signature
given in README.lsof_<revision>, check its man page to see what
block size it uses, then adjust its reported block count
appropriately.

1.2.5 Why won't gpg accept the lsof-signing PGP public key?

An older PGP key that once signed lsof distributions is
included in lsof revisions prior to 4.70. The PGP key is
indeed my key, but is incompatible with GPG. It was created
about ten years ago and is still acceptable to PGP versions
2.6.2 through 6.5.2.

Lsof revisions 4.70 and above are signed with a copy of my PGP
key that has been made acceptable for use with GPG by importing
it under GPG's "--allow-non-selfsigned-uid" option.

You can find my GPG compatible key in lsof revisions 4.70 and
above and at:

ftp://lsof.itap.purdue.edu/pub/Victor_A_Abell.gpg

If you have an older
lsof revision with my PGP key, there are
two possible ways to use it:

* Use it with a PGP version from 2.6.2 through 6.5.2.

* Use GPG's "--allow-non-selfsigned-uid" option when you
import my PGP key into your GPG key ring.

```
$ gpg --allow-non-selfsigned-uid --import Victor_A_Abell.pgp
```

1.3 Where can I get more lsof documentation?

A significant set of documentation may be found in the lsof distribution (See "Where can I get lsof?). There is a manual page, copious documentation in files whose names begin with 00, and a copy of this FAQ in the file 00FAQ (perhaps slightly less recent than this file if you're reading it via a web browser.)

Two URLs provide some documentation that appears in the lsof distribution:

FAQ: ftp://lsof.itap.purdue.edu/pub/tools/unix/lsof/FAQ

man page: ftp://lsof.itap.purdue.edu/pub/tools/unix/lsof/lsof_man

1.4 How do I report an lsof bug?

If you believe you have discovered a bug in lsof, you can report it via e-mail to <abe@purdue.edu>.
Do NOT report lsof bugs to the UNIX dialect vendor. Make sure "lsof" appears in the "Subject:" line so my e-mail filter won't classify your letter as Spam.

Before you send me a bug report, please read the "Bug Reports" section of the 00README file of the lsof distribution. It lists the steps you should take before and when reporting a suspected bug.

1.5 Where can I get the lsof FAQ?

This lsof FAQ is available in the file 00FAQ in the lsof distribution and at the URL:

ftp://lsof.itap.purdue.edu/pub/tools/unix/lsof/FAQ

1.5.1 How timely is the on-line FAQ?

The on-line FAQ is sometimes too timely. :-)

I update it as soon as new information is available. That may include information about support that won't appear in the lsof source distribution until the next revision. If you encounter something like that, please send me e-mail at <abe@purdue.edu>. I

may be able to point you at a pre-release distribution that contains the support of interest. Make sure "lsof" appears in the "Subject:" line so my e-mail filter won't classify your letter as Spam.

1.6 Is there a test suite?

Yes, as of lsof revision 4.63 there's an automated lsof test suite in the tests/ sub-directory of the lsof top-level directory.

More information on using the test suite, what it does, how to use it and how to configure it may be found in the 00TEST file of the lsof distribution. That file also explains where the test suite has been tested.

Frequently asked questions about the test suite will be asked and answered here in the FAQ. (See "Test Suite Problems.")

After lsof has been configured with the Configure script, lsof can be made and tested with:

```
$ make
$ cd tests
$ make
```

Under normal conditions -- i.e., unless the lsof tree has been cleaned or purged severely -- all tests or individual tests may be run by:

```
$ cd test
$ make
```

or

```
$ <run a single test> (See 00TEST.)
```

1.7 Is lsof vulnerable to the standard I/O descriptor attack?

Lsof revisions 4.63 and above are not vulnerable.

Lsof revisions 4.62 and below are vulnerable, but no damage scenarios have so far been demonstrated.

The standard I/O descriptor attack is a local programmed assault on setuid and setgid programs that tricks them into opening a sensitive file with write access on a standard descriptor, usually stderr (2), and writing error messages

to stderr. If the attacker can control the content of the error message, the attacker may gain elevated privileges.

The attack was first described in Pine Internet Advisory PINE-CERT-20020401, available at:

http://www.pine.nl/advisories/pine-cert-20020401.txt

If you are using an lsof revision below 4.63, you should remove any setuid or setgid permissions you might have given its executable. Then you should upgrade to lsof revision 4.63.

1.8 Can I alter lsof's make(1) behavior?

Yes. There are at least two ways to do that.

You can put replacements for lsof Makefile strings in your environment. If you specify the -e make option, make will give environment variable values precedence over strings from the Makefile. For example, to change the compiler string CC from the environment, you might do this with the Bourne shell:

```
$ CC=foobar; export CC
$ make -e
```

You can also replace lsof Makefile strings in the make command invocation. Here's the previous example done that way:

```
$ make CC=foobar
```

Changing the CFGF, CFGL, and DEBUG strings used in lsof Makefiles, either from the environment or from the make invocation, can significantly alter lsof make(1) behavior. I commonly use DEBUG to change the -O option to -g so I can build an lsof executable for debugging -- e.g.,

```
$ make DEBUG=-g
```

(Look for DEBUG in this FAQ for other examples of its use.)

Consult the Makefiles to see what CFGL, CFGL, and other lsof Makefile strings contain, and to see what influence their alteration might have on lsof make(1) behavior.

1.9 Is
there an lsof license?

No.

The only restriction on the use or redistribution of lsof
is contained in this copyright statement, found in every
lsof source file. (The copyright year in or format of the
notice may vary slightly.)

```
/*
 * Copyright 2002 Purdue Research Foundation, West Lafayette,
 * Indiana 47907.  All rights reserved.
 *
 * Written by Victor A. Abell
 *
 * This software is not subject to any license of the American
 * Telephone and Telegraph Company or the Regents of the
 * University of California.
 *
 * Permission is granted to anyone to use this software for
 * any purpose on any computer system, and to alter it and
 * redistribute it freely, subject to the following
 * restrictions:
 *
 * 1. Neither the authors nor Purdue University are responsible
 *    for any consequences of the use of this software.
 *
 * 2. The origin of this software must not be misrepresented,
 *    either by explicit claim or by omission.  Credit to the

*    authors and Purdue University must appear in documentation
 *    and sources.
 *
 * 3. Altered versions must be plainly marked as such, and must
 *    not be misrepresented as being the original software.
 *
 * 4. This notice may not be removed or altered.
 */
```

1.10 Language locale support

1.10.1 Does lsof support language locales? How do I use the support?

Most UNIX dialect versions of lsof support 8 bit language
locale characters -- e.g., the ability to print 8 bit
characters that have accents and other marks over them.

See the answer to the "Does lsof support wide characters in language locales?" question for information on when lsof's language locale support covers characters wider than 8 bits.

To see if lsof supports language locales for your dialect, look in the dialect's machine.h header file for the HASSETLOCALE definition. If it is present and not disabled, then lsof has language locale support for the dialect.

To enable lsof's language locale support, you must specify in a locale environment variable (e.g., LANG) a language locale known to your system that supports the printing of marked characters -- e.g, en_US. (On some dialects locale(1) may be used to list the known language locales.)

Note that LANG=C and LANG=POSIX are NOT language locales that support the printing of marked characters.

If the language locale doesn't support the printing of marked characters, lsof's OUTPUT of them follows the rules for non-printable characters described in the OUTPUT section of lsof(8).

Consult your dialect's setlocale(3) man page for the names of environment variables other than LANG -- e.g., LC_ALL, LC_TYPE, etc. -- which may be used to define language locales.

1.10.2 Does lsof support wide characters in language locales?

When lsof's language locale support is enabled with the HASSETLOCALE definition, for selected dialects lsof will also print wide characters (e.g., from UTF-8) when iswprint(3) reports them to be printable.

Wide character support is available when HASWIDECHAR is defined in a dialect's machine.h header file. As of this writing on July 22, 2004, the following dialect versions have wide character support:

- AIX >= 4.3.2
- Apple Darwin >= 7.3.0
- FreeBSD >= 5.2
- HP-UX >= 11.00
- /proc-based Linux
- NetBSD >= 1.6
- SCO OpenServer >= 5.0.6

Solaris >= 2.6
Tru64 UNIX 5.1

1.11 Are any files in the lsof distribution copyrighted?

Yes. Most files carry the copyright of the Purdue Research Foundation and may be redistributed under the terms that accompany the copyright notice. Those terms may also be found in the answer to the question, "Is there an lsof license?")

A few files carry other copyright notices. Some are BSD notices and they explain the terms under which they are included in the lsof distribution.

Those that carry vendor copyright notices have been reproduced in their original or modified forms with permission from the copyright
owners. That permission is indicated in the README files that accompany the files.

1.12 Are there other lsof-related resources?

There are other resources available, connected to lsof. Among them are FreeBSD and Linux packages whose products use lsof and two particularly interesting resources.

The two interesting resources are a Gnome Tool Kit (GTK) GUI for lsof and a Perl wrapper module.

The GTK GUI is called Glsof and was developed by Gnele. It can be found at:

http://www.sourceforge.net

The Perl wrapper module by Marc Beyer can be found at:

http://search.cpan.org/dist/Unix-Lsof/

1.13 What does the "WARNING: unsupported dialect or version" mean?

The lsof configure script issues that message for UNIX dialects or their versions where I have been unable to test the current revision of lsof. The message doesn't mean that lsof won't work, just that I have no direct evidence that it will.

If the COnfigure script succeeds, except for the warning, try
compiling) lsof. If that succeeds, try the lsof test suite.

2.0 Lsof Ports

2.1 What ports exist?

The pub/lsof.README file carries the latest port information:

AIX 5.[23] and 5.3
FreeBSD 4.9 and 6.4 for x86-based systems
FreeBSD 8.[02] for AMD64-based systems
Linux 2.1.72 and above for x86-based systems
Solaris 9, 10 and 11

In the above list the only UNIX dialects present are ones for
which I test the current lsof revision. Lsof may still support
unlisted dialect versions -- e.g., HP-UX 10.20, Solaris 7, etc.
-- but I don't have access to systems where I could test lsof
on them, so I can't claim lsof works on them. If your dialect
isn't in the list, you should try building lsof on it anyway.

Lsof version 4 predecessors, versions 2 and 3, may support older
version of some dialects. Contact me via e-mail at <abe@purdue.edu>
if you're interested in their distributions. Make sure "lsof"
appears in the "Subject:" line so my e-mail filter
won't classify
your letter as Spam.

2.2 What about a new port?

The 00PORTING file in the distribution gives hints on doing
a port. I will consider doing a port in exchange for
permanent access to a test host. I require permanent access
so I can test new lsof revisions, because I will not offer
distributions of dialect ports I cannot upgrade and test.

2.2.1 User-contributed Ports

Sometimes I receive contributions of ports of lsof to
systems where I can't test future revisions of lsof. Hence,
I don't incorporate these contributions into my lsof
distribution.

However, I do make descriptions of these contributions
available. You can find them in the 00INDEX and README
files at:

ftp://lsof.itap.purdue.edu/pub/tools/unix/lsof/contrib

Consult the 00INDEX file in the contrib/ directory for a list of the available contributions and consult README there for information on how to obtain them.

2.3 Why isn't there an AT&T SVR4 port?

I haven't produced an AT&T SVR4 port because I haven't seen a UNIX dialect that is strictly limited to the AT&T System V, Release 4 source code. Every one I have seen is a derivative with vendor additions.

The vendor additions are significant to lsof because they affect the internal kernel structures with which lsof does business. While some vendor derivatives of SVR4 are similar, each one I have encounted so far has been different enough from its siblings to require special source code.

If you're interested in an SVR4 version of lsof, here are some existing ports you might consider:

DC/OSx (This obsolete port is only available upon special request.)
Reliant UNIX (This obsolete port is only available upon special request.)
SCO|Caldera UnixWare (This is the most likely choice.)
Solaris

2.4 Why isn't there an SGI IRIX port?

Lsof support for IRIX was terminated at lsof revision 4.36, because it had become increasingly difficult for me to obtain information on the IRIX kernel structures lsof needs to access.

At IRIX 6.5 I decided the obstacles were too large for me to overcome, and I stopped supporting lsof on IRIX. I have sources to the last revision of lsof (4.36) for IRIX, but that version of lsof does not work on IRIX 6.5 and is vulnerable to the standard I/O descriptor attack. (See the "Is lsof vulnerable to the standard I/O descriptor attack?" Q&A for more information.) Contact me to discuss obtaining those sources.

If you wish to pursue the issue, don't contact me, contact SGI. This case was opened with SGI on the subject:

Case ID: 0982584
Category: Unix
Priority: 30-Moderate Impact

Problem Summary:
kernel structure header files needed for continued lsof
support

Problem Description:
Email In 07/17/98 19:09:23

2.5 Why does lsof's Configure script report "WARNING: unsupported dialect or version"?

Lsof's Configure script issues this message when it encounters a dialect or its version that lsof once supported, but no longer does. Usually I drop support for a dialect or version when I can no longer test lsof on it.

However, it's worth trying to compile and use lsof. Be sure to run the test suite. (See the answer to the "Is there a test suite? question for information on the test suite.)

If you have problems with an unsupported dialect or version, contact me via e-mail at <abe@purdue.edu> and I may be able to help. Make sure "lsof" appears in the "Subject:" line so my e-mail filter won't classify your letter as Spam.

3.0 Lsof Problems

3.1 Configuration Problems

3.1.1 Why can't Configure determine the UNIX dialect version?

The lsof Configure script uses UNIX shell commands, often in a command pipeline, to determine the UNIX dialect version. (Consult the dialect stanza in Configure to determine which commands are used.) If Configure can't determine the dialect version, probably one of the commands is not behaving as Configure expects.

Symptoms of the failure include Configure warning messages and incorrect version definitions in the Makefile CFLAGS.

If you suspect that the lsof Configure script is failing to

determine the dialect version correctly, try running the commands from Configure stanza one at a time. That will usually reveal the source of the problem. Be particularly mindful that the PATH environment variable can cause commands to be executed from non-standard directories.

If you can't determine the source of the problem, there is a work-around. You can supply the UNIX dialect version in the LSOF_VSTR environment variable. Use Configure as a guide to forming what it expects in LSOF_VSTR. There is also some information on LSOF_VSTR in the 00XCONFIG documentation file of the lsof distribution.

3.2 Compilation Problems

3.2.1 Why does the compiler complain about missing header files?

When you use make to build lsof, the compiler may complain that it can't find header files -- e.g.,

```
   $
make
   (cd lib; make DEBUG="-O" CFGF="-DAIXA=0 -DAIXV=4330 \
   -DLSOF_VSTR=\"4.3.3.0\"")
   gcc  -DAIXA=0 -DAIXV=4330 -DLSOF_VSTR="4.3.3.0" -O \
   -c ckkv.c
   In file included from ckkv.c:33: ../machine.h:70: \
   sys/types.h: A file or directory in the path name \
   does not exist. \
```

That type of complaint doesn't represent an lsof problem. It represents a problem with a missing system header file that probably should be found in /usr/include or in the system source tree.

As a first step try using find(1) to locate the problem header file. If it's a system header file and can't be found, here are some possible causes:

1. The file set, RPM or package containing the header files has not been installed. Instructions for doing that are specific to the UNIX dialect and beyond the scope of this document.

2. If the compiler is gcc, the private gcc header files:

   * May not have been installed;

* May have been installed incorrectly;

* May not have been updated properly after the last
compiler or system update;

* Ones from a previous installation may not have been
removed.

A path leading to the gcc private header files can be
found with `gcc -v`. Consult the gcc documentation for
instructions on proper installation of the private gcc
header files.

3. On some dialects -- e.g., FreeBSD, NetBSD, OpenBSD --
lsof may need to use header files that are located in
the system source tree -- /sys or /usr/src/sys, for
example. Make sure the system source tree has been
installed.

3.2.2 Why does gcc complain about the contents of header files distributed by the system's vendor?

When you use make to build lsof and gcc to compile it, gcc may complain that it finds errors in system header files -- e.g.,

```
$ make
(cd lib; make DEBUG="-O" CFGF="-Dsolaris=80000 \
 -DHASPR_GWINDOWS -m64 -DHASIPv6 -DHAS_VSOCK
\
 -DLSOF_VSTR=\"5.8\"")
 gcc -Dsolaris=80000  -DHASPR_GWINDOWS -m64 -DHASIPv6 \
 -DHAS_VSOCK -DLSOF_VSTR="5.8"  -O  -c  dvch.c
In file included from /usr/include/sys/proc.h:31, \
      from /homes/abe/gnu/gcc-3.2.1/lib/gcc-lib/sparcv9-sun-solaris2/ \
 3.2.1/include/sys/user.h:267, from /usr/include/kvm.h:13, \
 from ../dlsof.h:53, from ../lsof.h:172, from dvch.c:43: \
 /homes/abe/gnu/gcc-3.2.1/lib/gcc-lib/sparcv9-sun-solaris2/\
  3.2.1/include/sys/task.h:59: parse error before "uint_t"
```

Errors like the above are most likely not problems in the system's header files, but in the private copies of them that were created when gcc was made or installed. Note the presense of ".../gcc-3.2.1/lib/gcc-lib/sparcv9-sun-solaris2/3.2.1/include/..." in the paths for user.h and task.h. It indicates both header files are gcc-specific.

To solve errors like this requires comparing the header files in the vendor's /usr/include tree to the gcc-specific ones in gcc's private gcc-lib/.../include tree. It may be necessary to regenerate gcc-specific header files, correct them or remove them. See the gcc distribution for the appropriate tools.

A possible temporary work-around is to direct gcc to use the vendor's header files instead of its temporary ones by declaring -I/usr/include in the compilation flags.

3.2.3 Other header file problems

Don't overlook any vendor tools that might validate the vendor header files installed on the system -- e.g., the Solaris pkgchk tool can be used to check the header files that were installed from the SUNWhea package.

For other header file problems contact me at <abe@purdue.edu>. Please follow the reporting guidelines in the "How do I report an lsof bug?" section of this FAQ.

3.3 Why doesn't lsof report full path names?

Lsof reports the full path name when it is specified as a search argument for open files that match the argument. However, if the argument is a file system mounted-on directory, and lsof finds additional path name components from the kernel name cache, it will report them.

Lsof reports path name for file system types that have path name lookup features -- e.g., some versions of AdvFS for Digital and Tru64 UNIX. The Linux /proc-based lsof reports full path names, because the Linux /proc file system provides them. Lsof on recent builds of Solaris 10 also report full path names, because those Solaris kernels record the full path name in the vnode structure.

Otherwise, lsof uses the kernel name cache, where it exists and can be accessed, and reports some or all path name components (e.g., the sys and proc.h components of /usr/include/sys/proc.h) for these dialects:

Apple Darwin
DC/OSx

FreeBSD
HP-UX, /dev/kmem and PSTAT based
Linux, /dev/kmem-based
NetBSD
NEXTSTEP
OpenBSD
OPENSTEP
Reliant UNIX
SCO OpenServer
SCO|Caldera UnixWare
Solaris 2.x, 7, 8 and 9 (except for some VxFS versions;

see the "Why doesn't Solaris
lsof report VxFS path name
components?" section for more
information)
Solaris 10 (early builds) Tru64 UNIX

As far as I can determine, AFS path lookups don't share in kernel name cache operations, so lsof can't identify open AFS path name components. Apparently Solaris VxFS versions 4 and above don't share in kernel name cache operations, either, so lsof can't display path name components for those open files.

Since the size of the kernel name cache is limited and the cache is in constant flux, it does not always contain the names of all components in an open file's path; sometimes it contains none of them.

Lsof reports the file system directory name and whatever components of the file's path it finds in the cache, starting with the last component and working backwards through the directories that contain it. If lsof finds no path components, lsof reports the file system device name instead.

When lsof does report some
path components in the NAME
column, it prefixes them with the file system directory name, followed by " -- ", followed by the components -- e.g., /usr -- sys/path.h for /usr/include/sys/path.h. The " -- " is omitted when lsof finds all the path name components of a file's name.

The PSTAT-based HP-UX lsof relies on kernel name cache contents, too, even though its information comes to lsof via pstat() function calls. Consequently, PSTAT-based HP-UX lsof won't always report full paths, but may use the " -- " partial path name notation, or may occasionally

report no path name at all but just the file system mounted-on directory and device names.

Lsof can't obtain path name components from the kernel name caches of the following dialects:

AIX

Only the Linux kernel records full path names in the structures it maintains about open files; instead, most kernels convert path names to device and node number doublets and use them for subsequent file references once files have
been opened.

To convert the device and node number doublet into a complete path name, lsof would have to start at the root node (root directory) of the file system on which the node resides, and search every branch for the node, building possible path names along the way. That would be a time consuming operation and require access to the raw disk device (usually implying setuid-root permission).

If the prospect of all that local disk activity doesn't concern you, think about the cost when the device is NFS-mounted.

Try using the file system mount point and node number lsof reports as parameters to find -- e.g.,

```
$ find <mount_point> -inum <node_number> -print
```

and you may get an appreciation of what a file system directory tree search would cost.

3.3.1 Why do lsof -r reports show different path names?

When you run lsof with its repeat (``-r'') option, you may notice that the extent to which it reports path names for the same files may vary from cycle
to cycle. That happens
because other processes are making kernel calls affecting the cache and causing entries to be removed from and added to it.

3.3.2 Why does lsof report the wrong path names?

Under some circumstances lsof may report an incorrect path

name component, especially for files in a rapidly changing
directory like /tmp.

In a rapidly changing directory, like /tmp, if the kernel
doesn't clear the cache entry when it removes a file, a
new file may be given the same keys and lead lsof to believe
that the old cache entry with the same keys belongs to the
new file.

Lsof tries to avoid this error by purging duplicate entries
from its copy of the kernel name cache when they have the
same device and inode number, but different names.

This error is less likely to occur in UNIX dialects where the
keys to the name cache are node address and possibly a
capability ID. The Apple Darwin, Digital UNIX, FreeBSD, HP-UX,
NEXTSTEP, OPENSTEP, Solaris, Tru64 UNIX, and
UnixWare dialects
use node address. Apple Darwin, FreeBSD, NetBSD, OpenBSD,
Tru64 UNIX, and also use a capability ID to further identify
name cache entries.

3.3.3 Why doesn't lsof report path names for unlinked (rm'd) files?

When lsof gets path name components from the kernel's name
cache, it does not report the path names of a file that has
been unlinked from its parent directory -- e.g., deleted via
rm, or the unlink() system call -- even when some process may
still hold the file open; lsof reports only the file system's
mounted-on directory and device. That's because path name
components are removed from the kernel name cache when the file
is unlinked.

Unlinked open files are sometimes used by applications for
temporary, but invisible storage (i.e., ls won't show them,
and no other process can open them.) However, they may
occasionally consume disk space to excess and cause concern
for a system administrator, who will be unable to locate
them with find, ls,
du, or other tools that rely on finding
files by examining the directory tree.

By using lsof's +L option you can see the link count of
open files -- in the NLINK column. An unlinked file will
have an NLINK value of zero. By using the option +L1 you
can tell lsof to display only files whose link count is
less than one (i.e., zero).

There are some UNIX dialect-specific exceptions to lsof's inability to report unlinked path names. They are described in the answer to the "When will lsof report path names for deleted files?" question.

3.3.4 Why doesn't lsof report the "correct" hard linked file path name?

When lsof reports a rightmost path name component for a file with hard links, the component may come from the kernel's name cache. Since the key which connects an open file to the kernel name cache may be the same for each differently named hard link, lsof may report only one name for all open hard-linked files. Sometimes that will be "correct" in the eye of the beholder; sometimes it will not. Remember, the file identification keys significant to the kernel are the device and node numbers, and they're the same for all the hard linked names.

3.3.5 When will lsof report path names for deleted files?

Lsof will report path names for deleted files for two dialects: Linux and later builds of Solaris 10.

Deleted Linux path names are reported by default and have "(deleted)" at their ends.

The display of Solaris 10 deleted path names may be selected with the -X option. When selected they are also reported with "(deleted)" at their ends.

3.4 Why is lsof so slow?

Lsof may appear to be slow if network address to host name resolution is slow. This can happen, for example, when the name server is unreachable, or when a Solaris PPP cache daemon is malfunctioning.

To see if name lookup is causing lsof to be slow, turn it off with the ``-n" option.

Port service name lookup or portmap registration lookup may also be causes of slow-down. To suppress port service name lookup, specify the ``-P" option.

Lsof doesn't usually make direct portmap calls -- only when +M

is specified, or when HASPMAPENABLED is defined during lsof construction. (The lsof help panel, produced with `lsof -h` will display the default portmap registration reporting state.) The quickest first step in checking if lsof is slow because of the portmapper is to use lsof's ``-M'' option.

Lsof may be slow if UID to login name lookups are slow. Suppress them with ``-l''.

On dialects where lsof uses the kernel name cache, try disabling its use with ``-C''. (You can tell if lsof uses the kernel name cache by looking for ``-C'' in lsof's ``-h'' output.) Of course, disabling kernel name cache use will mean that lsof won't report full or partial path names, just file system and character device names.

If you're just interested in the open files of one process, try using the ``-p <Process-ID>'' option to limit lsof to that process.
(The ``-p'' option may also be followed with a list of Process-IDs.)

If you're interested in including or excluding certain commands, try lsof's "-c[^]cmd" option.

If you're interested in certain Internet TCP and UDP states (e.g., ESTABLISHED) or in excluding some (e.g., CLOSE_WAIT), try lsof's "-s p:s" option. More information on it may be found in the answer to the "How are protocol state name exclusion and inclusion used?" question.

Your UNIX dialect may not support "-s p:s" and its associated performance improvments to Internet-only file processing. You can find more information on those topics in the answer to the "Why doesn't my dialect support state name exclusion and inclusion?" question.

Older AIX lsof may be slow to start because of its oslevel identity comparison. (Newer AIX lsof uses uname(2).) See the "Why does AIX lsof start so slowly?" and "Why does lsof warn "compiled for x ... y; this is z.?" sections for more information.

3.5 Why doesn't lsof's setgid or setuid permission work?

If you install lsof on an NFS file system that has been mounted with the nosuid option, lsof may not be able to

use the setgid or setuid permission you give it, complaining
it can't open the kernel memory device -- e.g., /dev/kmem.

The only solution is to install lsof on a file system that
doesn't inhibit setgid or setuid permission.

3.6 Does lsof have security problems?

I don't think so. However, lsof does usually start with
setgid permission, and sometimes with setuid-root permission.
Any program that has setgid or setuid-root permission,
should always be regarded with suspicion.

Lsof drops setgid power, holding it only while it opens
access to kernel memory devices (e.g., /dev/kmem, /dev/mem,
/dev/swap). That allows lsof to bypass the weaker security
of access(2) in favor of the stronger checks the kernel
makes when it examines the right of the lsof process to
open files declared with -k and -m. Lsof also restricts
some
device cache file naming options when it senses the
process has setuid-root power.

On a few dialects lsof requires setuid-root permission
during its full execution in order to access files in the
/proc file system. These dialects include:

DC/OSx 1.1 for Pyramid systems
Reliant UNIX 5.4[34] for Pyramid systems

When lsof runs with setuid-root permission it severely
restricts all file accesses it might be asked to make with
its options.

The device cache file (typically .lsof_hostname in the home
directory of the real user ID that executes lsof) has 0600
modes. (The suffix, hostname, is the first component of
the host's name returned by gethostname(2).) However, even
when lsof runs setuid-root, it makes sure the file's
ownerships are changed to that of the real user and group.
In addition, lsof checks the file carefully before using
it (See the question "How do I disable the device cache
file feature or alter it's behavior?" for a description of
the
checks.); discards the file if it fails the scrutiny;
complains about the condition of the file; then rebuilds
the file.

See the 00DCACHE file of the lsof distribution for more information about device cache file handling and the risks associated with the file.

3.7 Will lsof show remote hosts using files via NFS?

No. Remember, lsof displays open files for the processes of the host on which it runs. If the host on which lsof is running is an NFS server, the remote NFS client processes that are accessing files on the server leave no process records on the server for lsof to examine.

3.8 Why doesn't lsof report locks held on NFS files?

Generally lock information held by local processes on remote NFS files is not recorded by the UNIX dialect kernel. Hence, lsof can't report it.

One exception is some patch levels of Solaris 2.3, and all versions of Solaris 2.4 and above. Lsof for those dialects does report on locks held by local processes on remotely mounted NFS
files.

3.8.1 Why does lsof report a one byte lock on byte zero as a full file lock?

When a process has a lock of length one, starting at byte zero, lsof can't distinguish it from a full file lock. That's because most UNIX dialects represent both locks the same way in their file lock (flock or eflock) structures.

3.9 Why does lsof report different values for open files on the same file system (the automounter phenomenon)?

On UNIX dialects where file systems may be mounted by an automounter with the ``direct'' type, lsof may sometimes report difference DEVICE, SIZE/OFF, INODE and NAME values when asked to report files open on the file system.

This happens because some files open on the file system -- e.g., the current directory of a shell that changed its directory to the file system as the file system's first reference -- may be characterized in the kernel with temporary automounter node information. The cd doesn't cause the file system to be mounted.

A subsequent

reference to the file system -- e.g., an ls
of any place in it -- will cause the file system to be
mounted. Processes with files open to the mounted file
system are characterized in the kernel with data that
reflects the mounted file system's parameters.

Unfortunately some kernels (e.g., some versions of Solaris
2.x) don't revisit the process that did only a change-directory
for the purpose of updating the data associated with the
open directory file. The file continues to be characterized
with temporary automounter information until it does another
directory change, even a trivial ``cd .".

Lsof will report on both reference types, when supplied
the file system name as an argument, but the data lsof
reports will reflect what it finds in the kernel. For the
different types lsof will display different data, including
different major and minor device numbers in the DEVICE
column, different lengths in the SIZE/OFF column, different
node numbers in the INODE column,
and slightly different
file system names in the NAME column.

In contrast, fuser, where available, can only report on
one reference type when supplied the file system name as
an argument. Usually it will report on the one that is
associated with the mounted file system information. If
the only reference type is the temporary automounter one,
fuser will often be silent about it.

3.10 Why don't lsof and netstat output match?

Lsof and netstat output don't match because lsof reports
the network information it finds in open file system objects
-- e.g., socket files -- while netstat often gets its
information from separate kernel tables.

The information available to netstat may describe network
activities never or no longer associated with open files,
but necessary for proper network state machine operation.

For example, a TCP connection in the FIN_WAIT_[12] state
may no longer have an associated open file, because the
connection has been closed at the application layer
and is
now being closed at the TCP/IP protocol layer.

3.10.1 Why can't lsof find accesses to some TCP and UDP ports?

Lsof stands for LiSt Open Files. If there is no open file connected to a TCP or UDP port, lsof won't find it. That's the most common reason why lsof doesn't find a port netstat might report open.

One reason I've found on some UNIX dialects is that their kernels set aside TCP and UDP ports for communicating with support activities, running in application layer servers -- the automounter daemons, and the NFS biod and nfsd daemons are examples. Netstat may report the ports are in use, but lsof doesn't.

Another reason is that netstat may also be able to report a port is open on a particular dialect, because it uses a source of data different from what lsof uses -- e.g., netstat might examine kernel tables or use streams messages to MIB2, while lsof relies on the information it finds in open file structures and their descendants.

Sometimes it's possible
to search the data netstat and lsof
use. For example, on Linux /proc/tcp and /proc/udp can be examined. There might an entry there for a particular protocol and port, but if the line on which the port appears doesn't have an inode number that matches an inode number of an open file, lsof won't be able to identify the process using the port.

This is a tough question to which there is no easy answer.

3.11 Why does lsof update the device cache file?

At the end of the lsof output you may see the message:

```
lsof: WARNING: /Homes/abe/.lsof_vic was updated.
```

In this message /Homes/abe/.lsof_vic is the path to the private device cache file for login abe. (See 00DCACHE.)

Lsof issues this message when it finds it necessary to recheck the system device directory (e.g., /dev or /devices) and rebuild the device cache file during the open file scan. Lsof may need to do these things it finds that a device directory node has changed, or if it cannot find a device in
the cache.

3.12 Why doesn't lsof report state for UDP socket files?

Lsof reports UDP TPI connection state -- TS_IDLE (Idle), TS_BOUND (Bound), etc. -- for some, but not all dialects. TPI state is stream-based TCP/IP information that isn't available in many dialects.

A fairly weak general rule is if netstat(1) reports UDP TPI state, lsof may be able to report it, too. But don't be surprised if lsof fails to report UDP TPI state for your dialect. Other factors influence lsof's ability to report UDP TPI state, including the availability of state number data in kernel structures, and state number to state name conversion data.

3.13 I am editing a file with vi; why doesn't lsof find the file?

Classic implementations of vi usually don't keep open the file being edited. (Newer ones may do so in order to maintain an advisory lock.) Instead classic vi opens the file, makes a temporary copy (usually in /tmp or /usr/tmp), and does its work in that file. When you save the
file being edited from a
classic vi implementation, it reopens and rewrites the file.

During a classic vi session, except for the brief periods when vi is reading or rewriting the file, lsof won't find an open reference to the file from the vi process, because there is none.

3.14 Why doesn't lsof report TCP/TPI window and queue sizes for my dialect?

Lsof only reports TCP/TPI window sizes for Solaris, because only its netstat reports them. The intent of providing TCP/TPI information in lsof NAME column output is to make it easier to match netstat output to lsof output.

In general lsof only reports queue sizes for both TCP and UDP (TPI) connections on BSD-derived UNIX dialects, where both sets of values appear in kernel socket queue structures. SYSV-derived UNIX dialects whose TCP/IP implementations are based on streams generally provide only TCP queue sizes, not UDP (TPI) ones.

While you may find that netstat on some SYSV-derived UNIX dialects with streams TCP/IP

may report UDP (TPI) queue
sizes, you will probably also find that the sizes are always
zero -- netstat supplies a constant zero for UDP (TPI)
queue sizes to make its headers align the same for TCP and
UDP (TPI) connections. Solaris seems to get it right --
i.e., its netstat does not report UDP (TPI) queue sizes.

When in doubt, I chose to avoid reporting UDP (TPI) queue
sizes for UNIX dialects whose netstat-reported values I
knew to be a constant zero or whose origin I couldn't
determine. OSR is a dialect in this category.

3.14.1 Why doesn't lsof report socket options, socket states, and TCP
flags and values for my dialect?

The lsof -T argument, 'f', that selects the reporting of socket
options, socket states and TCP flags was implemented at lsof
revision 4.71 for the following UNIX dialects, providing the
indicated information:

   AIX 4.3.2 and 5.1 and above
All socket options and values, socket states, and TCP
flags and values described in lsof(8) are reported.

  Apple Darwin 7.2 and above
All socket options and values, socket states, and TCP
flags and values described in lsof(8) are reported.
   Digital UNIX and Tru64 UNIX 4.0
All socket options and values, socket states, and TCP
flags and values described in lsof(8) are reported.
   FreeBSD 4.9 and above
All socket options and values, socket states, and TCP
flags and values described in lsof(8) are reported.
   HP-UX 11.00 (/dev/kmem-based lsof)
All socket options and values are reported. No socket
states are reported. Only the TF_NODELAY TCP flag and
the TF_MSS value are reported.
   HP-UX 11.11 and iiiv2 (PSTAT-based lsof)
All socket options and values, and socket states are
reported. No TCP flags or values are reported.
   Linux
No socket options and values, socket states, or TCP
flags and values are reported. The support for "-Tf"
could not be added to Linux, because socket options,
socket states, and TCP flags and values are not
available
via the /proc file system.
   NetBSD 1.6G and above

All socket options and values, socket states, and TCP
flags and values described in lsof(8) are reported.
OpenBSD 3.4 and above
All socket options and values, socket states, and TCP
flags and values described in lsof(8) are reported.
OPENSTEP 4.2
All socket options and values, socket states, and TCP
flags and values described in lsof(8) are reported.
OpenUNIX 8
All socket options and values, socket states, and TCP
flags and values described in lsof(8) are reported.
SCO OpenServer Release 5.0.6
All socket options and values, socket states, and TCP
flags and values described in lsof(8) are reported.
Solaris 2.6, 8 and above
The socket option display is limited to BROADCAST,
DEBUG, DGRAM_ERRIND, DONTROUTE and OOBINLINE. Socket
values are limited to KEEPALIVE and LINGER. No socket
states are reported. The TCP DELACK, NODELAY and
SENTFIN flags are reported. The TCP MSS value
is
reported.
UnixWare 7.1.[134]
All socket options and values, socket states, and TCP
flags and values described in lsof(8) are reported.

3.14.2 Why doesn't lsof report the partial listen queue connection
count for my dialect?

The reporting of partial listen queue connections was added to
-Tf processing at lsof revision 4.76. Currently it is reported
for these dialects:

AIX 4.3.2
This dialect is no longer supported, so no attempt
was made to add partial listen queue length support
for it.
AIX 5.1 and above
Partial listen queue information is available.
Apple Darwin 7.2 and above
Partial listen queue information is available.
Digital UNIX 4.0
This dialect is no longer supported, so no attempt
was made to add partial listen queue length support
for it.
FreeBSD 4.9 and above
Partial listen queue information is available.
HP-UX 11.00 (/dev/kmem-based lsof)

No partial listen queue information is available.

HP-UX

11.11 and iiiv2 (PSTAT-based lsof)

No partial listen queue information is available.

Linux

No partial listen queue information is available.

NetBSD 1.6G and above

Partial listen queue information is available.

OpenBSD 3.4 and above

Partial listen queue information is available.

OPENSTEP 4.2

Partial listen queue information is available.

OpenUNIX 8

This dialect is no longer supported, so no attempt
was made to add partial listen queue length support
for it.

SCO OpenServer Release 5.0.6

No partial listen queue information is available.

Solaris 2.6, 8 and above

Partial listen queue information is available.

Tru64 UNIX 5.0

This dialect is no longer supported, so no attempt
was made to add partial listen queue length support
for it.

Tru64 UNIX 5.1

Partial listen queue information is available.

UnixWare 7.1.[134]

Partial listen queue information is available.

3.15 What does "no more information" in the NAME column mean?

When lsof can find no successor structures -- a gnode, inode, socket, or vnode -- connected to the file structure of an open descriptor of a process, it reports "no more information" in the NAME column. The TYPE, DEVICE, SIZE/OFF, and INODE columns will be blank.

Because the file structure is supposed to contain a pointer to the next structure of a file's processing support, if the pointer is NUL, lsof can go no further.

Some UNIX dialects have file structures for system processes -- e.g., the sched process -- that have no successor structure pointers. The "no more information" NAME will commonly appear for these processes in lsof output.

It may also be the case that lsof has read the file structure while it is being assembled and before a successor structure pointer value has been set. The "no more information" NAME will again result.

Unless lsof output is filled with "no more information" NAME column messages, the appearance of a few should be no cause
for alarm.

3.16 Why doesn't lsof find a process that ps finds?

If lsof fails to display open files for a process that ps indicates exists, there may be several reasons for the difference.

The process may be a "zombie" for which ps displays the "(defunct)" state. In that case, the process has exited and has no open file information lsof can display. It does still have a process structure, sufficient for the needs of ps.

Another possible explanation is that kernel tables and structures may have been changing when lsof looked for the process, making lsof unable to find all relevant process structures. Try repeating the lsof request.

3.17 Why doesn't -V report a search failure?

The usual reason that -V won't report a search failure is that lsof located the search item, but was prevented from listing it by an option that doesn't participate in search failure reporting.

For example, this lsof invocation:

```
$ lsof -V -i TCP@foobar -a -d 999
```

won't report
it can't find the Internet address TCP@foobar,
even if there is an open file connected to that address,
unless the open file also has a file descriptor number of
999 (the ``-a -d 999'' options).

Compile-time options can also affect -V results in much the same way. For example, if HASSECURITY and HASNOSOCKSECURITY are defined at compile time, this lsof invocation, run by a non-root user:

```
$ lsof -V -c inetd
```

won't report that it can't find the inetd command, even if
there is a process running the inetd command, because the
HASSECURITY and HASNOSOCKSECURITY options prevent the
listing of all but the socket files of another user, and
no socket file selector (e.g., "-i") was specified.

3.18 Portmap problems

3.18.1 Why isn't a name displayed for the portmap registration?

When portmap registration reporting is enabled, any time
there is a registration for a local TCP or UDP port, lsof
displays it in square brackets, following the port number
or service name -- e.g.,
``:1234[name]" or ``:name[100083]".

The TCP or UDP port number or service number (what follows
the `:') is displayed under the control of the lsof -P
option. The registration identity is held by the portmapper
and may be a name or a number, depending on how the
registration's owner declared it. Lsof reports what the
port map holds and cannot derive a registration name from
a registration number.

Lsof can be compiled with registration reporting enabled
or disabled by default, under the control of the HASPMAPENABLED
#define (usually in machine.h). The lsof help panel (`lsof
-h`) will show the default. Lsof is distributed with
reporting disabled by default.

3.18.2 How can I display only portmap registrations?

Lsof doesn't have an option that will display only TCP or
UDP ports with portmap registrations. The +M option only
enables the reporting of registration information when
Internet socket files are displayed; +M doesn't select
the displaying of Internet socket
files -- the -i option
does that.

This simple lsof pipe to grep will do the job:

```
$ lsof -i +M | grep "\["
```

This works because -i selects Internet socket files, +M enables portmap registration reporting, and only output lines with opening square brackets will have registrations.

When portmap registration reporting is enabled by default, because the lsof builder constructed it that way, +M is not necessary. (The lsof help panel, produced with `lsof -h` will display the default portmapper registration reporting state.) However, specifying +M when reporting is already enabled is acceptable, as is specifying -M when reporting is already disabled.

Digression: lsof will accept `+' or `-' as a prefix to most options. (That isn't documented in the man page or help panel to reduce confusion and complexity.) The -i option is as acceptable as +i, so the above example could be written a little more tersely as:

```
 $ lsof +Mi | grep "\["
```

But be careful to use the ``Mi'' ordering, since ``iM'' implies M is an address argument to `i'.

3.18.3 Why doesn't lsof report portmap registrations for some ports?

Lsof reports portmap registrations for local TCP and UDP ports only. It identifies local ports this way:

* The port appears in the local address section of the kernel structure that contains it.

* The port appears in the foreign address section of a kernel structure whose local and foreign Internet addresses are the same.

* The port appears in the foreign address section of a kernel address structure whose Internet address is INADDR_LOOPBACK (127.0.0.1).

Following these rules, lsof ignores foreign portmapped ports. That's done for reasons of efficiency and possible security prohibitions. Contacting all remote portmappers could take a long time and be blocked by network difficulties (i.e., be inefficient). Many firewalls block portmapper access for security reasons.

Lsof may occasionally ignore portmap registration

information
for a legitimate local port by virtue of its local port
rules. This can happen when a port appears in the foreign
part of its kernel structure and the local and foreign
Internet addresses don't match (perhaps because they're on
different interfaces), and the foreign Internet address
isn't INADDR_LOOPBACK (127.0.0.1).

3.19 Why is `lsof | wc` bigger than my system's open file limit?

There is a strong temptation to count open files by piping
lsof output to wc. If your purpose is to compare the number
you get to some Unix system parameter that defines the
number of open files your system can have, resist the
temptation.

One reason is that lsof reports a number of "files" that
don't occupy Unix file table space -- current working
directories, root directories, jail directories, text files,
library files, memory mapped files are some. Another reason
is that lsof can report a file shared by more than one
process that itself occupies only one file
table slot.

If you want to know the number of open files that occupy
file table slots, use the +ff option and process the lsof
output's FILE_ADDR column information with standard Unix
tools like cut, grep, sed, and sort.

You might also consider using use lsof's field output with
+ff, selecting the file struct address with -FF, and
processing the output with an AWK or Perl script. See the
list_fields.awk, list_fields.perl, and shared.perl5 scripts
in the scripts/ subdirectory of the lsof distribution for
hints on file struct post-processing filters.

3.20 Why doesn't lsof report file offset (position)?

Lsof won't report a file offset (position) value if the -s
option has been specified, or if the dialect doesn't support
the displaying of file offset (position).

That lsof is reporting only file size is indicated by the
fact that the appropriate column header says SIZE instead
of SIZE/OFF.

If lsof doesn't support the displaying of file offset
(position) -- e.g., for

Linux /proc-based lsof -- the -h
or -? output panel won't list the -o option.

Sometimes the availability of file offset information
depends on the dialect's kernel. This is particularly true
for socket file offsets.

Maintenance of offsets for pseudo-terminal devices varies
by UNIX dialect and is related to how the dialect kernel
implements pseudo-terminal support. Kernels like AIX, for
example, that short-circuit the transfer of data between
socket and pseudo devices to reduce TCP/IP daemon interrupt
rates won't advance offsets in the TCP/IP daemon socket
files. Instead they will advance offsets in the open
standard I/O files of the shell child precess where the
pseudo-terminal devices are used.

When in doubt about the behavior of lsof in reporting file
offset information, do some carefully measured experiments,
consult the lsof sources, or contact me at <abe@purdue.edu>
to discuss the matter. Please follow the reporting guidelines
in the "How do I report an
lsof bug?" section of this FAQ.

3.20.1 What does lsof report for size when the file doesn't really have one?

When a file has no true size -- e.g., it's a socket, a
FIFO, or a pipe -- lsof tries to report the information it
finds in the kernel that describes the contents of associated
kernel buffers.

Thus, for example, size for most TCP/IP files is socket
buffer size. The size of the socket read buffer is reported
for read-only files; the size of the write buffer for
write-only files; and the sum of the buffers sizes for
read-write files.

3.21 Problems with path name arguments

3.21.1 How do I ask lsof to search a file system?

You can ask lsof to search for all open files on a file
system by specifying its mounted path name as an lsof
argument -- e.g.,

```
$ lsof /
```

Output of the mount command will show file system mounted
path names. It will also show the mounted-on device path
for the file system.

If the mounted-on device is a block device (the permission
field
in output of `ls -l <device>` starts with a `b/),
you can specify it's name, too -- e.g.,

```
$ lsof /dev/sd0a
```

If the mounted-on device isn't a block device -- for example,
some UNIX dialects call a CD-ROM device a character device
(ls output starts with a `c') -- you can force lsof to
assume that the specified device names a file system with
the +f option -- e.g.,

```
$ lsof +f -- /dev/sd0a
```

(Note: you must use ``--'' after +f or -f if a file name
follows immediately, because +f and -f can be followed by
characters that specify flag output selections.)

When you use +f and lsof can't match the device to a file
system, lsof will issue a complaint.

The +f option may be used in some dialects to ask lsof to
search for an NFS file system by its server name and server
mount point. If the mount application reports an NFS file
system mounted-on value that way, then this sample lsof
request should work.

```
$ lsof +f -- fleet:/home/fleet/u5
```

Finally, you can use
-f if you don't want a mounted file
system path name to be considered a request to report all
open files on the file system. This is useful when you
want to know if anyone is using the file system's mounted
path name. This example directs lsof to report on open
access to the `/' directory, including when it's being used
as a current working or root directory.

```
$ lsof -f -- /
```

The lsof -f option performs the same function as -f does
in some fuser implementations. However, since the lsof -c
option was chosen for another purpose before the `f' option

was added to lsof, +f was selected as the analogue to the
fuser -c option. (Sorry for the potential confusion.)

3.21.2 Why doesn't lsof find all the open files in a file system?

Lsof may not find all the open files in a file system for
several reasons.

First, some processes with files open on the file system
may have been changing status when lsof examined the process
table, and lsof "missed" them. Remember, the
kernel changes
much faster than lsof can respond to the changes.

Second, be sure you have specified the file system correctly.
Perhaps you specified a file instead. You can use lsof's
-V option to have lsof report in detail on what it couldn't
find. Make sure the report for the file system you specified
says "file system." Here's some -V output:

```
$ /lsof -V /tmp ./lsof.h ./lsof
COMMAND  PID USER   FD   TYPE DEVICE SIZE/OFF  INODE NAME
lsof    2688  abe  txt   VREG 18,1,7  1428583 226641 ./lsof
lsof    2689  abe  txt   VREG 18,1,7  1428583 226641 ./lsof
lsof: no file use located: ./lsof.h
```

You can also use lsof's +f option to force it to consider
a path name as a file system. If lsof can't find a file
system by the specified name, it will issue a complaint --
e.g.,

```
$ lsof +f -- /usr
lsof: not a file system: /usr
```

(/usr is a directory in the / file system.)

3.21.3 Why does the lsof exit code report it didn't find open files when some files were listed?

Sometimes lsof will list some open files, yet return a
non-zero exit code, suggesting it hasn't found all the
specified files.

The first thing you should when you suspect lsof is incorrect
is to repeat the request, adding the -V option. In the
resulting report you may find that your file system
specification really wasn't a file system specification,

just a file specification.

Finally, if you specify two files or two file systems twice,
lsof will credit all matches to the first of the two and
believe that there were no matches for the second. It's
possible to specify a single file system twice with different
path names by using both its mounted directory path name
and mounted-one device name.

```
$ lsof +f -V spcuna:/sysprog /sysprog
COMMAND   PID USER   FD   TYPE DEVICE SIZE/OFF  INODE NAME
ksh     11092  abe  cwd   VDIR 39,0,1     1536 226562 /sysprog
(spcuna:/sysprog)
...
lsof: no file system use located: spcuna:/sysprog
```

All
matches were credited to /sysprog; none to spcuna:/sysprog.

3.21.4 Why won't lsof find all the open files in a directory?

When you give lsof a simple directory path name argument
(not a file system mounted-on name), you are asking it to
search for processes that have the directory open as a
file, or as a process-specific directory -- e.g., root or
current working directory.

If you want to list instances of open files inside the
directory, you need to specify the individual path names
of those files, or use the lsof +D and +d options.

See the answer to the question "Why are the +D and +d
options so slow?" before you use +D or +d casually.

See the answer to the question "Why do the +D and +d options
produce warning messages?" for an explanation of some
process authority limitations of +D and +d.

3.21.5 Why are the +D and +d options so slow?

The +D and +d options cause lsof to build a path name search
list for a specified directory. +D causes lsof to descend
the
directory to its furthest subdirectory, while +d
restricts it to the top level. In both cases, the specified
directory itself is included in the search list. In both
symbolic links are ignored.

Building such a search list can take considerable time,
especially when the specified directory contains many files
and subdirectories -- lsof must call the system readlink()
and stat() functions for each file and directory. Storing
the search list can cause lsof to use more than its normal
amount of dynamic memory -- each file recorded in the search
list consumes dynamic memory for its path name, characteristics,
and search linkages. Using the list means lsof must search
it for every open file in the system.

Building the search list for a directory specified on some
file systems can be slow -- e.g., for an NFS directory with
many files. Some file systems have special logging features
that can introduce additional delays to the building of
the search list -- e.g.,
NFS logging, or logging on a
Solaris UFS file system. The bottom line is that slow
search list construction may not be so much an lsof problem
as a file system problem. (Hint: if you're using Solaris
UFS logging, consider specifying the "logging,noatime"
option pair to reduce the number of atime writes to the
UFS logging queue and disk.)

A somewhat risky way to speed up lsof's building of the
search list is to use lsof's ``-O'' option. It forces lsof
to do all system calls needed to build the search list
directly, rather than in a child process. While direct
system calls are much faster, they can block in the kernel
-- e.g., when an NFS server stops responding -- stopping
lsof until the kernel operation unblocks.

As an example of the load +D can impose, consider that an
`lsof +D /` on a lightly loaded NeXT '040 cube with a 1GB
root file system disk took 4+ minutes of real time. It
also generated several hundred error messages about files
and directories the
lsof process didn't have permission to
access with stat(2).

The bottom line is that +D and +d should be used cautiously.
+D is more costly than +d for deeply nested directory trees,
because of the full directory descent it causes. So use
+d where possible. And you might need to consider the
performance of the file system that holds the directory
you name with +d or +D.

In view of these warnings, when is it appropriate to use
+D or +d? Probably the most appropriate time is when you

would specify the directory's contents to lsof with a shell globbing construct -- e.g., `lsof *`. If that's what you need to do, `lsof +d .` is probably more efficient than having the shell produce a directory list, form it into an argument vector, and pass the vector to lsof for it to unravel.

See the answer to the question "Why do the +D and +d options produce warning messages?" for an explanation of some process authority limitations of +D and +d.

3.21.6 Why do the +D and +d options produce warning messages?

+D and +d option processing is limited by the authority of the lsof process -- i.e., lsof can only examine (with lstat(2) and stat(2)) files the owner of the process can access.

If the ownership, group membership, or permissions of the specified directory, file within it, or directory within it prevents the owner of the lsof process from using lstat(2) or stat(2) on it, lsof will issue a warning message, naming the path and giving the system's (lstat(2's or stat(2)'s) reason (errno explanation text) for refusing access.

As an example, assume user abc has a subdirectory in /tmp, owned by abc and readable, writable and searchable by only its owner. If user def asks lsof to search for all /tmp references with +D or +d, lsof will be unable to lstat(2) or stat(2) anything in abc's private subdirectory, and will issue an appropriate warning.

Lsof warnings can usually be suppressed with the -w option. However, using -w with +D or +d means that there will be no indication why lsof couldn't find an open reference to a restricted directory or something contained in it.

Hint: if you need to use +D or +d and avoid authority warnings, and if you have super-user power, su and use lsof with +D or +d as root.

3.22 Why can't my C compiler find the rpcent structure definition?

When you try to compile lsof your compiler may complain that the rpcent structure is undefined. The complaints may look like this:

>print.c: In function `fill_portmap':
>print.c:213: dereferencing pointer to incomplete type
>...

The most likely cause is that someone has allowed a BIND installation to update /usr/include/netdb.h (or perhaps /usr/include/rpc/netdb.h), removing the rpcent structure definition that lsof expects to find there.

Only Solaris has an automatic work-around. (See dlsof.h in dialects/sun.). The Solaris work-around succeeds because there is another header file, <rpc/rpcent.h>, with the rpcent structure
definition, and there is a Solaris C pre-processor test that can tell when the BIND <netdb.h> is in place and hence <rpc/rpcent.h> must be included.

Doubtlessly there are similar work-arounds possible in other UNIX dialects whose header files have been "touched" by BIND, but in general I recommend restoration of the vendor's <netdb.h> and any other header files BIND might have replaced. (I think BIND replaces <resolv.h>, <sys/bitypes.h>, <sys/cdefs.h> -- and maybe others.)

3.23 Why doesn't lsof report fully on file "foo" on UNIX dialect "bar?"

Lsof sometimes won't report much information on a given file, or may even report an error message in its NAME column. That's usually because the file is of a special type -- e.g., in a file system specific to the UNIX dialect -- and I haven't used a system where the file appeared during my testing.

If you encounter such a situation, send me e-mail at <abe@purdue.edu> and we may be able to devise an addition to lsof that
will report on the file in question. Please follow the reporting guidelines in the "How do I report an lsof bug?" section of this FAQ. Make sure "lsof" appears in the "Subject:" line so my e-mail filter won't classify your letter as Spam.

3.24 Why do I get a complaint when I execute lsof that some library file can't be found?

On systems where the LIBPATH (or the equivalent) environment

variable is used to record the library search path in
executable files when they are built, an incorrect value
may make it impossible for the system to find the shared
libraries needed to load lsof for execution.

This may be particularly true on systems like AIX >= 4.1.4,
where the lsof Makefile takes the precautionary step of
using the -bnolibpath loader flag to insure that the path
to the private static lsof library is not recorded in the
lsof binary. Should LIBPATH be invalid when lsof is built,
it will be recorded in the lsof binary as the default
library path search order and
lead to an inability to find
libraries when lsof is executed.

So, if you get missing library complaints when you try to
execute lsof, check LIBPATH, or whatever environment variable
is used on your system to define library search order in
executable files. Use the tools at your disposal to look
at the library paths recorded in the lsof binary -- e.g.,
chatr on HP-UX, dump on AIX, ldd on Solaris.

Make sure, too, that when the correct library search path
has been recorded in the executable file, the required
library files exist at one or more of the search paths.

3.25 Why does lsof complain it can't open files?

When lsof begins execution, unless it has been asked to
report only help or version information, typically it will
attempt to access kernel memory and symbol files -- e.g.,
/unix, /dev/kmem. Even though lsof needs only permission
to open these files for reading, read access to them might
be restricted by ownerships and permission modes.

So the first step
to diagnosing lsof problems with opening
files is to use ls(1) to examine the ownerships and permission
modes of the files that lsof wants to open. You may find
that lsof needs to be installed with some type of special
ownership or permission modes to enable it to open the
necessary files for reading. See the "Installing Lsof"
section of 00README for more information.

3.26 Why does lsof warn "compiled for x ... y; this is z."?

Unless warnings are suppressed (with -w) or the kernel

identity check symbol (HASKERNIDCK) definition has been deleted, all but one lsof dialect version (exception: /proc-based Linux lsof) compare the identity of the running kernel to that of the one for which lsof was constructed. If the identities don't match, lsof issues a warning like this:

```
lsof: WARNING: compiled for Solaris release 5.7; this is 5.6.
```

Two kernel identity differences can generate this warning -- the version number and the release number.

Build and running identity differences are usually significant, because they usually indicate kernels whose structures are different -- kernel structures commonly change at dialect version releases. Since lsof reads data from the kernel in the form of structures, it is sensitive to changes in them. The general rule is that an lsof compiled for one UNIX dialect version will not work correctly when run on a different version.

There are three work-arounds: 1) use -w to suppress the warning -- and risk missing other warnings; 2) permanently disable the identity check by deleting the definition of HASKERNIDCK in the dialect's machine.h header file -- with the same risk; or 3) rebuild lsof on the system where it is to be run. (Deleting HASKERNIDCK can be done with the Customize script or by editing machine.h.)

Generally checking kernel identity is a quick operation for lsof. However, it is potentially slow under AIX, where lsof must run /usr/bin/oslevel. To speed up lsof, use -w to suppress the /usr/bin/oslevel test. See "Why does AIX lsof start so slowly?" for more information.

3.27 How can I disable the kernel identity check?

The kernel identity check is controlled by the HASKERNIDCK definition. When it is defined, most dialects (exclusion: /proc-based Linux lsof) will compare the build-time kernel identity with the run-time one.

To disable the kernel identity check, disable the HASKERNIDCK definition in the dialect's machine.h header file. The Customize script can be used to do that in its section about the kernel identity check.

Caution: while disabling the kernel identity check may
result in smaller lsof startup overhead, it comes with the
risk of executing an lsof that may produce warning messages,
error messages, incorrect output, or no output at all.

3.28 Why don't ps(1) and lsof agree on the owner of a process?

Generally the user ID lsof reports in its USER column is
the process effective user ID, as found in the process
structure. Sometimes
that may not agree with what ps(1)
reports for the same process.

There are sundry reasons for the difference. Sometimes
ps(1) uses a different source for process information,
e.g., the /proc file system or the psinfo structure.
Sometimes the kernel is lax or confused (e.g., Solaris
2.5.1) about what ID to report as the effective user ID.
Sometimes the system carries only one user ID in its process
structure (some BSD derivatives), leaving lsof no choice.

The differences between lsof and ps(1) user identifications
should be small and normally it will be apparent that the
confusion is over a process whose application has changed
to an effective user ID different from the real one.

3.29 Why doesn't lsof find an open socket file whose connection
state is past CLOSE_WAIT?

TCP/IP connections in states past CLOSE_WAIT -- e.g.,
FIN_WAIT_1, CLOSING, LAST_ACK, FIN_WAIT_2, and TIME_WAIT
-- don't always have open files associated with them. When
they don't, lsof can't identify
them. When the connection
state advances from CLOSE_WAIT, sometimes the open file
associated with the connection is deleted.

3.30 Why don't machine.h definitions work when the surrounding
comments are removed?

The machine.h header files in dialect subdirectories have
some commented-out definitions like:

```
/* #define HASSYSDC "/your/choice/of/path */
```

You can't simply remove the comments and expect the definition
to work. That's intended to make you think about what

value you are assigning to the symbol. The assigned value might have a system-specific convention. HASSYSDC, for example, might be /var/db/lsof.dc for FreeBSD, but it might be /var/adm/lsof.dc for Solaris.

Symbols defined in the lsof documentation are described in 00PORTING, other machine.h comments, and other lsof documentation files. HASSYSDC, for example, is discussed in 00DCACHE. When comments and documentation don't suffice, consult the source code for hints on how the symbol is used.

3.31 What do "can't read inpcb at 0x...", "no protocol control block", "no PCB, CANTSENDMORE, CANTRCVMORE", etc. mean?

Sometimes lsof will report "can't read inpcb at 0x00000000", "no protocol control block", "no PCB, CANTSENDMORE, CANTRCVMORE" or a similar message in the NAME column for open TCP socket files. These messages mean the file's socket structure lacks a pointer to the INternet Protocol Control Block (inpcb) where lsof expects to find connection addresses -- local and foreign ports, local and foreign IP addresses. The socket file has probably been submitted to the shutdown(2) function for processing.

In some implementations lsof issues the "no PCB, CANTSENDMORE, CANTRCVMORE" message, which tries to explain the absence of a protocol control block by showing the socket state settings that have been made by the shutdown(2) function.

If a non-zero address follows the "0x" in the "can't read inpcb" message, it means lsof couldn't read inpcb contents from the indicated address in kernel memory.

3.32 What do the "unknown file system type" warnings mean?

Lsof may report a message similar to"

```
unknown file system type, v_op: 0x10472f10
```

in the NAME column for some files.

This means that lsof has encountered a vnode for the file whose operation switch address (from v_op) references a file system type for which there is no support in lsof. After lsof identifies the file system type, it uses

pre-compiled code to locate the file system specific node
for the file where lsof finds information like file size,
device number, node number, etc.

To get some idea of what the file system type might be,
use nm on your kernel symbol file to locate the symbol name
that corresponds to the v_op address -- e.g., on Solaris
do:

```
$ nm -x /dev/ksyms | grep 0x10472f10
0x10472f10 ... |file_system_name_vnodeops
```

Where "file_system_name" is the clue to the unsupported
file system.

Lsof doesn't use the v_op address to identify file
system
types on all dialects. Sometimes it uses an index number
it finds in the vnode. It will translate that symbol to
a short name in the warning message -- e.g., "nfs3" -- if
possible.

3.33 Installation

3.33.1 How do I install lsof?

There is no "standard" way to install lsof. Too much
depends on local conditions for me to be able to provide
working install rules in the lsof make files. (The skeleton
install rules you will find just give "hints.") See the
"Installing Lsof" section of 00README for a fuller explanation.

To install lsof you will need to consider these questions:

* Who should be able to use lsof? (See HASSECURITY and
  HASNOSOCKSECURITY in the "Security" section of 00README.)

* Where should lsof be installed? This is a decision
  mostly dictated by local conditions. Somewhere in
  /usr/local -- etc/ or sbin/ -- is a common choice.

* What permissions should I give the lsof executable?
  The answer to this varies by dialect. The make
files
  have install rules that give hints. The "Installing
  Lsof" section of 00README gives information, too.

* What if I want to install lsof in a shared file system

for machines that require different lsof configurations? See the next question and answer, "How do I install a common lsof when I have machines that need differently constructed lsof binaries?"

3.33.2 How do I install a common lsof when I have machines that need differently constructed lsof binaries?

A dilemma that faces some system administrators when they install lsof in a shared file system -- e.g., NFS -- is that they must have different lsof executables for different systems.

The answer is to build an lsof wrapper script that is executed in place of lsof. The script can use system commands to determine which lsof binary should be executed.

Consider this example. You have HP-UX machines with 32 and 64 bit kernels that share the /usr/local/sbin directory where you want to install lsof. Consequently, on each system you must use a different lsof executable, built for the system's bit size. (That's because lsof reads kernel structures, sized by the kernel's bit size.)

One answer is to install three things in /usr/local/sbin: 1) a 32 bit lsof as lsof32; 2) a 64 bit lsof as lsof64; and 3) an lsof script. The script might look like this one, based on work by Amir J. Katz:

```
  #!/bin/sh
  x=`/usr/bin/getconf KERNEL_BITS`  # returns 32 or 64
  if /usr/bin/test "X$x" = "X32"
  then
    lsof32 $*
  else
    if /usr/bin/test "X$x" = "X64"
    then
lsof64 $*
    else
echo "Can't determine which lsof executable to use;"
echo "getconf KERNEL_BITS says: $x"
exit 1
    fi
  fi
```

Solaris users should consult "How do I install lsof for Solaris 7, 8 or 9?" for information on a similar trick

using the Solaris isaexec command.

Users of other dialects might be able to use a command like uname(1) that can identify a distinguishing feature of the system to be incorporated in pre-installed lsof executable names. For example, use `uname -r` and install binaries with suffixes that match `uname -r` output.

3.34 Why do lsof 4.53 and above reject device cache files built by earlier lsof revisions?

When lsof revisions 4.53 run and encounter a device cache file built by an earlier revision, it will reject the file and build a new one. The rejection will be advertised with these messages:

```
lsof: WARNING: no /dev device in <name>: 2 sections
...
lsof: WARNING: created device cache file: <name>
```

This happens because the header line of the device cache file was changed at revision 4.53 to contain the number of the device on which the device directory resides. The old device cache file header line -- the "2 sections" line in the above warning message, node reads "2 sections, dev=600".

This is not a serious problem, since lsof automatically rebuilds the device cache file with the correct header line.

3.35 What do "like block special" and "like character special" mean in the NAME column?

When lsof comes across an open block or character file whose device, raw device and inode place it somewhere other than /dev (or /devices), lsof doesn't report the /dev (or /devices) name in the NAME column. Instead lsof reports the file system name and device or path name in the NAME column and parenthetically adds "like block special <path>" or "like character special <path>".

The value for <path> will point to a block or character device in /dev (or /devices) whose raw device number matches that of the open file being reported, but whose device number or node number (or both) don't match.

Such an open file is connected to a device node that has
been created in a directory other than /dev (or /devices.)
See mknod(8) for information on how such nodes are created.
(Generally one needs root power to create device nodes with
mknod.)

3.36 Why does an lsof make fail because of undefined symbols?

When lsof is compiled via the `make` step and the final
load step fails because of missing symbols, the problem
may not be lsof. The problem may be that ld, called by
the compiler as part of the `make` step, can't find some
library that lsof needs.

First check the last compiler line of the make operation
-- e.g., the last line with cc or gcc in it before the
undefined symbol report -- for loader arguments, i.e.,
ones beginning with "-l". Except for "-llsof" the rest
name system libraries. ("-L./lib" precedes "-llsof" to
tell the loader its location.)

Check that all the named system libraries exist. Look in
/lib and /usr/lib as a start, but that may not be the only
place system libraries live. Consult your dialect's
documentation, e.g., the compiler and loader man pages,
for other possible locations.

If some system library doesn't exist, that may mean it was
never installed or was removed. You'll have to re-install
the missing
library.

You may find that all the system libraries lsof uses exist.
Your next step might be to use nm and grep to see if any
of them contain the undefined symbols.

```
$ nm library | grep symbol
```

If the undefined symbol exists in some library named by
the lsof make step, then you might have a problem with some
environment variable that controls the load step. The most
common is LD_LIBRARY_PATH. It may have a setting that
causes ld to ignore a directory containing a library lsof
names. If this is the case, try unsetting LD_LIBRARY_PATH
in the environment of the ld process -- e.g., do:

```
$ unset LD_LIBRARY_PATH
```

or
    % unsetenv LD_LIBRARY_PATH

Consult your ld man page for other environment variables
that might affect library searching -- e.g., LIBPATH, LPATH,
SHLIB_PATH, etc.

If the undefined function doesn't exist in any libraries
lsof names, check other libraries. See if the function
has a man page that names its library. If the latter is
true,
please let me know, because that is an lsof problem
I need to fix.

If none of these solutions work for you, send me some
documentation via e-mail at <abe@purdue.edu>. Include `uname
-a` output, the output of the lsof `Configure ...` and `make`
steps, and the contents of the environment in force when the
`make` step was executed -- e.g., `env` or `printenv` output.
If you've located the libraries lsof names, send me that
information, too. Make sure "lsof" appears in the "Subject:"
line so my e-mail filter won't classify your letter as Spam.

3.37 Command Regular Expressions (REs)

3.37.1 What are basic and extended regular expressions?

Lsof's ``-c'' option allows the specification of regular
expressions (REs), enclosed in two slash ('/') characters and
followed by these modifiers:

    b the RE is a basic RE.
    i ignore case.
    x the RE is an extended RE (the default).

Note: the characters of the regular expression may need to
be quoted to prevent their expansion
by the shell.

Example: this RE is an extended RE that matches exactly
four characters, whose third may be an upper ('O') or lower
case ('o') oh:

    -c /^..o.$/i

For simplicity's sake, an RE that is acceptable to egrep(1)
is usually called an extended RE.

REs suitable for the old line editor, ed(1), are often called basic REs (and sometimes also called obsolete).

These are some ways basic REs usually differ from extended REs. (There are other differences.)

* `|', `+', `?', '{', and '}' are ordinary characters.

* `^' is an ordinary character except at the beginning of the RE.

* `$' is an ordinary character except at the end of the RE.

* `*' is an ordinary character if it appears at the beginning of the RE.

For more information on REs and the distinction between basic and extended REs, consult your dialect's man pages for ed(1), egrep(1), sed(1), and possibly regex(5) or regex(7).

3.37.2 Why can't I put a slash in a command regular expression?

Since a UNIX command name is the last part of a path to the command's executable, the lsof command regular expression (RE) syntax uses slash ('/') to mark the beginning and end of an RE. Slash may not appear in the RE and the `\' back-slash escape is ineffective for "hiding" it.

More likely than not, if you try to put a slash in an lsof command RE, you'll get this response:

```
$ lsof -s/.\// ...
lsof: invalid regexp modifier: /
```

Lsof is complaining the the first character it found after the second slash isn't an lsof command RE modifier -- 'b', 'i', or 'x'.

3.37.3 Why does lsof say my command regular expression wasn't found?

When you use both forms of lsof's -c option -- ``-c <command>" and ``-c /RE/[m]" -- and ask that lsof do a verbose search (``-V"), you may be surprised that lsof will say that the regular expression wasn't found.

This can happen if the ``-c <command>" form matches first, because then the ``-c/RE/[m]" test will never have been applied.
For example:

```
$ ./lsof -clsof -c/^..o.$/ -V -adcwd
COMMAND  PID USER   FD   TYPE DEVICE SIZE/OFF  NODE NAME
lsof    7850  abe  cwd   VDIR    6,0     2048 96442 / (/dev/sd0a)
lsof: no command found for regex: ^..o.$
```

The ``-clsof" option matched first, so the ``-c/^..o.$/ option wasn't tested.

3.38 Why doesn't lsof report on shared memory segments?

Lsof reports on shared memory segments only if they're associated with an open file. That's consistent with lsof's mission -- to LiSt Open Files. Shared memory segments with no file associations aren't open files.

That's not to say that a report on shared memory segments and their associated processes wouldn't be useful. But it calls for a new tool, not more baggage for lsof.

3.39 Why does lsof report two instances of itself?

When you ask lsof to report all open files and it has permission to do so, you may see two lsof processes in the output. The processes are connected via pipes -- e.g., here's
an HP-UX 11 example.

```
COMMAND     PID USER   FD   TYPE     DEVICE ...
...
lsof      29450  abe    7w  PIPE 0x48732408 ...
lsof      29450  abe    8r  PIPE 0x48970808 ...
...
lsof      29451  abe    6r  PIPE 0x48732408 ...
lsof      29451  abe    9w  PIPE 0x48970808 ...
```

The first process will usually be the lsof you initiated; the second, an lsof child process that is used to isolate its parent process from kernel functions that can block -- e.g., readlink() or stat().

Information to and from the kernel functions is exchanged via the two pipes. When the parent process detects that the child process has become blocked, it attempts to kill

the child. Depending on the UNIX dialect that may succeed
or fail, but the parent won't be blocked in any event.

See the "BLOCKS AND TIMEOUTS" and "AVOIDING KERNEL BLOCKS"
sections of the lsof man page for more information on why
the child process is used and how you can specify lsof
options
to avoid it. (Caution: that may be risky.)

3.40 Why does lsof report '\n' in device cache file error messages?

Lsof revisions prior to 4.58 may report '\n' in error
messages it delivers about problems in the device cache
file -- e.g.,

```
lsof: WARNING: no ...: 4 sections\n
```

That's deliberately done to show the exact contents of the
device cache file line about which lsof is complaining,
including its terminating NL (New Line) '\n' character.
In the above example the line in the device cache file
causing the lsof complaint contains "4 sections" and ends
with a '\n'.

At revision 4.58 and above, device cache error messages
like the one in the above example have been changed to
read:

```
lsof: WARNING: no ...: line "4 sections"
```

The terminal '\n' is no longer reported, the line contents
are enclosed in double quote marks (""), and the word
"line" has been added as a prefix to denote that what
follows is a line from the device cache file.

3.41 Kernel Symbol and Address Problems

3.41.1 What does "lsof: WARNING: name cache hash size length error: 0" mean?

When run on some systems, lsof may issue this warning:

```
lsof: WARNING: name cache hash size length error: 0
```

That is an example from a FreeBSD system where lsof reads
the kernel's _nchash variable and finds its value is zero.

Similar warnings include:

```
WARNING: kernel name cache size:
WARNING: can't read kernel's name cache:
WARNING: no name cache address
WARNING: name cache hash size length error:
WARNING: unusable name cache size:
```

These warnings are issued when lsof is attempting to read the kernel's name cache information. They are usually the result of a mis-match between the addresses for kernel symbols lsof gets via nlist(2) and the addresses in use by the kernel.

Lsof usually gets kernel symbol addresses from what it believes to be the kernel boot file. In FreeBSD, for example, that's the path returned by getbootfile(3), usually /kernel.
The boot file can have other names in other UNIX dialects -- /unix, /vmunix, /bsd, /netbsd, /mach, /stand/vmunix, etc.

Lsof will get incorrect (mismatched) addresses from the boot file if it has been replaced by a newer one which hasn't yet been booted -- e.g., if this is done in FreeBSD:

```
# mv /kernel /kernel.OLD
# mv /kernel.NEW /kernel
```

Until the FreeBSD system is rebooted, the booted kernel is /kernel.OLD, but getbootfile() says it is /kernel. If symbol addresses important to lsof in /kernel.OLD and /kernel don't match, the lsof WARNING messages result.

3.41.2 Why does lsof produce "garbage" output?

Kernel name cache warnings may not be the only sign that lsof is using incorrect symbol addresses to read kernel values. If there's no reasonable test lsof can make on what it reads from the kernel, it may issue other warnings or even report nonsensical results.

The warnings may appear on STDERR, such as:

```
lsof: can't read proc table info
```

Or the

warnings may appear in the NAME column as messages
saying lsof can't read or interpret some kernel structure --
e.g.,

```
... NAME
... can't read file struct from 0x12345
```

One possible work-around is to point lsof's kernel symbol
address gathering at the proper boot file. That can be
done with lsof's -k option -- e.g.,

```
$ lsof -k /kernel.OLD
```

The best work-around is to make sure the standard boot file
is properly sited -- e.g., if you've moved a new /kernel
in place, boot it.

3.42 Why does lsof report open files when run as super user that it doesn't report when run with lesser privileges?

The most likely cause is that the HASSECURITY option was
selected when the lsof executable was built.

If HASSECURITY is defined when lsof is built, and lsof is
run with the privileges of a non-ROOT user, it will only
list open files belonging to the user. The same lsof
executable, when run with root user privileges, will list
all open files.

However, if HASSECURITY
and HASNOSOCKSECURITY are both
defined when lsof is built, lsof will list open files
belonging to the user and will also list anyone else's open
socket files, provided their listing is selected with the
"-i" option.

So first ask yourself if the process whose open files lsof
won't list belong to a user other than the one under which
you're running lsof, and are not open socket files. If
either is true, use lsof's help (-h or -?) option and look
for a line near the bottom of the help panel that says:

```
"... can list all files..."
```

If the leading "..." says "Only root" then HASSECURITY was
defined when lsof was built. If the trailing "..." says
", but anyone can list socket files" then HASNOSOCKSECURITY
was also defined.

Should you want an lsof not built with HASSECURITY defined,
rerun the lsof Configure script. If you let Configure do
customization, make sure you answer 'n' when it asks if
you want to enable HASSECURITY and HASNOSOCKSECURITY. If
you don't
need to do customization, you can rebuild lsof
with the "-n" option to Configure. Here's an example of
such a rebuild sequence:

```
$ Configure -clean
$ Configure -n <dialect-abbreviation>
$ make
```

More information on the HASSECURITY and HASNOSOCKSECURITY
options may be found in the "Security" section of the
00README file of the lsof distribution.

3.43 Test Suite Problems

3.43.1 Errors all tests can report:

3.43.1.1 Why do tests complain "ERROR!!! can't execute ../lsof"?

All tests in the test suite expect an executable lsof file
to exist in the tests parent directory, ../lsof.

If there's none there, the tests/Makefile has a rule to
make it, but there are probably circumstances where that
rule may fail.

The work-around is to re-Configure and re-make lsof, then
run the test suite.

3.43.1.2 Why do tests complain "ERROR!!! can't find ..." a file?

Many tests create (or use from a supplied environment
variable path) a test file and use lsof to find it. When
lsof
can't file the file, the tests report the error with
messages of the form:

```
ERROR!!! can't find ... : <some file path>
```
or
```
ERROR!!! lsof couldn't find ...
```

These type of error messages mean that the lsof field output
delivered to the test didn't contain a file that the test

could identify as the one it intended lsof to find. It might also mean that the process information -- command name, PID or parent PID -- didn't match what the test expected.

This could imply a bug in the test or a bug in lsof. Try using lsof to find a known file that is open. For example, while in the tests sub-directory, do this:

```
$ sleep 30 < Makefile
$ ../lsof Makefile
```

If lsof doesn't report that Makefile is open, then the fault may be with lsof. If lsof reports the file is open, search further in the test code for the failure cause.

3.43.1.3 Why do some tests fail to compile?

If a test suite program fails to compile, it may be because I've never had an opportunity to compile the test on the particular UNIX version you are using.

See Appendix B in 00TEST for a list of the UNIX dialects where the test suite has been validate.

3.43.1.4 Why do some tests always fail?

There are several tests in the optional group that have conflicting or special requirements:

LTbigf needs a dialect and file system that support large files.

LTlock won't work if the tests/ sub-directory is on an NFS file system.

LTnfs won't work if the tests/ sub-directory is not on an NFS file system.

So for two tests in particular, LTlock and LTnfs, one will generally fail.

Some failing tests can be run successfully by supplying to them a path to the appropriate type of file system with the -p option.

3.43.1.5 Why does the test suite say it hasn't been validated on

my dialect?

When you use the default rule of the test suite's Makefile,
it may issue this complaint:

```
$ cd tests
$ make
!!!WARNING!!!

This dialect or its particular version may not have
been validated with the lsof test suite.  Consequently
some tests may fail or may not even compile.

!!!WARNING!!!
```

You are then given the opportunity to answer 'y' to have
the test suite operation continue.

This message means that the tests/TestDB file in the tests
sub-directory doesn't show that the test suite has been
run with the combination of compiler flags found in
tests/config.cflags. The tests might nor run; they may
encounter compiler failures.

See 00TEST for more information on the UNIX dialects where
the test suite has been validated and on the workings of
TestDB and its supporting scripts.

When the tests/Makefile "auto" rule is used, the message
is more terse and the condition is fatal.

```
This suite has not been validated on:

<dialect_description>
```

No opportunity to continue is offered.

The tests/Makefile "silent" rule will skip checking for
the validation footprint.

3.43.1.6
Why do the tests complain they can't stat() or open()
/dev/mem or /dev/kmem?

When the tests detect that lsof for the dialect reads its
information from kernel memory (i.e., the LT_KMEM definition
is present in tests/config.cflags), and when the lsof

executable path is ../lsof, the tests make sure they can
stat() and open() for read access the relevant kernel memory
devices, /dev/kmem and possibly /dev/mem.

If those stat() or open() operations fail, the tests issue
an error message and quit. The message explains why the
system rejected the operation in terms of system "errno"
symbols and messages. More often than not the explanation
will be that the process lacks permission to access the
indicated device node.

One work-around is to give the lsof executable being tested
the necessary permission -- e.g., via chgrp, chmod, etc.
-- and set its path in the LT_LSOF_PATH environment variable.
(See 00TEST.)

Another work-around is to make sure the process that runs
the
tests has the necessary permissions -- e.g., run it as
root, or enable the process login to access the resources.
For example, I can run the tests on my personal work-station
because /dev/kmem and /dev/mem are readable by the "kmem"
group and my login is in that group.

3.43.2 LTbigf test issues

3.43.2.1 Why does the LTbigf test say that the dialect doesn't
support large files?

Large file support is defined dialect by dialect in the
lsof source files and Configure script. If large file
support isn't defined there, it isn't defined in the LTbigf
test.

If you think that's wrong for a particular dialect, contact me
via e-mail at <abe@purdue.edu>. Make sure "lsof" appears in the
"Subject:" line so my e-mail filter won't classify your letter
as Spam.

3.43.2.2 Why does LTbigf complain about operations on its config.LTbigf*
file?

The LTbigf must be able to write a large file test (size
> 32 bits) and seek within it and the process file ulimit
size must permit the
operation. If the default location
for the test file, tests/, isn't on a file system enabled

for large file operations or if the process ulimit file
block size is too small, lsof will get file operation
errors, particularly when seeking

There may be a work-around. Specify the path to a file
LTbigf can write in a file system enabled for large file
operations a the -poption. Make sure that the ulimit file
block size permits writing a large file. For example,
presuming /scratch23 is large-file-enabled, and presuming
you have permission to raise the ulimit file block size,
this shell commands will allow the LTbigf test to run on
AIX:

```
$ ./LTbigf -p /scratch23/abe/bigfile
```

(Note: syntax for the ulimit command varies by dialect and
by shell. Discovering the proper variant is left to the
reader.)

More information on this subject can be found in the LTbigf
description in the 00TEST file. If course, the LTbigf.c
source file in tests/ is the ultimate source of information,

3.43.2.3
Why does LTbigf warn that lsof doesn't return file offsets?

On some dialects (e.g., Linux) lsof can't report file
offsets, because the data access method underlying lsof
doesn't provide them. If LTbigf knows that lsof can't
report file offsets for the dialect, it issues this warning:

```
LTbigf ... WARNING!!! lsof can't return file offsets
for this dialect, so offset tests have
been disabled.
```

LTbigf then performs the size test and skips the offset
tests.

For more information see 00TEST and the "Why doesn't
/proc-based lsof report file offsets (positions)?" Q&A of
this file.

3.43.3 Why does the LTbasic test complain "ERROR!!! lsof this ..."
and "ERROR!!! lsof that ..."?

The LTbasic test program uses lsof to examine a running
lsof process. It looks for the lsof current working
directory, executable (if possible), and kernel memory file

(if applicable).

Failures to find those things result in the LTbasic error
messages. More information
on how LTbasic produces the error
messages may be found in the LTbasic.c source file.

On HP-UX 11.11 and higher, for example, if the test's current
working directory is on a loopback (LOFS) file system, LTbasic
won't be able to find the current working directory of the lsof
process because of a bug in the HP-UX kernel.

The solution for that HP-UX problem is to install an HP-UX
patch. See the answer to the "Why doesn't PSTAT-based lsof
report a CWD that is on a loopback (LOFS) file system?"
question for more information on the patch.

3.43.4 NFS test issues

3.43.4.1 Why does the LTnfs test complain "couldn't find NFS file ..."?

The LTnfs test must work with an NFS test file. After it
opens the file it asks lsof to find it on an NFS file system.
If the file isn't on an NFS file system, lsof won't find it,
and the NFS test script complains and fails.

The work-around is to use -p option to supply a path to a
regular NFS file (not a directory) that is on an NFS file
system
that LTnfs can read. Presuming /share/bin/file is
such a file and can be opened for reading by the LTnfs
test, this sample shell command could be used to run the
LTnfs test successfully:

```
$ ./LTnfs -p /share/bin/file
```

(If the NFS file system is enabled for large files, the
NFS test will produce the error message described in the
following Q&A.)

3.43.5 LTnlink test issues

3.43.5.1 Why does the LTnlink test complain that its test file is on
an NFS file system?

The LTnlink test may complain:

```
LTnlink ... WARNING!!! test file <path> is NFS mounted.
```

and then issue an explanation and a hint about using the
-p option.

The LTnlist test does this because of the way NFS file
links are managed when an NFS file is unlinked and the
unlinking process still has the file open. Unlike with
files on a local file system, when an NFS file that is
still open is unlinked, its link count is not reduced.

The file name is changed to a name of the form .nfsxxxx
and
the link count is left unchanged until the process
holding the file open closes it. That's done by NFS so it
can keep proper track of the file on NFS clients and servers.

Since the link count isn't reduced when the LTnlink test
program closes the NFS test file it still has open, lsof
won't find it for LTnlink with a link count of zero.
Consequently, LTnlink disables that test section and issues
its warning.

The warning suggests that the unlink test section can be
run by giving LTnlink a path to a test file with the -p
option. That path must name a file LTnlink can write and
unlink. Presuming /scratch23/abe/nlinkfile is on a local
file system and the LTnlink test can write to it and unlink
it, this sample shell command can be used to run the complete
LTnlink test successfully:

```
$ LTnlink -p /scratch23/abe/nlinkfile
```

3.43.5.2 Why does LTnlink delay and report "waiting for link count
update: ..."?

On some UNIX dialects and file system combinations the
updating
of link count after a file has been unlinked can
be delayed. Consequently, lsof won't be able to report
the updated link count to LTnlink for a while.

When lsof doesn't report the proper link count to LTnlink,
it sleeps and repeats the lsof call, using the "waiting
for link count update: ..." message as a signal that it is
waiting for the expected lsof response. The wait cycle
duration is limited to approximately one minute.

3.43.5.3 Why does LTnlink fail because of an unlink error?

LTnlink may fail with an error similar to:

    LTnlink ... ERROR!! unlink(<name>) failed: (Permission denied).

That message will be followed by a short explanation.

The error means that the kernel support for the file system on
which the file <name> resides does not allow a process to
unlink a file while it has the file open. (When LTnlink is run
without the "-p path" option, it creates a <name> that begins
with "./config.LTnlink" and ends with the LTnlink process ID
number.)

An
unlink failure of this type runs counter to original UNIX
file system behavior, but it has been observed on some file
system types, especially on the ZFS file system.

The work-around is to run LTnlink on a file system that allows
a process to unlink a file it has open. Usually /tmp has that
support. So, try running LTnlink this way:

    $ ./LTnlink -p /tmp/<name>

where <name> is a unique name in /tmp of your choosing. To
be safe, create a subdirectory in /tmp, named by your login:

    $ rm -f /tmp/<login>
    $ mkdir /tmp/<login>
    $ ./LTnlink -p /tmp/<login>/<name>

3.43.6 LTdnlc test issues

3.43.6.1 Why won't the LTdnlc test run?

Lsof is unable to access the DNLC cache on AIX, because the
kernel symbols for the DNLC aren't exported. Contact IBM
to learn why that decision was made.

The LTdnlc test won't work on Apple Darwin because lsof
can't obtain reliable DNLC information.

The LTdnlc test may fail on other dialects. Failure causes
include: a busy
system with a DNLC that is changing rapidly;
path name components too large for the DNLC; a file system
-- e.g., NFS, /tmp, loopback -- which doesn't fully

participate in the DNLC; or DNLC limitations (Many DNLC implementations will only store path name components if they are 31 characters or less.)

If you suspect the file system doesn't fully participate in kernel DNLC processing, as a work-around rebuild and test lsof on one that does.

3.43.6.2 What does the LTdnlc test mean by "... <path> found: 100.00%"?

Even when it succeeds the LTdnlc test will report:

```
LTdnlc ... /export/home/abe/src/lsof4/tests found: 100.00%
```

This message means that the LTdnlc test asked lsof to find the file at the indicated path five times and lsof found the full path name in the indicated percentage of calls. The LTdnlc test considers it a failure if the percentage falls below 50.0%

3.43.6.3 Why does the DNLC test fail?

The DNLC test may fail when some component of the lsof tests/ sub-directory
can't be cached by the kernel DNLC.
Some kernels have a limit on the length of individual components (typically) 32.

3.43.7 Why hasn't the test suite been qualified for 64 bit HP-UX 11 when lsof is compiled with gcc?

When I attempted to qualify lsof for HP-UX 11, compiled with gcc 3.0, the LTsock test failed. I traced the failure to a gcc compilation error. Because LTsock is an important test, I didn't feel that the test suite was qualified if it failed.

LTsock compiles and runs correctly on 64 bit HP-UX 11 when compiled with HP's ANSI-C.

3.43.8 LTszoff test issues

3.43.8.1 Why does LTszoff warn that lsof doesn't return file offsets?

On some dialects (e.g., Linux) lsof can't report file offsets, because the data access method underlying lsof doesn't provide them. If LTszoff knows that lsof can't report file offsets for the dialect, it issues this warning:

LTszoff ... WARNING!!! lsof can't return file offsets
for this dialect, so offset tests
have
been disabled.

LTszoff then performs the size test and skips the offset tests.

For more information see 00TEST and the "Why doesn't /proc-based lsof report file offsets (positions)?" Q&A of this file.

3.43.9 LTlock test issues

3.44 File descriptor list (the ``-d'' option) problems

3.44.1 Why does lsof reject a ``-d'' FD list?

Lsof rejects ``-d'' FD lists that contain both exclusions and inclusions with messages like:

lsof: exclude in an include list: ^1
lsof: include in an exclude list: 2

That's because ``-d'' FD lists are processed as ORed lists, so it makes no sense for them to contain both exclusions and inclusions.

I.e.,, if a ``-d'' FD list were to contain ``^cwd,1'', the ``^cwd'' member is useless, because the ``1'' member dominates by saying "include only FD 1". That effectively excludes ``cwd'' FD.

Note that lists may have multiple members of the same type, exclude or include. They are processed as an ORed set. If an FD isn't
excluded by any member of an exclude list,
it is selected. If an FD is included by any member of an include list, it is selected.

3.44.2 Why are file descriptors other than those in my FD list reported?

The FD list that follows ``-d'' excludes or includes file descriptors, but unless the ``-a'' (AND) option is specified, the FD list selections are ORed to the other selections.

For example, the following lsof command will cause all file descriptors to be listed for the lsof command, and all but the cwd descriptor for all other commands, probably not what was intended.

```
$ lsof -clsof -d^cwd
```

Hint: use ``-a'' -- e.g.,

```
$ lsof -clsof -a -d^cwd
```

3.45 How can I supply device numbers for inaccessible NFS file systems?

When lsof can't get device numbers for inaccessible NFS file systems via stat(2) or lstat(2), it attempts to get them from the mount table's dev=xxx options. Successes are reported with a warning message that indicates the source of the device number
and that output might be incomplete as a consequence of the warnings.

Some system mount tables -- e.g., Linux /proc/mounts -- don't have a dev=xxx option. In that case, and provided lsof for the dialect supports them, you can use the +m option to create a mount table supplement file and the "+m m" option to use it.

First check the lsof -h (help) output to see if the +m and "+m m" options are supported. If they are, use +m to create a mount table supplement file when all mounted file systems are accessible. Use "+m m" later to make the supplement available when some mounted file systems might not be available.

Here's an example that creates a mount supplement file in $HOME/mnt-sup and later makes it available to lsof.

```
$ rm -f $HOME/mnt-sup
$ lsof +m > $HOME/mnt-sup
...
$ lsof +m $HOME/mnt-sup <other lsof options>
```

If lsof has to get the device number from the supplement, it will issue an informative warning message. The warning can be suppressed
with lsof's -w option.

Caution! Since the mount table supplement file is static, it is its supplier's responsibility to update it as file system

mounts change.

For more information, consult the lsof man page. The "ALTERNATE DEVICE NUMBERS" section has useful information on how lsof acquires device numbers when stat(2) or lstat(2) fail.

3.46 Why won't lsof find open files on over-mounted file systems?

When a file system, /xyz for example, is mounted on the same mount point as another file system, /abc for example, running lsof with an argument of the path of the first file system's mount point -- the over-mounted one, /abc -- probably will not reveal any files open on /abc.

That's because lsof looks for open files on a file system by looking for files with the file system's device number. The two file systems usually have different device numbers and lsof determines the device number search key from the supplied name of the second file system.

A general work-around exists only for Linux. On that UNIX dialect, when you know the over-mounted file system's mount point path, you can ask lsof to report on all open files and grep that output for the path of the over-mounted file system mount point.

3.47 What can be done when lsof reports no more space?

Many lsof methods cache information in memory, using the dialects malloc() library function. When malloc() can't allocate the requested amount of memory, lsof exits with warning messages similar to this AIX message:

```
lsof: no more dev-ch space at pid 2257750: 0x82a8e600
```

Lsof then exits immediately and produces no more output.

A possible work-around is to increase the memory foot print of the shell that runs lsof. That is often done with the ulimit(1) shell command.

3.48 What if the lsof build encounters ar and ld problems?

The lsof main and library Makefiles use the library archiver, ar, and the system loader, ld, applications. Improperly located, installed or

configured versions of them may cause the
lsof build to encounter errors with them.

The application producing the error should identify itself in
its error messages.

The first thing to check the path of the application that is
being used. Try `which ar` or `which ld` to see if perhaps the
PATH used during the build might be causing the wrong archiver
or loader to be used.

If the problem is with the use of the wrong archiver, and it's
not possible to correct the PATH to it, try using the LSOF_AR
environment variable to specify the path to and arguments for
the correct archiver. See 00XCONFIG for more information and
note that LSOF_AR must specify the path to the archive
application and the arguments for it, less the terminating
library and module name arguments.

If the problem is with the loader, there is no lsof work-
around. That's because lsof calls the loader via the C
compiler, so the problem must be fixed at the compiler (system)
level.

4.0 AIX Problems

4.1 What
is the Stale Segment ID bug and why is -X needed?

Kevin Ruderman reports that he has been informed by IBM
that processes using the AIX 3.2.x, 4.1[.12345]], 4.2[.1],
and 4.3.x kernel's readx() function can cause other AIX
processes to hang because of what appears to be file system
corruption.

This failure, known as the Stale Segment ID bug, is caused
by an error in the AIX kernel's journaled segment memory
handler that causes the kernel's dir_search() function
erroneously to believe directory entries contain zeroes.
The process using the readx() call need not be doing anything
wrong. Usually the system must be under such heavy load
that the segment ID being used in the readx() call has been
freed and then reallocated to another process since it was
obtained from kernel memory.

Lsof uses the readx() function to access library entry
structures, based on the segment ID it finds in the proc

structure of a process. Since IBM probably will never fix
the kernel
bug, I've added an AIX-specific option to lsof
that controls its use of the readx() function.

By default lsof readx() use is disabled; specifying the
``-X" option enables readx() use.

If you want to change the default readx() behavior of AIX
lsof, change the HASXOPT, HASXOPT_ROOT, and HASXOPT_VALUE
definitions in dialects/aix/machine.h. You can also use
these definitions to enable or disable readx() -- consult
the comments in machine.h. You may want to disable readx()
use permanently if you plan to make lsof publicly executable.

When HASXOPT_ROOT is defined, lsof will restrict use of
the -X option to processes whose real UID is root; if
HASXOPT_ROOT isn't defined, any user may specify the -X
option. The Customize script offers the option to change
HASXOPT_ROOT when HASXOPT is defined and HASXOPT_ROOT is
named in any dialect's machine.h header file.

I have never seen lsof cause a problem with its use of
readx(), but I believe there is some chance it could, given
the
right circumstances.

4.1.1 Stale Segment ID APAR

Here are the details of the Stale Segment ID bug and IBM's
response, provided by Kevin Ruderman.

AIX V3
  APAR=ix49183
     user process hangs forever in kernel due to file
     system corruption
  STAT=closed prs TID=tx2527 ISEV=2 SEV=2
      (A "closed prs" is one closed with a Permanent
      ReStriction.)
  RCOMP=575603001 aix v3 for rs/6 RREL=r320

AIX V4 (internal defect, no apar #)
  prefix   p
  name   175671
  abstract   KERMP: loop for ever in dir_search()

Problem description:

1. Some user application -- e.g., lsof -- gets the segment
   ID (SID) for the process private segment of a target
   process from the process table.

2. The target process exits, deleting the process private
   segment.

3. The SID is reallocated for use as a persistent segment.

4. The user application runs again and tries to read the
   user area structure from /dev/mem, using the SID it read

  from the process table.

5. The loads done by the driver for /dev/mem cause faults
   in the directory; new blocks are allocated; the size
   changed; and zero pages created.

6. The next application that looks for a file in the affected
   directory hangs in the kernel's dir_search() function
   because of the zero pages. This occurs because the
   kernel's dir_search() function loops through the variable
   length entries one at a time, moving from one to the
   next by adding the length of the current entry to its
   address to get the address of the next entry. This
   process should end when the current pointer passes the
   end of the known directory length.

   However, while the directory length has increased, the
   entry length data has not, so when dir_search() reaches
   the zero pages, it loops forever, adding a length of
   zero to the current pointer, never passing the end of
   the directory length. The application process is hung;
   it can't be killed
or stopped.

IBM closed the problem with a PRS code (Permanent ReStriction)
under AIX Version 3 and had targeted a fix for AIX 4.2. They
have recently (I became aware of it September 10, 1996)
cancelled the defect report altogether and have indicated they
are not going to fix the defect.

4.2 Gcc Work-around for AIX 4.1x

When gcc is used to compile lsof for AIX 4.1x, it doesn't
align one element of the user structure correctly. Xlc
sees the U_irss element as a type "long long" and aligns
it on an 8 byte boundary. That's because the default mode

of xlc is -qlonglong; when -qlonglong is enabled, the _LONG_LONG symbol is also defined.

Gcc sees U_irss as a two element array of type long, because _LONG_LONG isn't defined. Hence gcc aligns the U_irss element array on a 4 byte boundary, rather than an 8 byte one, making the gcc incantation of the user structure 4 bytes shorter than xlc's.

When the length of gcc's user structure is supplied as argument 4 to the undocumented getuser() function of the AIX kernel, getuser() rejects it as an incorrect size and returns EINVAL.

Lsof has a work-around for this problem. It involves a special test in the Configure script when the "aixgcc" Configure abbreviation is used -- e.g.,

```
$ Configure -n aixgcc
```

The test is to compile a small program with gcc and check the alignment of U_irss. If it's not aligned on an 8 byte boundary, the Configure script makes a special copy of <sys/user.h> in ./dialects/aix/aix<AIX_version> whose U_irss will align properly, and generates compile time options to use it.

While I have tested this work-around only with 4.1.4, it should work with earlier versions of AIX 4.1. It does not work for AIX 4.2; a different work-around is employed there. (See the next section.)

If you want to use this technique to compile other AIX 4.1x programs with gcc for using getuser(), check the Configure script.

Stuart D. Gathman identified this gcc AIX alignment problem.

4.3 Gcc and AIX 4.2[.1]

Alignment problems with gcc and AIX 4.2[.1] inside the user structure are more severe, because there are some new 64 bit types in AIX that gcc doesn't yet (as of 2.7.x) support. The <sys/user.h> U_irss element problem, discussed in 4.3 above, doesn't exist in 4.2[.1].

The AIX lsof machine.h header file has a work-around, provided by Henry Grebler, that bypasses gcc alignment problems. Later versions of gcc (e.g., 2.8.x) will probably bypass the problems as well.

4.4 Why won't lsof's Configure allow the use of gcc for AIX below 4.1?

Gcc can't reliably be used to compile lsof for AIX versions below AIX 4.1 because of possible kernel structure element alignment differences between it and xlc.

4.5 What is an AIX SMT file type?

When you run AIX X clients with the DISPLAY environment variable set to ``:0.0'' they communicate with the AIX X server via files whose kernel file structure has an undefined type (f_type == 0xf) -- at least there's no definition for it in <sys/file.h>.

These are Shared Memory Transport (SMT) sockets, an artifact of AIXWindows, designed for more efficient data transfers between the X server and its clients.

Henry Grebler and David J. Wilson alerted me to the existence of these files. Mike Feldman and others helped me identify them as SMT sockets.

The curious reader can find more about SMT sockets in /usr/lpp/X11/README.SMT.

4.6 Why does AIX lsof start so slowly?

When AIX lsof starts it compares the running kernel's identity to the one for which it was built, using /usr/bin/oslevel. That comparison can sometimes take a long time to complete, depending on the system's maintenance level and how recently it was examined with oslevel.

AIX revisions 4.67 and above for AIX 5 and above don't use oslevel to determine the kernel identity. They use uname(2) instead, and it is much faster.

You can skip the oslevel test by suppressing warning messages with lsof's -w option. Doing that carries with it the risk of missing other warning messages, however.

You can also disable the kernel identity check by disabling the definition of the HASKERNIDCK symbol by editing AIX machine.h header file or by using the Customize script to disable it.

See the "Why does lsof warn "compiled for x ... y; this is z.?" section for more information.

4.7 Why does exec complain it can't find libc.a[shr.o]?

When you try to execute lsof you may get this complaint:

```
    exec(): 0509-036 Cannot load program ./lsof because of
        the following errors:
     0509-022 Cannot load library libc.a[shr.o].
     0509-026 System error: A file or directory in
  the path name does not exist.
```

This is probably the result of making lsof when the LIBPATH environment variable contained a directory path that doesn't contain libc.a. You can see what LIBPATH contained when lsof was made by using the dump application on lsof. For example, if LIBPATH contained /foo/bar when lsof was made,
you will see this (partial) dump output:

```
    $ dump -H lsof
    ...
  ***Import File Strings***
    INDEX  PATH                    BASE        ...
    0      /foo/bar
```

To correct the problem, revisit the lsof source directory and remake lsof this way:

```
    $ unset LIBPATH; make  (sh or ksh)
or
    % unsetenv LIBPATH; make  (csh or tcsh)
```

4.8 What does lsof mean when it says, "no PCB, CANTSENDMORE, CANTRCVMORE" in a socket file's NAME column?

When an AIX application calls shutdown(2) on an open socket file, but hasn't called close(2) on the file, the file will remain visible to lsof as an open socket file without any extended protocol information.

Lsof reports that state in the NAME column by saying that
there is "no PCB" (Protocol Control Block) for the protocol
(e.g., TCP in the NODE column). If the open socket file
has the state variables SO_CANTSENDMORE and SO_CANTRCVMORE
set -- i.e., from the shutdown(2) call -- lsof reports them
with the CANTSENDMORE
and CANTRCVMORE notes in the NAME
column.

4.9 When the -X option is used on AIX 4.3.3, why does lsof disable
it, saying "WARNING: user struct mismatch; -X option disabled?"

The -X option causes lsof to read the loader information
of the user structure from virtual memory via the readx()
system call. It does that with the user structure definition
from <sys/user.h> that was compiled into the lsof executable.

On AIX 4.3.3 there are two different user structure
definitions in two separate <sys/user.h> header files,
distributed at different times by IBM. If lsof was compiled
with one and the kernel on which lsof is being run was
compiled with the other, lsof normally won't get correct
loader information when it calls readx().

In an attempt to compensate for that difference, lsof makes
an independent check of the loader information by getting
the user structure's open file count via readx() and
comparing it to the open file count obtained independently
via getprocs().
When the two counts don't match, lsof
tries to read the count (and re-read the loader information)
with two offsets, based on observed differences between
the two user structures.

When one of the three attempts produces a correct open file
count, lsof uses its corresponding offset on subsequent
readings of the loader information.

When none of the three attempts produces a correct open
file count, lsof issues the WARNING message and disables
-X processing.

To eliminate this problem, obtain an lsof binary that
matches the kernel of the AIX 4.3.3 system where you want
to run lsof. Compiling lsof on the target system is the
preferred way to get a matching binary.

4.10 Why doesn't the -X option work on my AIX 5L or 5.[123] system?

If your AIX 5L or 5.[123] system uses the ia64 architecture,
lsof needs setuid-root permission to be able to do the
processing that -X requires.

Check the output of `uname -a` to determine the architecture
type.

The work-around
is to give lsof setuid-root permission.

4.11 Why doesn't /usr/bin/oslevel report the correct AIX version?

The oslevel man page says, "The oslevel command reports
the level of the operating system using a subset of all
filesets installed on your system."

You can see which fileset is below the expected level with
oslevel's -l option. For example, if you believe your
system is at AIX level 4.3.3, but oslevel reports 4.3.2,
use this oslevel command to find the filesets below 4.3.3:

```
$ /usr/bin/oslevel -l 4.3.3.0
```

If you don't know what level argument to supply to oslevel's
-l option, use oslevel's -q option first.

4.11.1 Why doesn't /usr/bin/oslevel report the correct AIX version on AIX 5.1?

The subset list for oslevel on AIX 5.1 seems to include at
least two filesets, xlsmp.msg.en_US.rte and xlsmp.rte, that
do not install from AIX 5.1 media with a 5.1.0.0 level.
Hence, oslevel reports 5.0.0.0 instead of the expected
5.1.0.0.

If either xlsmp.msg.en_US.rte or
xlsmp.rte is installed,
lsof's Configure script and run-time tests will identify
the AIX version incorrectly. The run-time test will
issue a complaint message of this form:

```
lsof: WARNING: compiled for AIX version xxx; this is yyy.
```

You can correct the Configure test by pre-defining the
oslevel value, setting the correct value in the LSOF_VSTR
environment variable before running the Configure script
-- e.g., to pre-define AIX 5.1 when using ksh, do this:

```
$ LSOF_VSTR=5.1.0.0 Configure -n aix
```

You can't affect oslevel output without uninstalling xlsmp.msg.en_US.rte and xlsmp.rte. If you can't do that, you'll have to put up with the run-time complaint.

4.12 Why does lsof for AIX 5.1 or above Power architecture complain about kernel bit size?

When you run an lsof binary on an AIX 5.1 or above Power system, it might complain:

```
lsof: FATAL: compiled for a 32 bit kernel.
The bit size of this kernel is 64.
```

or

```
exec: 0509-036 Cannot load program ./lsof
because of
the following errors:
    0509-032 Cannot run a 64-bit program on a 32-bit
    machine.
```

Starting at lsof revision 4.61, lsof binaries for Power architecture systems running AIX 5.1 or above are closely tied to the kernel bit size. Lsof must do that so it can read and understand kernel structures.

Lsof's Configure script tunes the lsof configuration so that the binary built in the make(1) step is adjusted to the kernel bit size.

An lsof binary knows the bit size for which it was constructed, tests the bit size of the kernel under which it is running, and objects if the two sizes don't match. To see the bit size for which lsof was constructed, run it with its -v option and look for these lines in the output:

```
configuration info: 32 bit kernel
```

or

```
configuration info: 64 bit kernel
```

(Note: these lines will appear only in -v output for AIX 5.1 and above lsof binaries, built for Power architecture.)

You can see the kernel bit size test method in the aix stanza of the lsof Configure script and in the get_kernel_access() function of the lsof .../dialects/aix/dproc.c source file.

There is more information on pre-defining the kernel bit size when building lsof in Configure, 00PORTING, and 00XCONFIG.

The only work-around is to use an lsof binary built to match the running kernel bit size.

4.13 What can't gcc be used to compile lsof on the ia64 architecture for AIX 5 and above?

Gcc can't be used to compile lsof on the ia64 architecture for AIX 5 and above because I haven't had access to a system that has a working gcc compiler. The gcc compiler on my one and only ia64 AIX 5.1 test system, provided by IBM, didn't work at all.

4.14 Why does lsof get a segmentation fault when compiled with gcc for a 64 bit Power architecture AIX 5.1 kernel?

When lsof is configured with the lsof "aixgcc" Configure abbreviation, the resulting lsof executable may cause a segmentation violation when it is run. I've observed this
with gcc version 2.9-aix43-010414-7.

As far as I have been able to tell, the segmentation fault is the result of a gcc compilation, loading, or library error. Watching lsof run with gcc's companion debugger, gdb, shows no error in the lsof source code that might explain the fault.

The only work-around I know is to use the IBM C compiler in place of gcc -- i.e., use the "aix" lsof Configure abbreviation.

4.15 Why does lsof ignore AFS on my AIX system?

The lsof Configure script quits on AIX when AFS is present, the AIX version is greater than 4.3.3.0 or the AFS version is greater than 3.5. That's because I have no test systems available for those AIX and AFS version combinations.

When the lsof Configure script detects an AIX and AFS version combination that is unsupported, it will report:

```
!!!FATAL: Lsof does not support AFS on this combination of
    AIX and AFS versions.  To disable AFS, set the
```

value of the AIX_HAS_AFS environment variable
to
"no".

The only work-around is to set the AIX_HAS_AFS environment variable as explained in the error message:

```
$ AIX_HAS_NSF=no; export AIX_HAS_NFS
$ ./Configure -n aix
```

4.16 Why does lsof report "system paging space is low" and exit?

When AIX paging space runs low, the AIX kernel sends a SIGDANGER signal to processes, warning them that they should reduce their memory usage.

When lsof receives that signal, it issues the following fatal error message and exits:

```
lsof: FATAL: system paging space is low.
```

A possible work-around is to limit the amount of information lsof must cache in its process memory with the "-c", "-g", "-l" and "-p" options.

Also see the answer to the "What can be done when lsof reports no more space?" question.

4.17 Why does lsof have a compilation problem on AIX 5.3 above maintenance level 1?

On some AIX 5.3 systems with maintenance levels 2 and higher installed, lsof 4.77 and below may not compile properly. The compiler
complains the snapshotObject structure definition, needed by <j2/j2_inode.h>, is missing.

That problem is fixed in the 4.78 revision.

5.0 Apple Darwin Problems

5.1 What do /dev/kmem-based and libproc-based mean?

Lsof for Apple Darwin currently uses /dev/kmem to read kernel data structures from which it gathers and reports open file information. That version of lsof is called /dev/kmem-based lsof.

At an upcoming release lsof will use a library called libproc
to obtain information about open files. That version of lsof
wil be called libproc-based lsof.

The /dev/kmem-based lsof sources may be found in the kmem
subdirectory of the dialects/darwin branch of the lsof source
tree. When the supporting version of Apple Darwin is released,
the libproc-based lsof sources will be found in
.../dialects/darwin/libproc.

5.2 /dev/kmem-based Apple Darwin Questions

5.2.1 Why does Configure ask for a path to the Darwin XNU kernel
header files?

When lsof was ported to Apple
Darwin by Allan Nathanson at
revision 4.53, some kernel header files needed by lsof
weren't being exported by the developers. (That's still
true at lsof revision 4.76.)

At first a shell script that Allan provided would get the
missing header files by checking them out from the CVS
root. Although the script was updated from time to time,
eventually the re-organization of Darwin sources has made
it impossible to update the script to do an automatic
download of the missing header files.

At lsof revision 4.69 and above it is necessary for the Darwin
lsof builder to download the Darwin XNU kernel headers before
attempting to build lsof. The download my be done via a web
browser, starting at this URL:

    http://www.opensource.apple.com/darwinsource/index.html

Once there, select the link to the Mac OS X version that
matches the one on the system where lsof is to be built.

Follow that link's "[Source]" link. Once there, select the
tar.gz link of the xnu* entry
near the bottom of the page.
That entry should have a name that matches the xnu* name shown
by `uname -a` -- e.g., if uname reports:

    $ uname -a
    ... root:xnu/xnu-517.7.21 ...

Then the appropriate xnu* entry is xnu-517.7.21. Clicking its link should lead to an "Apple Open Source" page requesting an Apple ID and password.

Enter them if they're available. If an Apple ID and password are not available, get them by following the instructions on the page -- i.e., follow the signin.apple.com link.

Once a valid Apple ID and its password have been entered, the download will begin. Select the saving of the downloaded xnu*.tar.gz file in an appropriate place on the Mac OS X system.

Once the download completes, install it. Use gunzip to decompress the download and tar to extract the archive -- e.g.,

```
$ gunzip -c xnu-517.7.21.tar.gz | tar xf -
```

Remember the absolute path to the extracted archive. That is its installed place. E.g., if the xnu-517.7.21.tar archive was
extracted to the lsof builder's home directory, its full installation path will be something like:

```
~/xnu-517.7.21
```

Now run the lsof Configure script. When it asks for the path to the installed Darwin XNU kernel header files, supply the path to the gunzip'd and extracted xnu* archive -- e.g., ~/xnu-517.7.21.

The path to the Darwin XNU kernel headers may also be supplied to the Configure script in the DARWIN_XNUDIR environment variable, eliminating the need to enter it interactively -- e.g.,

```
$ DARWIN_XNUDIR=~/xnu-344.49 ./Configure -n darwin
```

5.2.1.1 Why does Configure complain that Darwin XNU kernel header files are missing?

These are some reasons why the lsof Configure script might claim that Darwin XNU header files are missing:

* The wrong path to them was specified.

* The files and directories in the path are not readable and searchable -- i.e., check the modes and ownerships.

* The downloaded archive doesn't match the Mac
OS X
version of the system.

If in doubt, revisit the Darwin XNU kernel header file
download instructions in the answer to the question "Why
does Configure ask for a path to the Darwin XNU kernel
header files?"

If Configure still can't find Darwin XNU kernel header
files, contact me via e-mail at <abe@purdue.edu> for help.
Make sure "lsof" appears in the "Subject:" line so my e-mail
filter won't classify your letter as Spam.

5.2.2 Why doesn't Apple Darwin lsof report text file information?

At the first port of lsof to Apple Darwin, revision 4.53,
insufficient information was available -- logic and header
files -- to permit the installation of VM space scanning
for text files. As of lsof 4.70 it is sill not available.

Text file support will be added to Apple Darwin lsof after
the necessary information becomes available.

5.2.3 Why doesn't Apple Darwin lsof support IPv6?

At the first port of lsof to Apple Darwin, revision 4.53,
Apple Darwin lacked IPv6 support.
IPv6 became available
in Apple Darwin version 1.5 and support for it was added
to lsof then.

5.2.4 Why does lsof complain about a mismatch between the release
for which lsof was compiled and the booted Mac OS X release?

When lsof is started on the "Gold Master" Darwin release
(aka Mac OS X), it complains:

lsof: compiled for 1.0 release; this is 1.3.2.

This happens because the lsof binary released with Mac OS
X was built on a system whose release number (1.0) doesn't
match that of the released system -- usually 1.3.x Lsof
makes this check because UNIX dialect OS changes are often
accompanied by header file changes that affect lsof.

In this specific case, this error can be ignored. If you

don't want to do that, get the lsof distribution and build
lsof so its built-on and running-on Mac OS X release numbers
match.

5.2.5 Why does lsof for Apple Darwin 8 and higher report "stat(...): ..." in the NAME column?

Lsof for Apple Darwin 8 may report messages like
these in the
NAME column:

```
   stat(/private/var/run/asl_prune): No such file or directory
 or
   stat(/private/var/db/netinfo/local.nidb/Config): Permission denied
```

Those messages indicate that lsof was unable to collect open
file information for the paths enclosed in "stat(...)" with the
stat(2) function, because the function encountered the reported
error.

A work-around for the "Permission denied" error is to run lsof
with elevated privileges -- e.g., when logged on as the super
user.

If the stat(2) error message is "No such file or directory",
the file probably has been unlinked (removed) and there is no
lsof work-around.

5.2.6 What are the limitations of Apple Darwin lsof link count reporting?

Lsof for Apple Darwin cannot report link count information
reliably.

For Apple Darwin below 8 link count information is not always
available in the kernel node structures available to lsof.
When link count information is available, however, it includes
link counts
of zero. Thus, using lsof's +L1 option may result
in the finding of some files whose link counts are zero.

Lsof can report only some link count information for Apple
Darwin 8 and above. Link count information is only available
for files where lsof can assemble the full file path and has
permission to apply stat(2) to it. (See the answer to the "Why
does lsof for Apple Darwin 8 and higher report "stat(...): ..."
in the NAME column?" question for more information on stat(2)
failures.)

Apple Darwin 8 and above files that have been unlinked and thus
have a link count of zero cannot be found by stat(2) -- i.e.,
stat(2) returns a "No such file or directory" error. As a
result lsof never displays link counts of zero and the use of
lsof's +L1 option to find them always fails.

5.3 Libproc-based Apple Darwin Questions

6.0 BSD/OS BSDI Problems

6.0.5 Statement of deprecation

As of lsof revision 4.76 support for BSDI BSD/OS has been
dropped. The 4.76 distribution of lsof
for BSDI BSD/OS may be
found on lsof.itap.purdue.edu in pub/tools/unix/lsof/OLD/src.

7.0 DEC OSF/1, Digital UNIX, and Tru64 UNIX Problems

7.1 Why does lsof complain about non-existent /dev/fd entries?

When you run lsof for Digital UNIX 3.2, lsof may complain:

```
lsof: can't lstat /dev/fd/xxx: No such file or directory
lsof: can't lstat /dev/fd/yyy: No such file or directory
```

(Or it may warn about other missing /dev/fd paths.) When
you do an ``ls /dev/fd" none of the missing paths are listed.

This is caused by a bug in the DEC library function
getdirentries(). For some reason, when /dev/fd is a file
system mount point, getdirentries() returns an incorrect
size for it to readdir(). (Lsof calls readdir() in its
ddev.c readdev() function.) Because of the incorrect size,
readdir() goes past the end of the /dev/fd directory buffer,
encounters random paths and returns them to lsof. Lsof
then attempts to lstat(2) the random paths, gets error
replies from lstat(2),
and complains about the paths.

Duncan McEwan discovered this error and has reported it to
DEC. Duncan also supplied an alternate readdir() function
as a work-around. I've incorporated his readdir() in
dialects/osf/ddev.c (as the static ReadDir() function) with
some slight modifications, and enabled its use when the

USELOCALREADDIR symbol is defined.

The Configure script defines USELOCALREADDIR for Digital UNIX version and 3.2. If you don't want to use Duncan's local readdir() function, edit the Makefile and remove -DUSELOCALREADDIR from the CFGF string. When DEC releases a corrected getdirentries() function, I'll modify the Configure script to stop defining USELOCALREADDIR.

7.2 Why does the Digital UNIX V3.2 ld complain about Ots* symbols?

When you compile lsof on your Digital UNIX V3.2 system, ld may complain:

```
   ld:
   Unresolved:
   knlist
   _OtsRemainder32Unsigned
   _OtsDivide64Unsigned
   _OtsRemainder64Unsigned
   _OtsDivide32Unsigned

  _OtsMove
   _OtsDivide32
   _OtsRemainder32
   *** Exit 1
```

Chris Eleveld reports this happens on Digital UNIX V3.2 systems after the Fortran compiler has been installed.

The best work-around seems to be to remove -lmld from the CFGL string in the Makefile produced by Configure -- i.e., change:

```
   CFGL=    -lmld
```

to

```
   CFGL=
```

According to the V3.2 man page for nlist(3), this shouldn't work, but my testing shows that it does. Although I haven't been able to test this second work-around, you might try adding -lots to CFGL, rather than removing -lmld -- i.e., change:

```
   CFGL=    -lmld
```

to

```
   CFGL=    -lmld -lots
```

WARNING: my testing also shows that the V2.0 nlist(3) man page means what it says when it calls for -lmld -- lsof loaded without -mld under V2.0 can't locate the proc (process) table address.

DON'T REMOVE -lmld FROM THE DIGITAL UNIX V2.0 MAKEFILE.

If you run into this problem, please let me know what problem you encountered and how you solved it.

7.3 Why can't lsof locate named pipes (FIFOs) under V3.2?

While lsof for V3.2 can report on named pipes (FIFOs), it can't find them by name. That appears to happen because of the way the V3.2 kernel lstat(2) function reports named pipe device numbers.

The V3.2 kernel reports the device number as 0xffffffff, while the kernel structures for named pipes that lsof examines contain the device number of the file system on which the named pipe resides.

Consequently, lsof can't match the device and inode number pair it receives from applying lstat(2) to the named pipe with any device and inode number pair it finds when scanning kernel structures.

I don't have a work-around. You can, of course, ask for full lsof output and use a post-processing filer (e.g., grep) to locate the named pipe of interest.

This problem doesn't exist under V2.0.

7.4 Why does lsof use the wrong configuration header files? For example, why can't the lsof compilation find cpus.h?

DEC
OSF/1, Digital UNIX, and Tru64 UNIX configuration header files describe the hardware and software environment for which your kernel boot file was constructed. For example, /sys/<name>/cpus.h defines the number of CPUs in its NCPUS #define.

Lsof searches for the configuration header file subdirectory in /sys (/usr/sys for Digital UNIX version 4.0 and Tru64 UNIX) by converting the first host name component to capital letters -- e.g., TOMIS is derived from tomis.bio.purdue.edu.

If that subdirectory exists, lsof uses header files from
it. (Configure reports what subdirectory is being used.)

If Configure doesn't find a host-name derived subdirectory,
it prompts you for the entry of a subdirectory name. If
you can't find one, quit Configure and run the kernel
generation process to create a proper configuration sub-
directory. If you don't identify a proper configuration
subdirectory and you try to compile lsof, the compiler will
complain about missing header files --
e.g., a missing
cpus.h.

Once you have located or generated a proper configuration
subdirectory, rerun Configure. If you have generated a
configuration subdirectory whose name is derived from the
host name, Configure will find and use it. If not, you
will have to specify its name to Configure.

7.5 Why does lsof indicate incomplete paths with " -- " for Tru64
UNIX 5.1 files?

When lsof can't find a component of a path in the kernel's
name cache (aka DNLC), or can't determine that the left-most
component has as its parent the file system root, it uses
an "incomplete path" notation. That notation begins with
the file system root name, followed by " -- ", followed by
the consecutive path name components lsof was able to find
in the DNLC -- e.g., "/ -- init".

Because the DNLC was significantly redesigned in Tru64 UNIX
5.1, lsof's handling of the cache had to be completely
redone. As part of the DNLC redesign a name cache entry
parameter lsof formerly used to locate
the file system root
of a path was removed. With help from Chang Song I've been
able to implement an alternate method for detecting the
root of these file system types: AdvFS (MSFS), CDFS, DVDFS,
FDFS, NFS, NFS3, and UFS.

When lsof doesn't know how to identify the root for a file
system type, it will resort to the " -- " incomplete path
notation.

7.6 Why doesn't lsof report link count, node number, and size
for some Tru64 5.x CFS files?

Lsof reports link count, node number, and size for open

CFS files as recorded in their kernel node structure's
cached attributes. Sometimes not all attributes are cached
on the system where lsof runs, so lsof cannot report them.

7.7 Why does lsof say it can't read the kernel name list or proc table on Digital UNIX 4.x or Tru64 UNIX?

By default on Digital UNIX 4 and Tru64 UNIX lsof reads the
addresses for kernel symbols with the knlist(3) function.
That function can fail, for example, when the kloadsrv
daemon isn't running or
is malfunctioning. When that
happens, lsof may abort with one of these error messages:

```
  lsof: can't read kernel name list from knlist(3): ...
or
  lsof: can't read proc table info
```

The first message suggests a complete knlist(3) or kloadsrv
failure; the second, a partial one.

If you know the name of the file from which the running
system was booted, e.g., /vmunix, you can use lsof's -k
option to direct it to read kernel symbol addresses from
the name list of that file --

```
  $ lsof -k /vmunix ...
```

If that works, then knlist(3) is malfunctioning and you
need to fix it.

8.0 FreeBSD Problems

8.1 Why doesn't lsof report on open kernfs files?

Lsof doesn't report on open FreeBSD kernfs files because
the structures lsof needs aren't defined in the kernfs.h
header file in /sys/misc/kernfs.

8.2 Why doesn't lsof work on my FreeBSD system?

If lsof doesn't work on your FreeBSD system, first make
sure you have the latest lsof revision. See the answer to
the "Where
do I get lsof?" question for information on how
to get the latest lsof revision.

Once you have gotten the latest lsof revision, Configure and make it. If Configure fails -- e.g., it complains about an unknown FreeBSD version -- then lsof probably hasn't been ported to your FreeBSD version yet, and there's no need to go any further. Follow the answer to the "How do I report an lsof bug" to report the Configure complaint to me.

If you are able to Configure and make lsof, run its test suite. (See the answer to the "Is there a test suite?" question for more information on how to use lsof's test suite.)

If lsof still fails, make sure your kernel sources, kernel header files, kernel boot file, standard header files and libraries are synchronized. They should all be built from the same CVS refresh. (Don't forget to do a "make buildworld" followed by a "make installworld".) If they aren't, then the KVM library or lsof may be using kernel structure definitions that
don't match the booted kernel; or lsof may fail to compile properly because of header files in /usr/src/sys/sys and /usr/include/sys that don't match.

If you have synchronized your kernel, header files and libraries, and still can't get lsof to work, follow the steps in the answer to the "How do I report an lsof bug" question to report the problem to me.

8.3 Why doesn't lsof work on the RELEASE version of CURRENT?

Lsof tracks the CURRENT release of the current leading edge FreeBSD version, because my access to leading edge FreeBSD is limited to FreeBDSD.org reference systems, all running the CURRENT release.

Sometimes that tracking leads to changes in lsof that won't work on an earlier RELEASE version of the current leading edge version.

When that happens, please send e-mail to me <abe@purdue.edu>. Make sure "lsof" appears in the "Subject:" line so my e-mail filter won't classify your letter as Spam.

8.4 Why does kvm_open() complain it can't find some file?

If

lsof issues this complaint:

```
    lsof: kvm_open(execfile=/boot/kernel/kernel,
   corefile=/dev/mem: No such file or directory
```

Your FreeBSD system might not have a /dev/mem device. If not, create one -- e.g., as root do:

```
    # mknod /dev/mem c <major> 0
    # chmod 440 /dev/mem
    # chgrp kmem /dev/mem
```

For <major> use /dev/kmem's major device number.

You may have to run kldload, too -- again as root do:

```
    # kldload mem
```

8.5 FreeBSD ZFS Problems

8.5.1 Why does FreeBSD lsof report "WARNING: no ZFS support has been defined."?

Lsof issues that message when it detects a file on a ZFS file system, but has not been built with support for ZFS. Lsof's Configure script detects support can be added for ZFS when it finds this file:

/usr/src/sys/contrib/opensolaris/uts/common/fs/zfs/sys/zfs_znode.h

That header file and others in the OpenSolaris files in /usr/src enable lsof to extract information about ZFS files from the kernel structures associated with them.

8.6 Why can't Configure create lsof_owner.h for FreeBSD 6 and above?

Lsof may report:

```
    Creating ./lockf_owner.h from /usr/src/sys/kern/kern_lockf.c
    FATAL ERROR: can't read /usr/src/sys/kern/kern_lockf.c
    FATAL ERROR: ./lockf_owner.h creation failed (see 00FAQ)
```

or

```
    Creating ./lockf_owner.h from /usr/src/sys/kern/kern_lockf.c
    FATAL ERROR: ./lockf_owner.h creation failed (see 00FAQ)
```

Those messages mean that lsof's Configure script failed to create a local header file, ./lockf_owner.h, needed to use the

new kernel file locking code of some versions of FreeBSD 6 and above.

The changes that implement that new locking code alter the lockf structure in <sys/lockf.h> and introduce a new structure, lockf_entry, to that header file. When Configure detects the presence of the lockf_entry definition in <sys/lockf.h>, it tries to construct the local header file, ./lockf_owner.h.

Configure has to do that because an unfortunate side effect of the new kernel file
locking code is that <sys/lockf.h> doesn't
contain the lockf_owner structure definition referenced in its own lockf structure. Lsof needs to access elements of that lockf_owner structure to determine if a lock belongs to the process that has a file open.

The missing lockf_owner structure definition is in the kernel source file, typically /usr/src/sys/kern/kern_lockf.c.
Configure tries to extract the lockf_owner structure definition from kern_lockf.c into lsof's local header file, ./lockf_owner.h.
If Configure can't do that, it reports:

```
FATAL ERROR: ./lockf_owner.h creation failed
```

If Configure can't even read kern_lockf.c, it first reports:

```
FATAL ERROR: can't read /usr/src/sys/kern/kern_lockf.c
```

The work-around for this problem is to update the FreeBSD kernel /usr/src tree (e.g., do a CVSup or csup) on the system where lsof is to be built and then do a "make buildworld" followed by a "make installworld".

8.6.1 Why are there lockf structure compiler errors for FreeBSD 6.0 and higher lsof?

If, when compiling lsof, the compiler complains with error messages like:

```
dnode.c: In function 'get_lock_state':
dnode.c:113: error: 'struct lockf' has no member named 'lf_flags'
dnode.c:115: error: 'struct lockf' has no member named 'lf_id'
...
```

Then lsof is being built on a system that has new kernel file locking code and lsof's Configure script failed to build a

local lockf_owner.h header file with a structure definition
lsof needs.

See the "Why can't Configure create lsof_owner.h for FreeBSD 6
and above?" section for more information and a work-around.

8.6.2 Why don't /usr/src/sys/sys/lockf.h and /usr/include/sys/lockf.h
match?

This mismatch can cause the errors explained in the answer to
the "Why are there lockf structure compiler errors for FreeBSD
6.0 and higher lsof?" question.

If /usr/src/sys/sys/lockf.h has been updated with a CVSup or
csup, the new lockf.h won't be propagated to /usr/include/sys
until
the "make buildworld" and "make installworld" steps have
been completed.

9.0 HP-UX Problems

9.1 What do /dev/kmem-based and PSTAT-based mean?

Lsof for HP-UX 11.0 and below uses /dev/kmem to read kernel
data structures from which it gathers and reports open file
information. That version of lsof is called /dev/kmem-based
lsof.

Starting with HP-UX 10.10, finding definitions for the
necessary kernel structures became more difficult as HP no
longer distributed header files in /usr/include that defined
all kernel structures. So I started "inventing" structure
definitions by using Q4 to display them.

By HP-UX 11, the process of invention became extremely
intensive to support. Following a patch to the ipc_s
structure in early 1999, my invented definition of that
structure became incorrect. Although I was able to devise
a work-around test for the patch with Q4, it was clear that
my inventions were bound to cause more problems.

Discussion with HP about the patch
led to my proposing that
an lsof API in the HP-UX kernel was the proper solution.
Much to my surprise, HP agreed. I believe Carl Davidson
was the prime mover behind that decision, but I know others
participated, among them Louis Huemiller, Rich Rauenzahn,

and Sailu Yallapragada. I am indebted to these folks and HP for their willingness to do this work.

The API was added to the PSTAT interface in a project named PEGL, Pstat Enhancements for Glance and Lsof. Louis and Sailu did the bulk of the design and implementation work and testing began in March, 2000

HP-UX 11.11 is the first version that provides PSTAT support for lsof. HP-UX versions in between 11.0 and 11.11 -- all Beta versions as far as I can determine -- have no lsof support.

See the "PSTAT-based HP-UX lsof Questions" section for questions and answers specific to PSTAT-based HP-UX lsof. The next section, "Why doesn't a /dev/kmem-based HP-UX lsof compilation use -O?" covers /dev/kmem-based HP-UX lsof.

The /dev/kmem-based lsof sources may be found in the kmem subdirectory of the dialects/hpux branch of the lsof source tree. The PSTAT-based lsof sources may be found in .../dialects/hpux/pstat.

9.2 /dev/kmem-based HP-UX lsof Questions

The sources for /dev/kmem-based lsof for HP-UX may be found in lsof_<revision>/dialects/hpux/kmem.

Lsof's Configure shell script decides to use these sources when it finds that the /usr/include/sys/pstat subdirectory doesn't exist.

Lsof can be forced to use the /dev/kmem sources by setting "/dev/kmem" in the HPUX_BASE environment variable. Consult the Configure shell script and 00XPORTING for more information.

9.2.1 Why doesn't a /dev/kmem-based HP-UX lsof compilation use -O?

If you only have the standard (bundled) HP-UX C compiler and haven't purchased and installed the optional one, then you can't use cc's -O option. The HP-UX cc(1) man page says this:

"Options
Note that in the following list, the cc and c89 options

-A , -G , -g , -O , -p , -v , -y , +z , and +Z are
not supported by the C compiler provided as part of
the standard HP-UX operating system. They are supported
by the C compiler sold as an optional separate product."

Lsof's Configure script tries to detect what C compiler
product you have installed by examining your compiler. If
that examination reveals a standard (bundled) compiler,
lsof avoids using -O.

If the Configure compiler test fails, the C compiler will
complain that it doesn't support -O. You can suppress that
complaint with this make invocation:

```
$ make DEBUG=""
```

9.2.2 Why doesn't the /dev/kmem-based CCITT support work under 10.x?

Pasi Kaara, who originally provided the HP-UX CCITT support,
reports that it no longer works under HP-UX 10.x.
Consequently, at lsof revision 4.02 it has been disabled.

9.2.3 Why can't /dev/kmem-based lsof be compiled with `cc -Aa` or
`gcc -ansi` under HP-UX 10.x?

Some HP-UX 10.x header files, needed
by lsof, can't be
compiled properly in ANSI_C mode; structure element definition
and alignment problems result. The f_offset member of the
file structure, for example, is incorrect.

This ANSI-C obstacle extends to using the -Aa option of
the HP C compiler and the -ansi option of gcc.

9.2.4 Why does /dev/kmem-based lsof complain about no C compiler?

Lsof's Configure script looks in /bin and /usr/ccs/bin for
an HP C compiler, because it needs to know if the compiler
is the standard (bundled) one or the optional separate
product. If it finds no compiler in either place, Configure
quits after complaining:

```
No executable cc in /bin or /usr/ccs/bin
```

If you don't have a C compiler in either of these standard
places, you should consider installing it. If you have
gcc installed, you can use it by declaring the ``hpuxgcc''
abbreviation to lsof's Configure script.

If you have a C compiler in a non-standard location, you
can use the HPUX_CCDIR[12] environment variables
to name
the path to it. Consult the 00XCONFIG file of the lsof
distribution for more information.

9.2.5 Why does Configure complain about q4 for /dev/kmem-based lsof for HP-UX 11?

When you run Configure on an HP-UX 11 system, it may complain:

```
 !!!ERROR!!!    !!!ERROR!!!    !!!ERROR!!!    !!!ERROR!!!
 Configure can't use /usr/contrib/bin/q4 to examine the ipis_s
 structure.  You must do that yourself, report the result in
 the HPUX_IPC_S_PATCH environment variable, then repeat the
 Configure step.  Consult the Configure script's use of
 /usr/contrib/bin/q4 and the 00XCONFIG file for information
 on ipis_s testing and the setting of HPUX_IPC_S_PATCH.
 !!!ERROR!!!    !!!ERROR!!!    !!!ERROR!!!    !!!ERROR!!!
```

This message states that Configure cannot use q4 from
/usr/contrib/bin to examine the kernel's boot image for
the ipis_s structure. Maybe q4 hasn't been installed, or
perhaps Configure can't execute it.

Lsof needs to gather information about ipis_s
to determine
if the ipis_s structure is defined in the kernel boot image,
if the ipis_s structure of the kernel boot image has an
ipis_msgsqueued member, and if the ipc_s structure of the
kernel boot image uses has an ipc_ipis member.

The ipis_s structure isn't described in any header file
HP-UX releases with HP-UX 11. It appears in the private
lsof header file .../dialects/hpux/kmem/hpux11/ipc_s.h.
Lsof gets local and remote connection addresses (IP and
port numbers) from ipc_s, so an incorrect ipc_s definition
may cause incorrect reporting of TCP/IP connection addresses.
It definitely will cause incorrect reporting on 32 bit
kernels. In any case lsof should be compiled with a correct
ipc_s definition no matter the kernel bit size, so the
Configure script always tests for it when the HP-UX version
is 11.

For lsof's Configure script to gather the necessary ipis_s
information q4 needs to be installed in /usr/contrib/bin
and the kernel boot image, /stand/vmunix,

needs to have
been processed with pxdb. If either is untrue, lsof issues
the above error message, perhaps preceded by q4 messages.
(Note: lsof's use of q4 may also fail if q4 can't execute
nm -- e.g., it can't find /usr/bin/nm, or there is a
conflicting, private version of nm earlier in the path.)

If /stand/vmunix hasn't been processed by pxdb, the q4
messages will include:

```
   q4: (error) vmunix not pxdb'd
```

or

```
   q4: (warning) /stand/vmunix has not been processed by pxdb.
```

It's possible to make a suitable private copy of /stand/vmunix
for configuring lsof. That requires /opt/langtools/bin/pxdb
or the q4 version of pxdb from /usr/contrib/bin/q4pxdb.
The path to the result is supplied to the lsof Configure
script in the HPUX_BOOTFILE environment variable. Configure
still requires /usr/contrib/bin/q4.

The following sample Bourne shell commands make a private
copy of /stand/vmunix in /tmp, process it with pxdb or
q4pxdb, and supply its path to lsof's Configure script
in
HPUX_BOOTFILE.

```
   $ cp /stand/vmunix /tmp/vmunix.lsof

   $ /opt/langtools/bin/pxdb /tmp/vmunix.lsof
  or
   $ /usr/contrib/bin/q4pxdb /tmp/vmunix.lsof

   ... pxdb messages ...
   $ HPUX_BOOTFILE=/tmp/vmunix.lsof Configure -n hpux
```

It may also be necessary to use q4 outside the lsof Configure
script. In that case q4 can be to determine the state of
ipis_s and ipc_s with these q4 commands:

```
   $ /usr/contrib/bin/q4 /stand/vmunix
   ...
   q4> fields -c struct ipc_s
   ...
   q4> fields -c struct ipis_s
```

Look in the q4 output for the ipc_ipis member of the ipc_s
structure, and look in the q4 output for the ipis_s structure

for the ipis_msgsqueued member. If ipc_s has ipc_ipis but ipis_s lacks ipis_msgsqueued, set HPUX_IPC_S_PATCH environment variable to "1". If ipc_s has ipc_ipis and ipis_s has ipis_msgsqueued, set HPUX_IPC_S_PATCH to "2" -- e.g.,

```
$ HPUX_IPC_S_PATCH=1 Configure -n hpux
or
$ HPUX_IPC_S_PATCH=2 Configure -n hpux
```

If ipc_s has no ipc_ipis member, set HPUX_IPC_S_PATCH to "N" -- e.g., use this Configure step:

```
$ HPUX_IPC_S_PATCH=N Configure -n hpux
```

9.2.6 When compiling /dev/kmem-based lsof for HP-UX 11 what do the "aCC runtime: ERROR..." messages mean?

When the lsof Makefile asks the HP-UX unbundled compiler to load lsof, it may complain:

```
/bin/cc -o lsof  -DHPUXV=1100 -DHASVXFS -DHPUXKERNBITS=64 \
-I/home/abe/src/lsof4/dialects/hpux/kmem/hpux11 +DD64 \
-DHAS_IPC_S_PATCH=2 -I/home/abe/src/lsof4/dialects/hpux/kmem \
-DLSOF_VSTR=\"B.11.00\"  -g dfile.o dmnt.o dnode.o dnode1.o \
dnode2.o dproc.o dsock.o  dstore.o  arg.o main.o misc.o \
node.o print.o proc.o store.o usage.o -L./lib -llsof  -lelf \
-lnsl
  aCC runtime: ERROR: Unexpected use of shared libraries
  aCC runtime: ERROR: Read aCC manpage, +A option
  /usr/lib/nls/loc/locales.1//is_IS.iso88591
```

This is a bug in the HP-UX national language support. (Notice the last message with "locales" in it?) Complain to HP -- then use this work-around before executing make:

```
$ unset LANG
$ make
```

9.2.7 Why doesn't /dev/kmem-based lsof for HP-UX 11 report VxFS file link counts, node numbers, and sizes correctly?

This is usually the result of running an lsof binary whose revision number is less than 4.57 on a system that has OnlineJFS support installed. It can also happen with lsof 4.57 binaries when the OnlineJFS support with which they were built doesn't match the OnlineJFS status of the system

on which they are run.

The OnlineJFS status of lsof 4.57 and higher binaries can
be determined by running:

```
$ lsof -v 2>&1 | grep HASONLINEJFS
```

If that shell pipe produces output, lsof was compiled with
OnlineJFS support enabled; no output, disabled.

If OnlineJFS is installed on an HP-UX 11 system the
/sbin/fs/vxfs/subtype executable exists and outputs "vxfs3.3"
when run.

The problem occurs because the optional OnlineJFS support
installation doesn't update <sys/fs/vx_inode.h>.
Consequently
lsof can be compiled with an incorrect definition of the
vx_inode structure and look for for link counts, node
numbers, and sizes in the wrong places in the structure.

The current response I have gotten from HP is that no
<sys/fs/vx_inode.h> update will be provided for OnlineJFS.

I've addressed this problem temporarily with a work-around
(hack) in lsof revision 4.57.

9.2.8 Why can't /dev/kmem-based lsof be built with gcc for 64 bit
HP-UX 11?

When Configure is given the "hpuxgcc" abbreviation, the
HP-UX version is 11, and the kernel bit size is 64, the
lsof Configure script may abort with the messages:

```
!!!!!!!!!!!!!!!! FATAL ERROR !!!!!!!!!!!!!!!!!!

APPARENTLY GCC CANNOT BUILD 64 BIT EXECUTABLES.
A COMPILER MUST BE USED THAT CAN.  SEE 00FAQ
FOR MORE INFORMATION.
```

(This is the "more information" in 00FAQ.)

This means the Configure script compiled a test program
with gcc the result wasn't an ELF-64 binary. Lsof tries
two gcc modes,
one with no options and another with the
-mlp64 option, before it concludes gcc can't be used.

See the "How can I acquire a gcc for building lsof for 64 bit HP-UX 11?" answer for information on where you might be able to get a gcc for HP-UX 11 that can produce ELF-64 executables.

9.2.8.1 How can I acquire a gcc for building lsof for 64 bit HP-UX 11?

Check this HP URL:

http://h21007.www2.hp.com/dspp/tech/tech_TechSoftwareDetailPage_IDX/1,1703,547,00.html

(That's one very long link; be careful you cut 'n paste it all.)

In November 2001 that URL led to a web page whose title was "gcc for hp-ux 11." The page offered a link for downloading a 64 bit gcc 3.0 compiler for HP-UX 11.0 and 11i. Rich Rauenzahn of HP installed that compiler on an HP test system he allows me to use and I successfully built a 64 bit lsof with it.

The HP package may install the 64 bit capable gcc in /usr/local/pa20_64/bin/gcc, so you may have to adjust your path or set the LSOF_CC environment variable to compensate.

9.2.9 Why does /dev/kmem-based lsof for HP-UX 11 report "unknown file system type" for some open files?

The lsof binary being used probably doesn't have support for the VxFS file system.

To confirm that, check `lsof -v` output for "-DHASVXFS". If it's not present, lsof doesn't have VxFS support.

You also need to establish that lsof really is complaining about VxFS files by checking the kernel boot file for the symbol associated with the hexadecimal address reported in the "unknown file system type" message -- e.g., "v_op: 0x8711c8." Use nm(1) to do that:

```
$ nm -x /stand/vmunix | grep 8711c8
```

If nm reports the symbol associated with the address is vx_vnodeops, then lsof is complaining about an open VxFS file.

The solution in that case is to build lsof yourself (The bundled C compiler will do it.), making sure that lsof's

Configure script detects the presence of VxFS. Configure does
that by finding these two header files:

```
/usr/include/sys/fs/vx_hpux.h
/usr/include/sys/fs/vx_inode.h
```

If the system where you are building lsof doesn't have those
header files, but does have VxFS, you might be able to install
the header files by installing the HP JournalFS package from
the CoreOS CD -- in particular the file set JournalFS.VXFS-PRG
and its associated patch, PHKL_18543. (My thanks to Steve
Bonds for that information.)

Finally, if you find that lsof isn't complaining about VxFS
when it complains about an unknown file system type, send
e-mail to me <abe@purdue.edu> for further assistance. Make
sure "lsof" appears in the "Subject:" line so my e-mail filter
won't classify your letter as Spam.

9.2.10 Why does the ANSI-C compiler complain about comments in HP-UX
11 header files?

When compiling lsof on HP-UX 11, the HP ANSI-C compiler's
pre-processor, cpp, may complain about comments in HP-UX header
files -- e.g.,

```
cpp: "/usr/include/sys/cdfs.h", line 232: warning 2028:
 Found comment
inside comment started on line 232.
cpp: "/usr/include/sys/cdnode.h", line 196: warning 2028:
 Found comment inside comment started on line 196.
cpp: "/usr/include/nfs/snode.h", line 30: warning 2028:
 Found comment inside comment started on line 30
```

This is not a problem with lsof. It is a problem with the
HP-UX header files; they have non-compliant ANSI-C comment
sequences in them -- e.g.,

```
<sys/cdfs.h>: 232
 /* struct  cdfs *cdfs_link;  /* linked list of file systems */
```

The initial "/*" is not terminated by an ending "*/" before the
appearance of a second "/*".

9.2.11 Why does dnode1.c cause the HP-UX 11 compiler to complain that
<sys/fs/vx_inode.h> is missing or incorrect?

If CFLAGS in the lsof Makefile for an HP-UX 11 compilation includes HASONLINEJFS, indicating the system has OnlineJFS support, lsof needs the <sys/fs/vx_inode.h> header file. Sometimes it is missing from /usr/include/sys/fs.

<sys/fs/vx_inode.h> is a header file that must be obtained from
Veritas. If that proves impossible, please contact me via e-mail at <abe@purdue.edu>. Make sure "lsof" appears in the "Subject:" line so my e-mail filter won't classify your letter as Spam.

9.3 PSTAT-based HP-UX lsof Questions

The sources for PSTAT-based lsof for HP-UX may be found in lsof_<revision>/dialects/hpux/pstat.

Lsof's Configure shell script decides to use these sources when it finds that the /usr/include/sys/pstat subdirectory exists.

Lsof can be forced to use the PSTAT-based sources by setting "pstat" in the HPUX_BASE environment variable. Consult the Configure shell script and 00XPORTING for more information.

9.3.1 Why does PSTAT-based lsof complain about pst_static and other PSTAT structures?

When lsof starts it may issue one of these fatal error messages:

```
lsof: FATAL: can't determine PSTAT static size
lsof: FATAL: can't read <n> bytes of pst_static
lsof: FATAL: pst_static doesn't contain <name>_size
lsof: FATAL: <name>_size
should be <n>
```

These messages indicate that lsof's tests for the proper level of PSTAT support have failed. The structure names, given in <name>, and sizes, given in <n>, identify the support deficiency more precisely.

You may need to upgrade the PSTAT support in your kernel to be able to use PSTAT-based lsof.

9.3.2 Why does PSTAT-based lsof complain it can't read pst_* structures?

Lsof may put messages like the following in the NAME column of its output.

```
can't read cwd pst_filedetails: Permission denied
can't read mem pst_filedetails: Permission denied
can't read rtd pst_filedetails: Permission denied
can't read txt pst_filedetails: Permission denied
can't read pst_filedetails: Permission denied
can't read 3 stream structures: Permission denied
can't read pst_socket: Permission denied
```

These messages indicate that the lsof binary lacks the authority to read the name structures for processes other than ones belonging to the
UID under which lsof is running.
Authority to read the structures of other processes is limited to root processes -- i.e., lsof must have setuid-root permission if it is to list open files for arbitrary processes.

If you want to eliminate these errors, you must run lsof as root or install it with setuid-root permission.

9.3.3 Why does PSTAT-based lsof rebuild the device cache file after each reboot?

After each HP-UX rebuild, the first time a user runs lsof it will report:

```
lsof: WARNING: device cache mismatch: /dev/tun...
lsof: WARNING: created device cache file: /<user_path>
```

This happens because the device numbers on /dev/tun* device nodes are recalculated at each reboot. When lsof detects a change in the device number of a /dev/tun* file, it rebuilds its local device cache file.

9.3.4 Why doesn't PSTAT-based lsof report TCP addresses for telnetd's open socket files?

When lsof can't report TCP addresses for telnetd's open socket files it is because an
unpatched PSTAT kernel
interface doesn't report the addresses to lsof.

This has been addressed in PSTAT kernel patch PHKL_24047.
It is available from the HP IT Resource Center at:

http://itrc.hp.com

In the page's "maintenance / support" box select the
"individual patches" link. Once at its page, select the
"hp-ux" link. On that page select the "Series 800" or
"Series 700" radio button and select "11.11" from the
pull-down list to the right of the button. Under "search
or browse the path list" select "Search by Patch IDs" from
the pull down list, enter PHKL_24047 in the following text
box, and select search. That should lead to information
about PHKL_24047 and a link for downloading it. (You may
have to log in first and you may have to create a login
identity by registering before you can log in.)

Some time in March 2006 the PHKL_24047 patch was "lost"
by the HP-UX networking lab. It has been "found" again
in August 2006 and will be re-released as a GRO patch
"some
time." I don't yet know when that will be. You
must contact HP to learn about the availability of the
GRO patch.

9.3.5 Why does PSTAT-based lsof cause an HP-UX 11.11 kernel panic?

When PSTAT-based lsof runs on some HP-UX 11.11 kernels,
the kernel may panic. Symptoms include:

Console message:
0xFBE000301100EF00 00000000 0000EF00 -
type 31 = legacy PA HEX chassis-code

/var/adm/syslog:
... vmunix: Trap Type 15 (Data page fault)
... vmunix: Instruction Address (pcsq.pcoq) = 0x...

The panic is caused by a bug in the way PSTAT's pstat_getstream()
function obtains module names from streams managed by the
otsam stream driver (part of OSI Transport Services). Lsof
calls pstat_getstream() when it encounters an open otsam
stream file. An HP-UX 11.11 system uses otsam if otsam
appears in /stand/system.

HP-UX 11.11 patch PHKL_24507 (available some time after
July 15, 2001) fixes the pstat_getstream() bug. See the
information in the answer
to the "Why doesn't PSTAT-based
lsof report TCP addresses for telnetd's open socket files?"

question for information on how to obtain the patch.

9.3.6 Why doesn't PSTAT-based lsof report a CWD that is on a loopback (LOFS) file system?

When PSTAT-based lsof reports on processes whose current working directory (CWD) is on a loopback file system, lsof can't report the open CWD file. The reason is that the HP-UX 11.11 and above kernel's loopback file system code is not passing the CWD file ID to the kernel's pstat(2) code. Hence lsof is given no information on the lofs CWD.

The problem was first reported to me by Ermin Borovac and an internal bug report was filed with the HP-UX file system group on October 26, 2004. That report has now been answered by the patch PHKL_33200 -- s700_800 11.11 lofs cumulative patch. The HP IT Resource Center (http://itrc.hp.com) is a source for the patch.

9.3.7 Why do some swinstall packages for PSTAT-based HP-UX 11.11 packages
complain about setgid and setuid bits?

First, let me explain that I do not provide lsof swinstall packages for lsof. Others provide them and they should be contacted about problems with their packages.

However, I have become aware of a problem with one package about which I have some information I can share. The problem shows up in these swinstall messages:

```
ERROR:   Unknown owner and/or group for file
  "/usr/local/bin/lsof". SUID and/or SGID bit was
  not set.
ERROR:   Failed installing fileset "lsof.lsof-RUN,r=4.73".
  Check the above output for details.
```

The swpackage SUID/SGID functionality was restricted by changes for POSIX compliance, breaking backward compatibility. The patch PHCO_27671 allows SUID/SGID for uid/gid of 0 only, as a compromise between backward compatibility and POSIX conformance.

If the setuid bit is to be set on the executable, the UID and GID of the executable must be 0 (zero).

9.3.8 Why won't the bundled C compiler
build PSTAT-based lsof for
PA-RISC HP-UX 11.23?

A PA-RISC HP-UX 11.23 bundled C compiler dated May 2005 or later will not build PSTAT-based lsof. It will deliver error messages related to the system's <gssapi/gssapi.h> header file.

There is nothing wrong with that header file or lsof. The problem is that the bundled C compiler can't cope with the gssapi.h header file.

The work-around is to use the HP ANSI C compiler. Using gcc is not a satisfactory work-around. See the answer to the "Why won't gcc build PSTAT-based lsof for PA-RISC HP-UX 11.23?" question for more information.

9.3.9 Why won't gcc build PSTAT-based lsof for PA-RISC HP-UX 11.23?

Gcc will not even compile PSTAT-based lsof revisions below 4.77 for PA-RISC HP-UX 11.23 dated May 2005 or later. It reports errors in lsof's print.c fill_portmap() function about missing members of the rpcent structure. That happens because gcc defines _XOPEN_SOURCE_EXTENDED which disables the definition of the rpcent
structure in <netdb.h>.

Using the HP bundled C compiler is not a viable work-around. That is explained in the answer to the "Why won't the bundled C compiler build PSTAT-based lsof for PA-RISC HP-UX 11.23?"

While an lsof revision 4.77 or higher can be compiled with gcc, the results are unreliable. Lsof will compile, but it occasionally produces segment faults when it runs. I have not been able to reproduce the failure reliably or locate a debugger that will work with the gcc-compiled lsof.

The only reliable work-around is to use the HP ANSI C compiler.

9.3.10 Why does PSTAT-based lsof complain, "FATAL: pst_stream_size should be: 672; is 72" on HP-UX 11.11 and above?

This message indicates a mismatch between the PSTAT header files used to build lsof (<sys/pstat.h> and those in the /usr/include/sys/pstat subdirectory), and those that built the running kernel.

Unfortunately the June 2008 patch set for HP-UX 11.23 creates this inconsistency, because it does not

contain all the patches
needed to match the kernel with the PSTAT header files. Even
more serious is that the missing patches update the kernel's
PSTAT support to provide TCP/UDP endpoint information to lsof
from TCP/TLI streams.

The patch inconsistency comes about because, while the following
patch is installed,

PHKL_36577 1.0 PM-PSTAT section 2 manpage changes

other kernel patches are not.

The PHKL_36577 patch updates the PSTAT header files and manual
pages to match kernel changes that other patches with the
following numbers (or patches that contain or supersede them)
contain:

PHNE_36575 1.0 Cumulative STREAMS Patch
PHNE_37670 1.0 cumulative ARPA Transport patch
PHNE_37851 1.0 NFS cumulative patch

Those patches implement the kernel changes that support the
delivery of information promised in patch PHKL_36577.

The work-around is to install the missing patches.

9.4 Why won't the HP-UX depot install?

I don't distribute lsof depots, so
I can't support them.

From time to time depots prepared by various sites -- e.g.,
usually HP-UX software collection sites -- will contain errors
that cause installation of the depot to fail.

Do not contact me when this happens. Instead, contact the
administrator of the site that prepared the depot.

As should be clear from the bulk of the lsof documentation, I
do not recommend you use pre-built lsof binaries in any form.
Instead, I recommend you obtain the lsof source distribution
and build lsof yourself.

10.0 Linux

10.1 What do /dev/kmem-based and /proc-based lsof mean?

At approximately Linux 2.1.72 and exactly at lsof revision
4.23 support for Linux forks. The first fork, containing
the oldest lsof form is based on access to kernel memory
structures, and is called /dev/kmem-based lsof. A
/dev/kmem-based lsof is heavily intertwined with the Linux
kernel version, its header files, and its system map file.
Typically a /dev/kmem-based lsof needs only setgid permission
to
local all open file information.

After approximately Linux 2.1.72 and at revision 4.23 lsof
obtains all its information from the /proc file system.
That lsof is called the /proc-based lsof. A /proc-based
lsof does not read kernel memory, needs neither kernel
header files nor the system map file, and is less likely
to be affected by Linux kernel changes. However, it does
require setuid-root permission to list all open files, and
it can't report file offsets (positions).

After revision 4.52 the /dev/kmem-based Linux sources for
lsof are no longer distributed. Information about them
may be found in the 00INDEX and README files at:

ftp://lsof.itap.purdue.edu/pub/tools/unix/lsof/OLD/src

10.2 /proc-based Linux lsof Questions

10.2.1 Why doesn't /proc-based lsof report file offsets (positions)?

/proc-based lsof revisions 4.79 and above can only report file
offsets (positions) for the files of Linux kernels 2.6.22 and
above.

During its initialization /proc-based
lsof tests to see if
offset information can be obtained. If it cannot, lsof
disables offset reporting. If the -o option was selected, lsof
also issues this warning:

lsof: WARNING: can't report offset; disregarding -o.

10.2.2 Why does /proc-based lsof report "can't identify protocol" for
some socket files?

/proc-based lsof may report:

```
COMMAND PID ... TYPE ... NODE NAME
pump    226 ... sock ...  309 can't identify protocol
```

This means that it can't identify the protocol (i.e., the AF_* designation) being used by the open socket file. Lsof identifies protocols by matching the node number associated with the /proc/<PID>/fd entry to the node numbers found in selected files of the /proc/net sub-directory. Currently /proc-based lsof examines these protocol files:

```
/proc/net/ax25  (untested)
/proc/net/ipx  (needs kernel patch)
/proc/net/raw
/proc/net/raw6
/proc/net/tcp
/proc/net/tcp6
/proc/net/udp
/proc/net/udp6

/proc/net/unix
```

If /proc-based lsof says it can't identify the protocol for an open socket file, you may be able to identify the protocol yourself by using grep to look for the specific node number in the files of /proc/net -- e.g.,

```
$ grep <node_number> /proc/net/*
```

You may not be able to find the desired node number, because not all kernel protocol modules fully support /proc/net information.

If you find a matching node number in a /proc/net file that is not currently being processed by lsof, contact me via e-mail at <abe@purdue.edu>. I'll discuss adding support to /proc-based lsof for the protocol of the /proc/net file with you. Make sure "lsof" appears in the "Subject:" line so my e-mail filter won't classify your letter as Spam.

The code that matches node numbers of open IPX protocol socket files to those in /proc/net/ipx requires Jonathan Sergent's Linux 2.1.79 patch to /usr/src/linux/net/ipx/af_ipx.c. The patch, suitable for input to Larry Wall's patch program, may be found in the lsof distribution file:

```
.../dialects/linux/proc/patches/net_ipx_af_ipx.c.patch
```

10.2.3 Why does /proc-based lsof warn about unsupported formats?

Lsof may issue the following warning:

    lsof: WARNING: unsupported format: /proc/net/<file>

if the header line of the indicated <file> in /proc/net --
ax25, ipx, raw, tcp, udp, or unix -- doesn't match what
lsof expects to find.

When the header line of a /proc/net file isn't what lsof
expects, lsof probably can't parse the rest of the file
correctly and doesn't try. As a result, lsof can't report
any NAME column information (e.g., local and remote addresses)
for socket files bound to the indicated network protocol.

If you get this warning, please send me e-mail at <abe@purdue.edu>.
Include the contents of the file lsof claims has an unsupported
format. Make sure "lsof" appears in the "Subject:" line so my
e-mail filter won't classify your letter as Spam.

10.2.4 Why does /proc-based lsof report "(deleted)" after a path name?

The "(deleted)" notation following a path name in /proc-based
lsof's NAME column comes from the /proc/<PID>/fd/<FD> entry
for the open file. It's the Linux kernel's way of indicating
the file is open but has been unlinked (rm'd).

10.2.5 Why doesn't /proc-based lsof report full open file information for all processes?

/proc-based lsof can only report on processes whose /proc
files it has permission to read. /proc normally grants
permission to read all its files only to root or to the
owning user ID.

Without permission to read most /proc files, lsof can only
report full information for processes belonging to the user
who is running lsof. /proc-based lsof may be able to report
some information for all processes, depending on the
permissions of their associated /proc files, but usually
/proc-based lsof won't be able to access the files in
/proc/<PID>/fd/ that describe regular open files.

If you want /proc-based lsof
to report on all processes, you
must install it with setuid-root permission.

10.2.6 Why won't Customize offer to change HASDCACHE or WARNDEVACCESS for /proc-based lsof?

/proc-based lsof doesn't read device information from /dev or the device cache file, so it makes no sense to change the state of device cache processing or /dev node accessibility warnings.

10.2.7 /proc-based lsof Linux NFS questions

10.2.7.1 Why can't lsof find files on an accessible NFS file system?

On occasion lsof may be unable to identify that an open file is on an NFS file system. This is most likely the result of a bug in the way the Linux kernel supplies information to the reader of /proc/mounts (lsof) -- sometimes that pseudo-file is truncated by the kernel.

One way to see if this is the case is to search for the NFS file system in /proc/mounts -- e.g.,

```
$ grep <NFS_file_system_mount_point> /proc/mounts
```

If you get no output or the third word of the output isn't "nfs", then lsof won't consider the file system an NFS file system.

A second test is to look at the end of /proc/mounts -- e.g.,

```
$ tail /proc/mounts
```

If tail reports "# truncated" then /proc/mounts is incomplete because of a Linux kernel bug. The bug is documented at:

```
http://www.xss.co.at/sysinfo/mounts.html
```

The bug is fixed in Linux kernel 2.4.18, and possibly in some earlier Linux kernel versions.

10.2.7.2 Why can't lsof find files on an inaccessible NFS file system?

If lsof issues this message about a Linux file system, mounted from an NFS server:

```
lsof: WARNING: can't stat() nfs file system /xxx/yyy
```

Then lsof won't be able to find any open files on the file system.

That's because of an inadequacy in the Linux /proc file system. Its /proc/mounts file doesn't give the device doublet (major and minor numbers) of the file system as do many UNIX systems (e.g., Solaris). The only way lsof can get the device doublet for a Linux file system is to call stat(2) on the file system path, which fails if the NFS server isn't accessible.

When lsof doesn't know the device doublet of a file system, it can't find open files on the inaccessible file system, because it can't match the doublets of open files to the doublet of the inaccessible file system.

This topic is covered extensively in lsof(8) it its ALTERNATE DEVICE NUMBERS and BLOCKS AND TIMEOUTS sections.

10.2.8 Why doesn't /proc-based Linux lsof report socket options and values, socket state flags, and TCP options and values?

The Linux /proc file system doesn't report socket options and values, socket states, and TCP options and values to lsof.

10.2.9 Does /proc-based Linux lsof use a device cache?

No. The Linux /proc/<PID>/fd/* entries provide device names to lsof via readlink(2). It is not necessary to enable device cache processing for /proc-based Linux lsof via the Customize script or modifications to the Linux machine.h header file.

10.2.10 Why doesn't /proc-based Linux lsof report any or all file structure values for its +fcfgGn option?

/proc-based lsof revisions 4.79 and above can only report some file structure values for Linux kernels below 2.6.22.

When running on Linux kernels at 2.6.22 and above lsof 4.79 can report some file flag values -- i.e., in response to the +fg or +fG options. The flag values are obtained from the /proc/<PID>/fdinfo/ files introduced at Linux kernel 2.6.22.

/proc-based Linux lsof tests its availability to obtain file

flag values at initialization. If values are not available, lsof disables file flag reporting. If the flags were requested with +fg or +fG, lsof displays this warning:

lsof: WARNING: can't report file flags; disregarding +f.

As a special note, when Linux lsof can report flag bits, it will not report 'R' for a read-only file. There is no read-only flag bit O_* symbol in <fcntl.h> (or <bits/fcntl.h>) and lsof reports only bits that are set. The absence of O_RDWR and O_WRONLY flag bits implies the file is read-only.

10.3 Special Linux file types

10.3.1 Why is ``DEL" reported as a Linux file type?

Lsof usually reports entries from the Linux /proc/<PID>/maps file with ``mem" in the TYPE column. However, when lsof can't stat(2) a path in the process' ``maps" file and the ``maps" file entry contains ``(deleted)", indicating the file was deleted after it had been opened, lsof reports the file type as ``DEL".

10.3.2 Why is ``unknown" reported as a Linux file type?

Lsof may report a Linux file's type as ``unknown" in the TYPE column when lsof can't obtain complete stat(2) results for the file.

Usually the NAME column will contain a ``(stat: xxx)" error message, but that could have been suppressed with the lsof ``-w" option.

10.4 Linux ``mem" Entry Problems

10.4.1 What do ``path dev=xxx" and ``path inode=yyy" mean in the NAME column of Linux ``mem" file types?

When the device or inode number in the process' ``maps" file entry doesn't match the stat(2) results from the file path, lsof reports the inconsistent information from the stat(2) of the path parenthetically after the path in the NAME column in one of these forms:

(path dev=xxx) only the device number, ``xxx", from a stat(2) of the

``maps" file entry path
differs from the ``maps" file
entry value reported in the
DEVICE column.

(path inode=yyy) only the inode number,
``yyy", from a stat(2) of the
``maps" file entry path
differs from the ``maps" file
entry value reported in the
NODE column.

(path dev=xxx inode=yyy) Both device and inode numbers
differ.

Lsof reports the ``maps" file device number in the DEVICE column and the inode number in the NODE column.

When device and inode mismatches occur, lsof suppresses the reporting of link count and size. See the answer to the "Why is neither link count nor size reported for some Linux ``DEL" and ``mem"
file types?" question for more information.

Device and inode inconsistencies can occur when a file at a ``maps" path is replaced after the process has started, or when a different file system with similar path names is mounted on top of the original file system.

The device inconsistency parenthetical messages can be suppressed with lsof's ``-w" option.

10.4.2 Why is neither link count nor size reported for some Linux ``DEL" and ``mem" file types?

Link count and size are not reported for some entries from the process' ``maps" file because a stat(2) of the entry file path failed or stat(2) delivered device or inode numbers that don't match the ones in the ``maps" entry.

When the stat(2) device or inode numbers don't match those in the ``maps" file entry, it is likely that the stat(2) results don't apply to the file that was originally mapped by the process and whose path appears in the ``maps" file entry, so lsof tries to avoid reporting possibly incorrect information.

See

the answer to the "What do ``path dev=xxx" and ``path inode=yyy" mean in the NAME column of Linux ``mem" file types?" for more information on how mismatched stat(2) device and inode numbers are reported.

10.5 Special Linux NAME column messages

10.5.1 What does ``(stat: xxx)" mean in the NAME column of Linux files?

When lsof tried to stat(2) the path in the NAME column, the stat(2) system call failed and produced an error message of ``xxx".

This situation usually occurs if the lsof process lacks permission to stat(2) the path -- e.g., the lsof executable lacks root permission, or lsof is attempting to stat(2) a path on an NFS device mounted with the root_squash option.

The message can be suppressed with lsof's ``-w" option.

10.5.2 What does ``(readlink: xxx)" mean in the NAME column of Linux files?

When lsof tried to convert the /proc/<PID>/fd path, reported in the NAME column, to its full and more meaningful path, the readlink(2) system
call used to do the conversion failed. The readlink(2) failure message is ``xxx".

This situation usually occurs if the lsof process lacks permission to readlink(2) some part of the path -- e.g., the lsof executable lacks root permission, or lsof is attempting to stat(2) a path on an NFS device mounted with the root_squash option.

The message can be suppressed with lsof's ``-w" option.

10.6 Why is ``NOFD" reported as a Linux file type?

When lsof lacks permission to use opendir() on the fd/ subdirectory of a process' /proc/<PID> directory, it reports a single file of the type ``NOFD" (for no file descriptors).

Lsof reports the the /proc/<PID>/path in the NAME column, followed by "(opendir: xxx)", where ``xxx" is the error message returned by opendir().

The ``NOFD'' entry can be suppressed with lsof's ``-w'' option.

10.7 Why does Linux lsof report a NAME column value that begins with ``/proc''?

When lsof has problems processing a ``/proc/<PID>'' entry -- e.g.,
it can't convert the entry to a full and more meaningful
path name, or it can't access the /proc/<PID>/fd subdirectory
with opendir() -- it will report the /proc/<PID> path in the
NAME column.

10.8 Linux /proc/net/tcp* and /proc/net/udp* issues

10.8.1 Why use the Linux -X option?

If you're not interested in TCP/IP socket information for a
particular use of lsof, adding the -X option will make lsof run
more quickly, because -X inhibits the reading of the
/proc/net/tcp* and /proc/net/udp* files. For example, you may
only be interested in knowing what process has a particular
file open.

When the Linux system has a large number of open TCP/IP socket
files, the time savings provided by -X can be significant.

10.8.2 Why does lsof say ``-i is useless when -X is specified''?

If -X is specified, lsof can't report much information on open
TCP/IP socket files. However, lsof's -i option requests that
information. Hence, the two options conflict and can't be used
together.

10.8.3 Why
does lsof say ``can't identify protocol (-X specified)''?

If the Linux lsof -X option is specified and an open socket
file can't be identified without accessing the /proc/net/tcp*
and /proc/net/udp* files, lsof will report that it can't
identify the socket's protocol and that the failure may be
caused by the -X specification

11.0 NetBSD Problems

11.1 Why doesn't lsof report on open kernfs files?

Lsof doesn't report on open NetBSD kernfs files because the

structures lsof needs aren't defined in the kernfs.h header file in /sys/misc/kernfs.

11.2 Why doesn't lsof report on open files on: file descriptor file systems; /proc file systems; 9660 (CD-ROM) file systems; MS-DOS (floppy disk) file systems; or kernel file systems?

Lsof is not able to report on open files on certain file system if /usr/src/sys/msdosfs didn't exist when the lsof Configure script ran and lsof was made. /usr/src/sys/msdosfs contains header files lsof needs for collecting data on certain
file system files.

You can tell if an lsof executable above) lacks support for a file system if the following test of `lsof -v` produces nothing:

```
$ lsof -v 2>&1 | grep <support_enabled_definition>
```

The <support-enabled_definition> will be:

File System Type	Definition	Note
File descriptor	HASFDESCFS	
/proc	HASPROCFS	
9660	HAS9660FS	
MS-DOS	HASMSDOSFS	(lsof 4.61 and above)
Kernel	HASKERNFS	

The work-around is to install /usr/src/sys, rerun the lsof Configure script, and remake lsof.

11.3 Why does lsof produce confusing results for nullfs file systems?

Consider this report from /sbin/mount:

```
/usr/home on /home type null (local)
```

(According to /sbin/mount /usr/home is the mounted-on device and /home is the mounted-on directory.)

When lsof is asked to report on open files on /home, it will report them as files on /usr/home instead. That's an artifact of the NetBSD kernel's dynamic
name lookup cache
(DNLC) and the way the kernel handles nullfs mounted-on

directories.

While lsof will report all open files on /home when given /home as a file system directory argument, even though reporting them as located on /usr/home, lsof will not find the same files when asked to report on all open files on /usr/home when given /usr/home as a file system device argument. That's because from the mount perspective /usr/home is equivalent to a device, but from the device perspective it is still a directory.

So, what this lsof command reports:

```
$ lsof /home
... NAME
... /usr/home/...
```

Won't be duplicated by this lsof command:

```
$ lsof /usr/home
```

Another way to look at this confusing /home and /usr/home example is to consider what stat(2) reports. For /home stat(2) reports a device doublet that matches what lsof finds in open file node structures, while the device doublet stat(2) reports for /usr/home won't match what lsof finds. Nor does the
mode reported by stat(2) indicate a block
devices, as is the expected case.

There is no simple answer to this confusion, nor is there even a simple explanation. Simply be aware that when supplying file system arguments to lsof on NetBSD, use the mounted-on directory name for a nullfs as the lsof argument, and don't be surprised when the NAME column reports the mounted-on device name.

11.4 NetBSD header file problems

11.4.1 Why can't the compiler find some NetBSD header files?

If the compiler's pre-processor complains it can't find some header files when it compiles lsof source files, /usr/include and /usr/src may not have all the header files lsof needs.

As a work-around use the NETBSD_SYS environment variable to specify to lsof the location of the additional header files -- e.g.,

```
% setenv NETBSD_SYS /my_source
% ./Configure -n netbsd
```

or

```
$ NETBSD_SYS=/mys_source ./Configure -n netbsd
```

Caution: using this work-around may cause the lsof Configure script
to activate or omit different features, depending
on where it finds the header files that determine the state
of the features.

11.4.2 Why does NetBSD lsof produce incorrect output?

If the NetBSD system's kernel was built from header files that don't match those in /usr/include -- e.g., //usr/src has the ones from which the kernel was built -- lsof may build, but won't produce correct output.

As a possible work-around, try directing the C compiler to select header files from /usr/src before it selects them from /usr/include. That can be done with the DEBUG make string -- e.g.,

```
$ make DEBUG="-I/usr/src -I/usr/include"
```

If that work-around fails, try using the LSOF_INCLUDE and NETBSD_SYS environment variables to swap /usr/include and /usr/src when running the Configure script, then use the make DEBUG string when running make -- e.g.,

```
$ LSOF_INCLUDE=/usr/src; export LSOF_INCLUDE
$ NETBSD_SYS=/usr/include; export NETBSD_SYS
$ ./Configure -n
netbsd
$ make DEBUG="-I/usr/src -I/usr/include"
```

11.5 Why isn't lsof feature xxx enabled for NetBSD?

Lsof's Configure script enables NetBSD features by locating and examining header files associated with the features, and based on what it finds, setting compile-time definitions in Makefiles. (See 00PORTING for a list of the definitions.)

When Configure doesn't find header files or doesn't find appropriate values in header files, that may mean the header file tree lsof is searching is incomplete or out of date.

Lsof normally looks for NetBSD header files in /usr/include.
It can also be directed to look in other directories --
e.g., /sys -- if told to do so with the contents of the
LSOF_INCLUDE and NETBSD_SYS environment variables.

To determine what header file enables a missing feature,
check the NetBSD stanza in the Configure script. Then
check the locations it checks for the indicated header
files and contents.

See 00XCONFIG for more information on LSOF_INCLUDE
and
and NETBSD_SYS.

12.0 NEXTSTEP and OPENSTEP Problems

12.1 Why can't lsof report on 3.1 lockf() or fcntl(F_SETLK) locks?

Lsof has code to test for locks defined with lockf() or
fcntl(F_SETLK) under NEXTSTEP 3.1, but that code has never
been tested. I couldn't test it, because my NEXTSTEP 3.1
lockf() and fcntl(F_SETLK) functions return "Invalid
argument" every way I have tried to invoke them.

If your NEXTSTEP 3.1 system does allow you to use lockf()
and fcntl(F_SETLK) and lsof doesn't report locks set with
them, then the code in .../dialects/next/dnode.c probably
isn't correct. Please contact me via e-mail at <abe@purdue.edu>
and tell me how you got your lockf() and fcntl(F_SETLK) system
calls to work. Make sure "lsof" appears in the "Subject:" line
so my e-mail filter won't classify your letter as Spam.

12.2 Why doesn't lsof compile for NEXTSTEP with AFS?

I no longer have a NEXTSTEP test system that has AFS.
Changes to lsof since I once had a test system
have caused
me to change the AFS code in NEXTSTEP without being able
to test the changes.

If you need AFS support for NEXTSTEP and can't get it to
compile, please contact me. Perhaps we can jointly fix
the problems.

13.0 OpenBSD Problems

13.1 Why doesn't lsof support kernfs on my OpenBSD system?

Lsof supports the kernel file system on OpenBSD versions whose /sys/miscfs/kernfs/kernfs.h (or <miscfs/kernfs/kernfs.h> header file correctly defines the kern_target structure. The lsof Configure script's openbsd stanza checks for the presence of the structure's kt_name element and activates kernfs support for the CFLAGS -DHASKERNFS definition only when it finds kt_name.

The kernfs.h header file is scheduled to be updated in the OpenBSD 2.1 release, according to Kenneth Stailey, who authored its changes.

13.2 Will lsof work on OpenBSD on non-x86-based architectures?

I've not tested lsof on an OpenBSD system that uses a non-x86-based architecture, but I've had one report that
lsof 4.33 compiles and works on OpenBSD for the pmax architecture (decstation 3100).

13.3 <sys/pipe.h> problems

13.3.1 Why does the compiler claim nbpg isn't defined?

When compiling lsof on some (older) OpenBSD SPARC versions, the compiler may complain:

```
In file included from ../dlsof.h:191,
     from ../lsof.h:166,
     from fino.c:52:
/usr/include/sys/pipe.h:83: `nbpg' undeclared here
(not in a function)
/usr/include/sys/pipe.h:83: size of array `ms' has
non-integer type
```

This happens because <sys/pipe.h> uses NBPG from <machine/param.h> to size the `ms' array, and some OpenBSD systems define NBPG in terms of a kernel integer variable, nbpg.

Lsof revisions 4.46 and above have a hack to dlsof.h, developed by Volker Borchert that avoids the compiler problem for SPARC OpenBSD 2.3. The hack might work for other OpenBSD SPARC versions, but hasn't been tested there.

If you want to enable the hack for your OpenBSD SPARC
version,
modify this code in .../dialects/n+obsd/dlsof.h:

```
# if    defined(OPENBSDV)
#  if   OPENBSDV==2030 && defined(__sparc__)
#   if  defined(nbpg)
#undef  nbpg
#   endif       /* defined(nbpg) */
#define nbpg    4096            /* WARNING!!!  ... */
#  endif       /* OPENBSDV==2030 && defined(__sparc__) */
#include <sys/pipe.h>
#endif  /* defined(OPENBSDV) */
```

You will probably want to change the second #if test to
match your OpenBSD version. You may also want to change
what value is assigned to nbpg. See the next section,
"What value should I assign to nbpg?"

13.3.2 What value should I assign to nbpg?

If you need to enable the nbpg hack, described in "Why does
the compiler claim nbpg isn't defined?", you may also need
to assign a value other than 4096 to nbpg. 4096 works for
the sun4c processor and should work for sun4m, but 8192
may be needed for sun4.

Check <machine/param.h> and other OpenBSD documentation to
determine the
correct nbpg assignment.

13.4 Why doesn't lsof report on open MS-DOS file system (floppy
disk) files?

Lsof is not able to report on open MS-DOS file system files
if /usr/src/sys/msdosfs didn't exist when the lsof Configure
script ran and lsof was made. /usr/src/sys/msdosfs contains
header files lsof needs for collecting data on MS-DOS file
system files.

You can tell if an lsof executable (revisions 4.61 and
above) lacks MS-DOS file system support if the following
command reports nothing:

```
$ lsof -v 2>&1 | grep HASMSDOSFS
```

The work-around is to install /usr/src/sys, rerun the lsof

Configure script, and remake lsof.

13.5 Why isn't lsof feature xxx enabled for OpenBSD?

Lsof's Configure script enables OpenBSD features by locating
and examining header files associated with the features,
and based on what if finds, setting compile-time definitions
in Makefiles. (See 00PORTING for a list of the definitions.)

When Configure doesn't find header files or doesn't find
appropriate
values in header files, that may mean the header
file tree lsof is searching is incomplete or out of date.

Lsof normally looks for OpenBSD header files in /usr/include
and /sys. It can also be directed to look in other
directories if told to do so with the contents of the
LSOF_INCLUDE and NETBSD_SYS environment variables.

To determine what header file enables a missing feature,
check the OpenBSD stanza in the Configure script. Then
check the locations it checks for the indicated header
files and contents.

See 00XCONFIG for more information on LSOF_INCLUDE and
and NETBSD_SYS.

14.0 Output Problems

14.1 Why do the lsof column sizes change?

Lsof dynamically sizes its output columns each time it runs
to make sure that each column takes the minimum space.
Column parsing -- e.g., with awk -- is possible, because
each column is guaranteed to be separated from the preceding
one by at lease one space, and no column except the last
(NAME) contains embedded
spaces.

14.2 Why does the offset have ``0t' and ``0x'' prefixes?

The offset value that appears in the SIZE/OFF column has
``0t' and ``0x'' prefixes to distinguish it from size values
that may appear in the same column.

Normally if the offset value is less than 100,000,000 (8
digits), it appears in decimal with a ``0t' prefix; over

99,999,999, in hexadecimal with a ``0x" prefix.

A decimal offset is handy, for example, when tracking the progress of an outbound ftp transfer. When lsof reports on the ftp process, it will report the size of the file being sent with its open descriptor; it will report the progress of the transfer via the offset of the outbound open ftp data socket descriptor.

The ``-o [n]" option may be used to specify the maximum number of decimal digits to be printed after ``0t" before lsof switches to the hexadecimal digits after `0x". As already noted, the default decimal digit count is 8.

14.3 What are the values printed in the FILE_FLAG column and
why is 0x<value> sometimes included?

The two comma separated lists, separated by a semicolon, printed in the FILE-FLAG column (when the "+fg" option is specified), are short-hand names or hexadecimal values for the bits lsof finds in the f_flag or f_flags member of file structures for files (the first list, the one before the semicolon), and process open files flags found in various kernel structures, often named "pofile" (the second list, the one after the semicolon).

Lsof determines the short-hand names from symbols in the <fcntl.h>, <linux/fs.h>, <sys/fcntl.h>, <sys/fcntlcom.h>, o<sys/file.h>, and <sys/user.h> header files.

See the discussion of FILE-FLAG in the OUTPUT section of the lsof man page, and the FF_* and POF_* symbols in lsof.h for a list of the names.

Bits with no names defined for them are represented by an 0x<value> member of the comma-separated list -- a hexadecimal integer. When "+fG" is specified (instead of "+fg"), lsof will list all
flag values as two hexadecimal integers, separated by a semicolon.

When "-FG" is specified to get the flags in an output field, the format defaults to hexadecimal. You can get names instead by following "-FG" with "+fg" -- e.g.,

```
$ lsof -FG +fg ...
```

However, when you precede "-FG" with "+fg" -- e.g.,

```
$ lsof +fg -FG
```

the format will be hexadecimal; order is important.

14.3.1 Why doesn't lsof display FILE_FLAG values for my dialect?

All versions of lsof except the /proc-based Linux lsof report FILE-FLAG values. Lsof can't obtain FILE-FLAG information from the Linux /proc interface.

14.4 Network Addresses

14.4.1 Why does lsof's -n option cause IPv4 addresses, mapped to IPv6, to be displayed in IPv6 notation?

When you use the -n option to tell lsof to display numeric network addresses, and an IPv4 address has been mapped to IPv6, lsof displays the address in IPv6 format and puts "ipv4" in the TYPE column. That combination indicates the IPv4 address
has been mapped to IPv6.

For example, the IPv4 address 1.2.3.4, when mapped to an IPv6 address, will be displayed by lsof as:

```
[::ffff:1.2.3.4]
```

The enclosing brackets are lsof's signal that this is an IPv6 address. Inside the brackets is a standard IPv6 address, reported by inet_ntop(). The first two colons, signifying zeroes in the first 64 bits of the IPv6 address, and the hexadecimal ffff in the next 32 bits, indicate that the last 32 bits contains a mapped IPv4 address, which is then displayed in IPv4 dot notation.

14.5 Why does lsof output \x, ^x, or \xnn for characters sometimes?

Lsof displays only printable ASCII characters. Lsof considers a character printable if isprint(3) says it is. If isprint(3) says a character isn't printable, the lsof may page explains:

> "... Non-printable characters are printed in one of three forms: the C ``\[bfrnt]" form; the control character `^' form (e.g., ``^@"); or hexadecimal

leading ``\x" form
(e.g., ``\xab"). Space is
non-printable in the COMMAND column (``\x20") and
printable elsewhere."

14.5.1 Why is space considered a non-printable character in command names?

Space is considered an unprintable character in command names because it is sometimes possible to hide the full command name from scripts that parse ps(1) output by embedding a space in the name.

14.6 Why doesn't lsof print all the characters of a command name?

By default lsof prints the first nine characters of the names of commands associated with processes. If more characters are required, the "w" value of the "+c w" option may be used to specify a larger width.

If "w" is zero ('0') lsof will print all characters of all command names up to the limit of the number of characters supplied by the particular UNIX dialect. When reporting command names, lsof replaces non-printable characters as discussed in the answer to " Why does lsof output \x, ^x, or \xnn for characters sometimes?"

See
the answer to the "Why is space considered a non-printable character in command names?" question for an explanation of why spaces are replaced by the ``\x20" representation in command names.

The number of command name characters supplied to lsof by UNIX dialects in files and structures varies by dialect. For example, Linux 2.4.27 supplies lsof the first 15 characters of command names and Solaris 9 supplies 16. Thus, even if "w" is zero ('0'), lsof can't report more characters for command names on those two UNIX dialects than they provide lsof.

14.7 Why does lsof reject some -c command names, saying their lengths are "> what system provides (nn)"?

The command name length that a specific system provides varies from dialect to dialect. As noted in the answer to the "Why doesn't lsof print all the characters of a command name?" question, Linux and Solaris provide a limited number of command name characters.

When more characters are specified in the parameter
to the -c
option, lsof considers it an error and issues a fatal error
message -- e.g.,

```
lsof: "-c xxxxyyyy" length (8) > what system provides (7)
```

The only work-around is to specify no more characters to -c
that the system provides to lsof.

14.8 Why does lsof sometimes print TYPE numbers instead of names?

When lsof can't convert a type number to a name for printing in
the TYPE column, it will report the number as four octets.

14.9 Marker line format problems

14.9.1 Why won't lsof accept a marker line format?

Lsof's Configure script must find the localtime(3) and
strftime(3) functions in the dialect's C library in order to
enable support for marker line formats.

Check the output of lsof's -v option for the presence of
-DHAS_STRFTIME in the compiler flags. If it isn't there,
Configure didn't find the necessary two C library functions.

If you think lsof should have found the functions, make a copy
of the C test program in the Configure script that it uses to
find
the functions. Then use the copy, or a more informative
modification of it, to learn why Configure can't find the
functions. You can find that program by searching for
strftime.

14.9.2 Why does lsof reject the NL (%n) marker line format?

When repeat mode and field output (with -F) have both been
specified, lsof won't allow new line (NL) formats to be
specified with ``%n''. That's because the marker line is
always guaranteed to be a single line.

There is no work-around to this restriction.

14.10 How are protocol state name exclusion and inclusion used?

Protocol state name inclusion and exclusion with the ``-s p:s''

option and its arguments have some issues to consider.

First, there is the problem of determining what state names, if any, the dialect produces. Try running this lsof command to find them:

```
$ lsof -i
```

Knowing the state names of interest, the next problem is to decide on the lsof options and their parameters that will produce the desired output.
Here some examples are probably
the most useful.

To list only TCP socket files in LISTEN and CLOSE_WAIT states, use:

```
$ lsof -itcp -stcp:listen,close_wait
```
or
```
$ lsof -iTCP -sTCP:LISTEN,CLOSE_WAIT
```

Case isn't important to lsof in protocol and state names.

To exclude TCP socket files in CLOSE_WAIT state, use:

```
$ lsof -itcp -stcp:^close_wait
```

Note the `^' preceding close_wait; it selects exclusion. You can mix included and excluded names in a comma separated list, but you may not include and exclude the same name for the same protocol.

To list TCP files in LISTEN state and UDP files in Idle state, use:

```
$ lsof -i -stcp:listen -sudp:idle
```

Note: if you don't accompany the ``-s p:s" list option and arggument with the -i option, lsof will list all other regular files, while applying the specified inclusion and exclusion specifications to network files. Generally, then, you want to use -i with -s.

14.10.1 Why doesn't my dialect support state name exclusion and inclusion?

When state name inclusion and exclusion was added, I had access to test systems for AIX, Darwin, FreeBSD, Linux, PSTAT-based

HP-UX and Solaris.

Therefore, I was unable to add and test the support to any other
UNIX dialects.

If a dialect has the support, then the HASTCPUDPSTATE definition
in its machine.h header file will be active; if not, it will be
absent or commented out.

If your dialect doesn't have the support and you want it added,
you will have to provide me Internet access to a test host, where
I can compile lsof and have the credentials to test the changes
the support requires. If that's possible for you, please contact
me via e-mail at <abe@purdue.edu>. Make sure "lsof" appears in
the "Subject:" line so my e-mail filter won't classify your letter
as Spam.

15.0 Pyramid Version Problems

15.0.5 Statement of deprecation

As of lsof revision 4.52 support for all Pyramid versions has
been dropped. Contact me via e-mail at <abe@purdue.edu>
if you
are interested in obtaining the last lsof Pyramid distribution.
Make sure "lsof" appears in the "Subject:" line so my e-mail
filter won't classify your letter as Spam.

16.0 SCO Problems

16.1 SCO OpenServer Problems

16.1.1 How can I avoid segmentation faults when compiling lsof?

If you have an older SCO OpenServer compiler, it may get
a segmentation fault when compiling some lsof modules.
That appears to happen because of the -Ox optimization
action requested in the lsof Makefile.

Try changing -Ox to -O with this make invocation:

```
$ make DEBUG=-O
```

Bela Lubkin supplied this tip and Steve Williams verified
it.

16.1.2 Where is libsocket.a?

If you compile lsof and the loader says it can't find the socket library, libsocket.a, called by the -lsocket option in the lsof compile flags, you probably are running an SCO OpenServer release earlier than 5.0 and don't have the TCP/IP Development System package installed.

You may have the necessary header files, because you have the TCP/IP run-time package installed, but if you don't have the TCP/IP Development System package installed, you won't have libsocket.a.

Your choices are to install the TCP/IP Development System package or upgrade to OpenServer Release 5.0. You will find libsocket.a in 5.0 -- you'll find all the libraries and header files there, in fact -- and you can use gcc to compile lsof if you don't want to install the 5.0 Development System package.

16.1.3 Why do I get "warning C4200" messages when I compile lsof?

When you compile lsof under OSR 3.2v4.2 (and perhaps under earlier versions as well), you may get many compiler warning messages of the form:

```
node.c(183) : warning C4200: previous declarator is not
compatible with default argument promotion
```

In my opinion this is a bug in the OSR compiler. Because the compiler cannot handle full ANSI-C prototypes, it assumes default types for function parameters as it encounters untyped in a function prototype -- e.g., in this function declaration from node.c,

```
   readrnode(ra, r)
 KA_T ra;
 struct rnode *r;
   {
   ...
```

the compiler assigns default int types to the ra and r arguments.

Then, when the compiler encounters the fully typed parameters after the function skeleton and sees parameters with types

that don't match the assumptions it previously made, it
whines about its own assumptions.

You can ignore these messages.

16.2 SCO|Caldera UnixWare Problems

16.2.1 Why doesn't lsof compile on my UnixWare 7.1.1 or above system?

When you Configure lsof with the "uw" abbreviation and try
to compile it for UnixWare 7.1.1, you may get compiler
error messages like this:

```
   UX:acomp: ERROR: "dproc.c", line 98:
 undefined struct/union member: p_pgidp
```

This suggest that you probably have a non-stop cluster
UnixWare 7.1.1 system. Its <sys/proc.h> header file differs
from the one on the system where I did the lsof port to
UnixWare 7.1.1. I currently
don't have access to a non-stop
cluster system to be able to develop changes to lsof that
would make it compile and work there.

If you have a non-stop cluster UnixWare 7.1.1 system, want lsof
for it, and can offer me a test account on the system, please
contact me via e-mail at <abe@purdue.edu>. Make sure "lsof"
appears in the "Subject:" line so my e-mail filter won't
classify your letter as Spam.

If you have a system with nsc_cfs and can offer me a test
account on it, please contact me via e-mail at <abe@purdue.edu>.
Make sure "lsof" appears in the "Subject:" line so my e-mail
filter won't classify your letter as Spam.

16.2.2 Why does lsof complain about node_self() on my UnixWare 7.1.1 or above system?

If lsof exits immediately after issuing this message:

```
   can't identify process NSC node; node_self(): <message>
```

It means that lsof has been built to run on a NonStop
Cluster (NSC) UnixWare 7.1.1 or higher system and can't
get the number of the node on which
it is running. Lsof
uses the node number to determine the path to the kernel

boot file.

You can tell if lsof has been built for NSC by looking for "-DHAS_UW_NSC" in lsof's "-v" option output.

If the system on which you're trying to run lsof isn't running an NSC kernel, you will need to build a non-NSC lsof.

16.2.3 Why does UnixWare 7.1.1 or above complain about -lcluster, node_self(), or libcluster.so?

When you build, compile, and load lsof for UnixWare 7.1.1 and above, ld may complain that it can't find the -lcluster library or that the node_self symbol is undefined. When you try to run an existing lsof binary it may complain that libcluster.so can't be found.

These messages mean the tests made by Configure on your system led it to believe your system is running a NonStop Cluster (NSC) kernel, or the lsof binary you're trying to use was built on a NonStop Cluster system. If an lsof binary was built for NSC, this shell command produces output:

```
  $ strings
<lsof_binary> | grep HAS_UW_NSC
```

If that's not the case, and you can rebuild lsof, set the UW_HAS_NSC environment variable to "N" and do this:

```
  $ Configure -n clean
  $ UW_HAS_NSC=N
  $ export UW_HAS_NSC
  $ Configure -n uw
  $ make
```

You can also edit Makefile and lib/Makefile. Remove -DHAS_UW_NSC from the CFGF strings. Remove -lcluster from the CFGL strings. Then run make again.

If you have an existing NSC lsof binary and you want one for a non-NSC system, you will have to build lsof yourself on the system where you want to use it. (That's always a good idea anyway.)

16.2.4 Why does UnixWare 7.1.1 or above lsof complain it can't

read the kernel name list?

If lsof complains:

    can't read kernel name list from <path>

It means that lsof can't find the booted kernel image file
at <path>. On NonStop Cluster (NSC) UnixWare 7.1.1 or
higher systems lsof determines the booted file path by
examining this file:

    /stand/`node_self`/boot

If examining
that file doesn't lead to an NSC path, lsof
uses:

    /stand/1/unix

On non-NSC systems lsof expects the booted kernel image to
be in /stand/unix.

If your booted kernel image is in a different place, use
lsof's "-k <path>" option to specify its path.

16.2.5 Why doesn't lsof report link count, node number, and size
for some UnixWare 7.1.1 or above CFS files?

Lsof reports link count, node number, and size for open
CFS files as recorded in their kernel node structure's
cached attributes. Sometimes not all attributes are cached
on the node where lsof runs, so lsof cannot report them.

16.2.6 Why doesn't lsof report open files on all UnixWare 7.1.1
NonStop Cluster (NSC) nodes?

Lsof can only report on files open on the node on which it
runs, because the information lsof reports comes from the
private kernel memory of the node. This may mean that
asking lsof to find a specific open file, or use of a
specific Internet address or port, may not report all open
instances
on nodes other than the one used to run lsof.

You can use the NSC onnode(1) command to run lsof on specific
nodes, or the onall(1) command to run lsof on all nodes --
e.g.,

```
   $ onall lsof [options] 2>&1 | less
 or
   $ onnode node-number lsof [options] 2>&1 | less
```

Note that, when lsof is run all nodes, the path name component assembly results it reports in its NAME column may vary, because the dynamic name cache from which lsof gets the components is private to the kernel of each node.

Also note the use of shell redirection in the examples to merge the standard error file information from onnode and onall with lsof's standard output file output. That will put the onnode and onall node announcements in proper sequence with lsof's output.

16.2.7 Why doesn't lsof report the UnixWare 7.1.1 NonStop Cluster (NSC) node a process is using?

To induce lsof to report the node on which a process runs would be a significant, non-standard modification to lsof. It
has much wider implications than merely the printing of a number in an output column. I'm not currently (April 2001) prepared to undertake such a modification.

If you want node-specific NSC information about open files, run lsof under the control of onall(1) or onnode(1).

```
   $ onall lsof [options] 2>&1 | less
 or
   $ onnode node-number lsof [options] 2>&1 | less
```

16.2.8 Why does the compiler complain about missing UnixWare 2.1[.x] header files?

SCO|Caldera didn't ship the following header files with UnixWare 2.1 through 2.1.3:

```
   <fs/proc/prdata.h>
   <fs/procfs/prdata.h>
   <sys/fs/fifonode.h>
   <sys/fs/namenode.h>
```

Lsof needs those header files for its compilation. Contact SCO|Caldera to get copies of those header files.

If you can't get the header files from SCO|Caldera, please contact me via e-mail at <abe@purdue.edu>. Make sure "lsof"

appears in the "Subject:" line so my e-mail filter won't
classify your letter as Spam.

17.0 Sun Problems

17.0.5 Statement of deprecation

Lsof support for SunOS 4.1.x was last tested at revision 4.51.
Contact me via e-mail at <abe@purdue.edu> if you're interested in
obtaining it. Make sure "lsof" appears in the "Subject:" line so
my e-mail filter won't classify your letter as Spam.

17.1 My Sun gcc-compiled lsof doesn't work -- why?

Gcc can be used to build lsof successfully. However, an
improperly installed Sun gcc compiler will usually not
produce a working lsof.

If your Sun gcc-compiled lsof doesn't report anything, or
reports ``can't read proc table,'' or gcc refuses to compile
lsof without error, check that the gcc step that "fixes"
Sun header files was run on the system where you're using
gcc to compile lsof. As an alternative, if you have the
SunPro C 5.0 compiler or later available, use it to compile
lsof -- e.g., use the solariscc Configure abbreviations.

17.2 How can I make lsof compile with gcc under Solaris 2.[456], 2.5.1, 7, 8 or 9?

Presuming your gcc-specific
header files are wrong for
Solaris, edit the lsof Configure-generated Makefile and
lib/Makefile and make this change:

```
 CFGF=   -Dsolaris=20400 ...
to
 CFGF=   -Dsolaris=20400 -D__STDC__=0 -I/usr/include ...
```

or change:

```
 CFGF=   -Dsolaris=20500 ...
to
 CFGF=   -Dsolaris=20500 -D__STDC__=0 -I/usr/include ...
```

or change:

CFGF= -Dsolaris=20501 ...
to
CFGF= -Dsolaris=20501 -D__STDC__=0 -I/usr/include ...

This is only a temporary work-around. You really should instruct gcc to to update your gcc-specific header files or install a recent gcc (e.g., 3.2), which has no need for private copies of Solaris include files.

17.3 Why does Solaris Sun C complain about system header files?

You're probably trying to use /usr/ucb/cc if you get compiler complaints like:

```
cc -O -Dsun -Dsolaris=20300 ...
"/usr/include/sys/machsig.h", line 81: macro BUS_OBJERR
redefines previous macro at "/usr/ucbinclude/sys/signal.h",
line 444
```

Note the reference to "/usr/ucbinclude/sys/signal.h". It reveals that the BSD Compatibility Package C compiler is in use. Lsof requires the ANSI C version of the Solaris C compiler, usually found in /usr/opt/bin/cc or /opt/SUNWspro/bin/cc.

Try adding a CC string to the lsof Makefile that points to the Sun ANSI C version of the Sun C compiler -- e.g.,

```
CC= /usr/opt/bin/cc
```
or
```
CC= /opt/SUNWspro/bin/cc.
```

17.4 Why doesn't lsof work under my Solaris 2.4 system?

If lsof doesn't work under your Solaris 2.4 system -- e.g., it produces no output, little output, or the output is missing command names or file descriptors -- you may have a pair of conflicting Sun patches installed.

Solaris patch 101945-32 installs a kernel that was built with a <sys/auxv.h> header file whose NUM_*_VECTORS definitions don't match the ones in the <sys/auxv.h> updated by Solaris patch 102303-02.

NUM_*_VECTORS in the kernel of patch 101945-32 are smaller than the ones in the <sys/auxv.h> of patch 102303-02.

The
consequence is that when lsof is compiled with the <sys/auxv.h>
whose NUM_*_VECTORS definitions are larger than the ones
used to compile the patched kernel, lsof's user structure
does not align with the one that the kernel employs.

If you have these two patches installed, contact Sun and
complain about the mis-match.

You may be able to work around the problem by editing
/usr/include/sys/auxv.h to have the following NUM_*_VECTORS
definitions:

```
#define NUM_GEN_VECTORS 4
#define NUM_SUN_VECTORS 8
```

The Configure script issues a prominent WARNING that you should
try the work-around.

I thank Leif Hedstrom for identifying the offending patches.

17.5 Where are the Solaris header files?

If you try to compile lsof under Solaris and get a compiler
complaint that it can't find system header files, perhaps
you forgot to add the header file package, SUNWhea.

17.6 Where is the Solaris /usr/src/uts/<architecture>/sys/machparam.h?

When you try to Configure lsof for
Solaris 2.[23456], 2.5.1,
and 7 -- e.g., on a `uname -m` == sun4m system -- Configure
complains:

```
  grep: /usr/src/uts/sun4m/sys/machparam.h:
No such file or directory
  grep: /usr/src/uts/sun4m/sys/machparam.h:
No such file or directory
```

And when you try to compile the configured lsof, cc or gcc
complains:

```
  dproc.c:530: `KERNELBASE' undeclared (first use this function)
```

The explanation is that somehow your Solaris system doesn't
have the header files in /usr/src/uts it should have. Perhaps
someone removed the directory to save space. Perhaps you're
using a gcc installation, copied from another system. In any

event, you will have to load the header files from the SUNWhea
package of your Solaris distribution.

KERNELBASE is an important symbol to lsof -- it keeps lsof
from sending an illegal kernel value to kvm_read() where
a segmentation violation might result (a bug in the kvm
library). Lsof can get illegal kernel values because it
reads kernel values
slowly with kvm_read() calls that the
kernel is changing rapidly.

Lsof doesn't need KERNELBASE at Solaris 2.5 and above,
because it has a KERNELBASE value whose address lsof can
find with /dev/ksyms and whose value it can read with
kvm_read(). Under Solaris 2.5 /usr/src/uts has moved to
/usr/platform.

17.7 Why does Solaris lsof say ``can't read proc table''?

When lsof collects data on processes, using the kvm_*()
functions to scan the kernel's proc structure table, it
checks to make sure it has identified a reasonable number
of them -- a minimum of three. When lsof can't identify
three processes during a scan, it repeats the scan.

When five scans fail to yield three processes, lsof issues
the fatal message:

lsof: can't read proc table

and exits.

Usually lsof fails to identify three processes during a
scan because its idea of the form of the proc structure
differs from that being used by the kernel. Since the proc
structure is defined in <sys/proc.h>
and other /usr/include
header files, the root cause of a proc structure discrepancy
usually can be found in the composition of /usr/include.

One common way that /usr/include header files can be
incorrect is that gcc was used to compile lsof, gcc used
its special (i.e., "fixed") header files instead of the
ones in /usr/include, and the special gcc header files
weren't updated when Solaris was. Answers to these questions:

My Sun gcc-compiled lsof doesn't work -- why?

How can I make lsof compile with gcc under Solaris 2.[456], 2.5.1, 7, 8 or 9?

Why does Solaris Sun C complain about system header files?

discuss the gcc header file problem and offer suggestions on how to fix it or work around it.

It may also be that you are trying to run a version of lsof that was compiled on an older version of Solaris. For example, an lsof executable, compiled for Solaris 2.4, will produce the ``can't read proc table'' message if you try to run it under Solaris 2.5.
If you have compiled lsof under Solaris 2.5 and it still won't work, see if the header files in /usr/include have been updated to 2.5, or still represent a previous version of Solaris.

Another source of header file discrepancies to consider is the Solaris patch level and whether a binary kernel patch was not matched with a corresponding header file update. See the "Why doesn't lsof work under my Solaris 2.4 system?" question for an example of one in Solaris 2.4 -- there may be other such patch conflicts I don't know about.

17.8 Why does Solaris lsof complain about a bad cached clone device?

When lsof revisions below 4.04 have been run on a Solaris system and have been allowed to create a device cache file, the running of revisions 4.04 and above on the same systems may produce this complaint:

lsof: bad cached clone device: ...
lsof: WARNING: created device cache file: ...

This is the result of a change in the device cache file that took place at lsof revision 4.04. The change introduced a node number into the clone device lines of the device cache file and was done in such a way that lsof could detect device cache files whose clone lines don't have node numbers (lines created by previous lsof revisions) and recognize the need to regenerate the device cache file.

17.9 Why doesn't Solaris make generate .o files?

Solaris /usr/ccs/bin/make won't generate .o files from .c files if /usr/share/lib/make/make.rules is missing. It

may be found in and installed from the SUNWsport package.

17.10 Why does lsof report some Solaris 2.3 and 2.4 lock types as `N'?

For Solaris 2.3 with patch P101318 installed at level 45
or above, and for all versions of Solaris 2.4, NFS locks
are represented by a NFS-specific kernel lock structure
that sometimes lacks a read or write lock type indicator.
When lsof encounters such a lock structure, it reports the
lock type as `N'.

17.11 Why does lsof Configure say "WARNING: no cc in ..."?

When
lsof's Configure script is executed with the solariscc
abbreviation it tries to make sure it's using the Sun C
compiler and not the UCB substitute from /usr/ucb/cc.
Thus, it looks for cc in the "standard" Sun compiler
location, /opt/SUNWspro/bin.

If Configure can't find cc there, it issues the warning:

```
lsof: WARNING: no cc in /opt/SUNWspro/bin;
using cc without path.
```

and uses cc for the compiler name, letting the shell find
cc with its PATH environment variable.

You can tell Configure where to find your cc with the
SOLARIS_CCDIR cross-configuration environment variable.
(See 00XCONFIG for more information on SOLARIS_CCDIR).
For example, use this Configure shell command:

```
SOLARIS_CCDIR=/usr/special/bin Configure -n solariscc
```

(SOLARIS_CCDIR should be the full path to the directory
containing your cc.)

17.12 Solaris 7, 8 and 9 Problems

17.12.1 Why does lsof say the compiler isn't adequate for Solaris 7, 8 or 9?

Solaris 7, 8 and 9 kernels come in two
flavors, 32 and 64
bit. 64 bit kernels run on machines that support the SPARC
v9 instruction set architecture. Separate executables for
some programs, -- e.g., ones using libkvm like lsof -- must

be built for 32 and 64 bit kernels.

Previous Sun (e.g., SC4.0) and earlier gcc compilers will
build lsof for 32 bit kernels, but they won't build it for
64 bit kernels. Compilers that will build lsof for 64 bit
Solaris 7, 8 and 9 kernels are the Sun WorkShop Compilers
C 5.0 and above, and recent gcc versions, e.g., 3.2.

When given the ``-xarch=v9" flag, the C 5.0 compiler and
above, and associated loader and 64 bit libraries will
build a 64 bit lsof executable; when given the "-m64" or
"-mcpu=v9" (deprecated) flags, an appropriate gcc compiler
will build a 64 bit lsof executable.

When the lsof Configure script detects a 64 bit kernel is
in use (e.g., by executing `/bin/isainfo -kv`), and when
it finds that the specified compiler is inappropriate,
it complains with these
messages:

For gcc:

```
   "!!!WARNING!!!=========!!!WARNING!!!=========!!!WARNING!!!"
   "!                                           !"
   "! LSOF NEEDS TO BE CONFIGURED FOR A 64 BIT KERNEL, BUT  !"
   "! THIS GCC DOESN'T SUPPORT THE BUILDING OF 64 BIT       !"
   "! SOLARIS EXECUTABLES.  LSOF WILL BE CONFIGURED FOR A   !"
   "! 32 BIT echo KERNEL.                                   !"
   "!                                           !"
   "!!!WARNING!!!=========!!!WARNING!!!=========!!!WARNING!!!"
```

For Sun C:

```
  !!!WARNING!!!==========!!!WARNING!!!==========!!!WARNING!!!
  !                                          !
  ! LSOF NEEDS TO BE CONFIGURED FOR A 64 BIT KERNEL, BUT    |
  ! THE VERSION OF SUN C AVAILABLE DOESN'T SUPPORT THE      !
  ! -xarch=v9 FLAG.  LSOF WILL BE CONFIGURED FOR A 32 BIT   !
  ! KERNEL.                                      !
  !                                          !

 !!!WARNING!!!==========!!!WARNING!!!==========!!!WARNING!!!
```

17.12.2 Why does Solaris 7, 8 or 9 lsof say "FATAL: lsof was compiled
for..."?

Solaris 7, 8 or 9 lsof may say:

lsof: FATAL: lsof was compiled for a xx bit kernel,
but this machine has booted a yy bit kernel.

Where: xx = 32 or 64
yy = 64 or 32

(xx and yy won't match.)

This message indicates that lsof was compiled for one size kernel and is being asked to execute on a different size one. That's not possible for programs like lsof that use libkvm.

Depending on the instruction sets for which you need Solaris 7, 8 or 9 lsof, you may need two or more versions of lsof, compiled for each kernel size, installed for use with /usr/lib/isaexec. See the "How do I install lsof for Solaris 7, 8 or 9?" section of this document for more information on that.

17.12.3 How do I build lsof for a 64 bit Solaris kernel under a 32 bit Solaris kernel?

If your Solaris system has an appropriate compiler (e.g.,
WorkShop Compilers C 5.0 and above, or a recent gcc like 3.2) and the 64 bit libraries have been installed, you can force lsof's Configure script to build a 64 bit version of lsof with:

$ SOLARIS_KERNBITS=64 Configure -n solariscc

The SOLARIS_KERNBITS environment variable is part of the lsof cross-configuration support, described in the 00XCONFIG file of the lsof distribution.

17.12.4 How do I install lsof for Solaris 7, 8 or 9?

If you are installing lsof where it will be used only under the bit size kernel for which it was built, no special installation is required.

If, however, you are installing different versions of lsof for different bit sizes -- e.g., for use on a 64 bit NFS server and from its 32 bit clients -- you should read the man page for isaexec(3C) and install lsof according to its instructions.

The executable at the directory where lsof is to be found
should be a hard link to /usr/lib/isaexec or a copy of it.
In the directory there
must be instruction architecture
subdirectories -- e.g., .../sparc/ and .../sparcv9/. The
lsof for 64 bit size kernels is installed in the .../sparcv9/
subdirectory; the one for 32 bit size kernels, in .../sparc/.

For example, if you're installing 32 and 64 bit lsof
executables in /usr/local/etc, you would:

```
 # cd /usr/local/etc
 # ln /usr/lib/isaexec lsof
 # mkdir sparc sparcv9
 # install the 32 bit lsof as sparc/lsof
 # install the 64 bit lsof as sparcv9/lsof
 # chmod, chown, and chgrp sparc/lsof and
   sparcv9/lsof appropriately
```

Lsof permissions and ownerships are the same whether one
or more lsof executables are being installed, with or
without the /usr/lib/isaexec hard link.

17.12.5 Why does my Solaris 7, 8 or 9 system say it cannot execute
lsof?

When you attempt to execute lsof, your Solaris 7, 8 or 9
shell may complain:

```
    ksh: ./lsof: cannot execute
```

If the lsof executable exists and has the proper execution
permissions, this error may be the result
of trying to
execute an lsof, built for a 64 bit kernel, on a 32 bit
kernel.

This will tell you about the lsof executable:

```
    $ file lsof
    lsof: ELF 64-bit MSB executable SPARCV9 Version 1,
   dynamically linked, not stripped
```

The "64-bit" notation indicates the binary was built for
a 64 bit kernel. To see the running kernel bit size, use
this command:

```
    $ isainfo -kv
```

32-bit sparc kernel modules

The "32-bit" notation indicates a 32 bit kernel has been booted.

The only work-around is to obtain, or Configure and make, an lsof for the appropriate kernel bit size. If you Configure and make lsof on the kernel where you wish to run it the proper compiler, the lsof Configure step will generate Makefiles that can be used with make to build an appropriate lsof executable.

To compile a 64 bit lsof, you must have an appropriate compiler -- i.e., Sun WorkShop Compilers C 5.0 or higher or a recent gcc like 3.2.

17.12.6 What gcc will produce 64 bit Solaris 7, 8 and 9 executables?
8 and 9 executables?

Properly built and installed recent gcc versions -- e.g., 3.2 -- will build lsof for 64 bit Solaris kernels.

If you update your gcc version to 3.2 or later, make sure the private gcc header files become current -- i.e., clear out any private header files from a previous gcc or Solaris installation before installing the new ones, or build to a new --prefix root and replace the old root with it after the build and installation are complete.

17.12.7 Why does lsof on my Solaris 7, 8 or 9 system say, "can't read namelist from /dev/ksyms?"

You're probably trying to use an lsof executable built for an earlier Solaris release on a 64 bit Solaris 7, 8 or 9 kernel. The output from `lsof -v` will tell you the build environment of your lsof executable. You should also have gotten a warning message that lsof is compiled for a different Solaris version than the one under which it is running -- something like this:

lsof: WARNING:
compiled for Solaris release X; this is Y

You need to build lsof on the system where you want to use it. For 64 bit Solaris 7, 8 and 9 you need a compiler that can generate 64 bit Solaris executables -- e.g., the Sun Workshop 5 C compiler or later, or a recent gcc version

like 3.2. See the "Why does lsof say the compiler isn't adequate for Solaris 7, 8 or 9?" section and the ones following it for a discussion of building lsof for 64 bit Solaris 7, 8 or 9.

17.13 Solaris and COMMON

17.13.1 What does COMMON mean in the NAME column for a Solaris VCHR file?

When lsof puts COMMON or (COMMON) in the NAME column of a Solaris VCHR file, it means that the file is handled by the special file system functions of the kernel through a common vnode.

17.13.2 Why does a COMMON Solaris VCHR file sometimes seem to have an incorrect minor device number?

When lsof reports on an open file in a Solaris special file system that uses a COMMON vnode, and the file is a VCHR file, lsof tries to locate the associated device node by looking for matches on the major and minor device numbers first.

If no major and minor match results, lsof then looks for a match on pseudo and clone device files. (See /devices/pseudo.) Those device nodes are matched specially by either their major or minor device numbers, but not both. Hence, when lsof finds a match under those special conditions, it may report a value in its output DEVICE column that differs from one of the major and minor numbers of the device node.

Here's an example from a sun4m Solaris 7 system:

```
$ ls -li /devices/pseudo/pm@0:pm
151261 crw-rw-rw-   1 root     sys      117,  0 ...
$ lsof /devices/pseudo/pm@0:pm
COMMAND ... DEVICE ...   NODE NAME
powerd       117,1 ... 151261 /devices/pseudo/pm@0:pm (COMMON)
Xsun    ...  117,0 ... 151261 /devices/pseudo/pm@0:pm
```

Note that the DEVICE value for the file with (COMMON) in its name field has a different minor device number (1) from what ls reports (0), while the DEVICE value for the file without (COMMON) matches the ls output exactly. Both match on the major device number, 117. The minor device number

mis-match is a result of the way the Solaris kernel handles special file system common vnodes, and it's the reason lsof puts (COMMON) after the name to signal that a mis-match is possible.

17.14 Why don't lsof and Solaris pfiles reports always match?

/usr/proc/bin/pfiles for Solaris 2.6, 7, 8, and 9 also reports information on open files for processes. Sometimes the information it reports differs from what lsof reports.

There are several reasons why this might be true. First, because pfiles is a Sun product, based on Sun kernel features, its developers have a better chance of knowing exactly how open file information is organized. I sometimes have to guess at how kernel file structure linkages are constructed by gleaning hints from header files.

Second, lsof is aimed at providing information, specifically
device and node numbers, that can be used to identify named file system objects -- i.e., path names. Thus, lsof tries to make sure its device and node numbers match those reported by stat(2). Pfiles doesn't always report numbers that match stat(2) -- e.g., for files using clone and pseudo devices via common vnodes like the nlist() /dev/ksyms usage.

Here's the Solaris 7 COMMON VCHR example again with additional pfiles output:

```
$ ls -li /devices/pseudo/pm@0:pm
151261 crw-rw-rw-   1 root     sys      117,  0 ...
$ lsof /devices/pseudo/pm@0:pm
vic1: 10 = lsof /dev/pm
COMMAND ... DEVICE ...   NODE NAME
powerd  ...  117,1 ... 151261 /devices/pseudo/pm@0:pm (COMMON)
Xsun    ...  117,0 ... 151261 /devices/pseudo/pm@0:pm
$ pfiles ...
0: S_IFCHR ... dev:32,24 ino:61945 ... rdev:117,1
...
14: S_IFCHR ... dev:32,24 ino:151261 ... rdev:117,0
```

Note that the NODE number, reported by lsof, matches what ls(1) and
stat(2) report, while the ino value pfiles reports doesn't. Lsof also indicates with the (COMMON) notation that the DEVICE number is a pseudo one, derived from the character device's value. The lsof DEVICE value matches

the pfiles rdev value, correct behavior for a character device, but pfiles gives no sign that it's not possible to find that character device number in /devices with ls(1) or stat(2).

17.15 Why does lsof say, "kvm_open(namelist=default, core=default): Permission denied?"

Lsof needs permission to read from the /dev/kmem and /dev/mem memory devices. Access to them is opened via a call to the kvm_open() library function and it reports the indicated message.

You must give lsof permission to read the memory devices. The super user can almost always do that, but other lsof users can do it if some group -- e.g., sys -- has permission to read the memory devices, and the lsof binary is installed with the group's ownership and with the setgid permission bit
enabled.

17.16 Why is lsof slow on my busy Solaris UFS file system?

Lsof may be slow on a busy Solaris UFS file system when UFS logging has been enabled with the "logging" mount option. That option can significantly increase disk operations under certain conditions -- e.g., when a lot of files are accessed quickly.

When only the "logging" option is specified to mount, all file accesses (atime updates) are logged to the UFS logging queue. Each atime update requires two writes to the disk to complete it.

If you want to do UFS logging -- and there are reliability advantages to it -- consider using the "logging,noatime" mount options instead. That will shift atime updates from the logging queue to fewer and independent asynchronous operations, consequently making the UFS logging queue a smaller bottleneck.

Consult mount_ufs(1M) for more information on the logging and noatime options.

(My thanks to Casper Dik for this tip on improving the performance of UFS logging.)

17.17 Why

is lsof so slow on my Solaris 8 or 9 system?

Solaris 8 has a post-release feature upgrade modifying kernel name cache (DNLC) handling that can slow lsof throughput dramatically. The feature, sometimes called negative DNLC caching, is standard in Solaris 9.

As best I can tell, when you install the Solaris 8 MU1 package, you get negative DNLC caching. If this pipe produces any output, your system has negative DNLC caching.

```
$ nm /dev/ksyms | grep negative_cache_vnode
```

The reason negative DNLC caching perturbs lsof is that a single vnode address (found in the negative_cache_vnode kernel variable) is used to mark entries in the DNLC that are not (the negative part) found on disk.

Since a single vnode address (the DNLC key lsof uses) can represent many (I've seen upwards of 30,000.) DNLC entries, their presence overloads lsof's internal DNLC hashing function. An overloaded hash function is a slow hash function, and lsof's slows to a crawl when it encounters
thousands of keys that produce the same value when the lsof DNLC hash function is applied to them.

The solution is simple -- ignore negative DNLC cache keys. They don't represent path name components lsof can use. Lsof revisions 4.50 and above have an addition that ignores them and the performance of those lsof revisions improves significantly when presented with negative DNLC cache keys.

If you don't have an lsof revision at 4.51 or later, there's a work-around. Use lsof's ``-C'' option. It disables lsof's DNLC caching. Of course, that also inhibits the reporting of any path name components from the kernel DNLC. When ``-c'' is used, lsof will continue to report file system and character device paths.

17.18 Solaris and VxFS

17.18.1 Why doesn't lsof support VxFS 3.4 on Solaris 2.6, and above?

Lsof will not support VxFS version 3.4 on Solaris 2.6 and above unless some files from VxFS Update 2 have been installed. VxFS 3.4 FCS and VxFS 3.4 update 1 lack

the header files lsof
normally uses to obtain information from the VxFS 3.4 kernel
node structure, vx_inode. VxFS 3.4 Update 2 provides a method
whereby lsof can obtain the necessary vx_inode information from
the vxfsu_get_ioffsets() function in Veritas utility
libraries.

The utility libraries (32 bit and 64 bit versions) may be
found in /opt/VRTSvxfs/lib. An ancillary header file may
be found in /opt/VRTSvxfs/include/sys/fs/vx_libutil.h.
Documentation of the vxfsu_get_ioffsets(3) function may be
found in /opt/VRTS/man/man3/vxfsu_get_ioffsets.3.

Those files of VxFS 3.4 Update 2 may be downloaded from:

ftp://ftp.veritas.com/pub/support/vxfs_34.i64243.tar

The vxfs_34.i64243.tar archive will unpack into an i64243
directory containing these files:

```
$ ls i64243
README
libvxfsutil.sol26.sums
libvxfsutil.sol26.tar.Z
libvxfsutil.sol27.sums
libvxfsutil.sol27.tar.Z
libvxfsutil.sol28.sums
libvxfsutil.sol28.tar.Z
```

Read README. Select
the *.tar.Z file appropriate for your
Solaris version. Its contents will unpack into /opt/VRTS
and /opt/VRTSvxfs, so you will need sufficient permission
-- e.g., do it as root -- to unpack the uncompressed archive.
Once you've done that, it's a good idea to compare the
checksums of the archive you unpacked with the ones recorded
in the appropriate *.sums file. Use `sum -r` to verify
the checksums.

For example, if you want the Solaris 8 version, uncompress
and unpack libvxfsutil.sol28.tar.Z -- e.g.,

```
$ su
...
# cd i6423
# zcat libvxfsutil.sol28.tar.Z | tar xf -
```

That should create these new files and subdirectories with

the indicated checksums:

File or subdirectory sum -r

/opt/VRTSvxfs/include/vxfsutil.h 03938
/opt/VRTSvxfs/lib/libvxfsutil.a 51794
/opt/VRTSvxfs/lib/sparcv9/
/opt/VRTSvxfs/lib/sparcv9/libvxfsutil.a 07420
/opt/VRTS/man/man3/
/opt/VRTS/man/man3/vxfsu_get_ioffsets.3 62480

Once these files are
in place, run lsof's Configure script
for the solaris or solariscc abbreviation. Configure will
locate the appropriate VxFS 3.4 Update 2 files and set up
for the making of an lsof that will properly display open
VxFS 3.4 file information.

17.18.2 Why does lsof report "vx_inode: vxfsu_get_ioffsets error"
for open Solaris 2.6 and above VxFS 3.4 and above files?

Even when lsof supports VxFS 3.4 and above on Solaris 2.6 and
above, it may report "vx_inode: vxfsu_get_ioffsets error" in
the NAME column for all VxFS files.

The usual cause is that lsof doesn't have permission to
read the file at the end of the /dev/vxportal symbolic
link. If, for example, lsof has been installed setgid(sys),
then the /dev/vxportal symbolic link destination should be
owned by the sys group and readable by it.

Update 2 for VxFS 3.4 sets the modes of the /dev/vxportal
symbolic link destination to 0640 and the group ownership
to sys. But I have had a report that the modes are wrong
in a VxFS
4.0 installation.

Another cause may be that the system has more than one version
of VxFS installed (Only one can be active.), and lsof's
Configure script did not choose the header files and libraries
for the active VxFS version. Configure opts for VxFS 4.0 and
above header files and libraries (in /opt/VRTS) in preference
to those for VxFS below 4.0 (in /opt/VRTSvxfs).

Look for the directories /opt/VRTS and /opt/VRTSvxfs. If you
have /opt/VRTS, make sure its header and library symbolic links
point to those of the active VxFS version.

If you have both directories, look at the CFLAGS that Configure constructed for making lsof and see which directory path follows a -I option. If that doesn't match the directory path of the active VxFS version, try pointing Configure at the correct directory with the SOLARIS_VXFSINCL environment variable -- e.g.,

```
$ SOLARIS_VXFSINCL=/opt/.../include ./Configure -n solaris
```

17.18.3 Why does Solaris Configure claim there is no VxFS library?

The lsof Configure script, when configuring for Solaris, may report:

```
FATAL: no VxFS .../libvxfsutil.a
```

That fatal error message indicates lsof has found the VxFS utility library's header files, but can't find the library itself in the expected location adjacent to the header files.

One possible cause is an incorrect symbolic link from /opt/VRTS/lib/sparcv9/libvxfsutil.a to the library's real location. (Some VxFS distributions declared the link incorrectly.) Use `ls -lL` on that path to see if it exists. If it doesn't exist, the link may be missing an additional leading "../" component.

If the problem is a missing "../" from the library's link, you can correct the link or check with Veritas/Symantec for the patch that corrects it.

If the problem is not a missing "../", and you know the libvxfsutil.a location, you can define its path in the SOLARIS_VXFSLIB environment variable before running the lsof Configure script. (See 00XCONFIG for information about using the SOLARIS_VXFSLIB environment variable.)

If you have no libvxfsutil.a, you must obtain it from Veritas/Symantec or find it in your VxFS installation package.

17.18.4 Why doesn't Solaris lsof report VxFS path name components?

Solaris lsof will report path name components for VxFS versions that use the common Solaris Dynamic Name Lookup Cache (DNLC) or on some file systems of VxFS versions that support the VxFS Reverse Name Lookup (RNL) facility.

VxFS versions 3.3 (approximately) and below use the common Solaris DNLC. (I haven't been able to determine exactly when VxFS stopped using the DNLC.) For versions above that boundary, but below 4.0, lsof can't report path name components.

At VxFS 4.0 and above, lsof can be compiled to use the VxFS RNL facility for reporting path names. If "-DHASVXFSRNL" appears in the compiler flags section of lsof "-v" option output, then the lsof Configure script detected the VxFS RNL facility and lsof has been compiled
to use it.

Lsof's use of the RNL facility can fail when the VxFS file system disk layout version is below 6. In that case, lsof can report no path name components. For more information, see the vxfs_inotopath(3) manual page. any of the following commands will show the disk layout version for a VxFS file system, when supplied the block device or mount point on which the file system is mounted.

```
   fstyp -v <block_device>
 or
   mkfs -m <block_device>
 or
   vxupgrade <mount_point>
```

You must have permission to read the block device -- e.g., be the root user.

You may also be able to upgrade an older disk layout to one that will work with the RNL. See the vxupgrade(1M) man page for more information on that.

When lsof can't report VxFS path name components, it reports the file system mount point and the path name of device on which it is mounted. The device path name is enclosed in parentheses.

17.18.5 Why does Solaris 10 lsof report scrambled VxFS paths?

Solaris
10 lsof may report a bogus, scrambled path for an open VxFS file, when lsof obtains the path from a vnode's cached path. Veritas/Symantec reports that their Solaris 10 implementation has bugs in the way it handles the Solaris 10 vnode cached path and those bugs will be fixed in an upcoming patch some time after August 15, 2005.

When Solaris 10 lsof reports a path for an open VxFs file obtained via the VxFS Reverse Name Lookup facility, the path will be correct.

Also see the answers to the questions "Why does Solaris 10 lsof sometimes report the wrong path name?" and "Why doesn't Solaris lsof report VxFS path name components?"

17.19 Large file problems

17.19.1 Why does lsof complain it can't stat(2) a Solaris 2.5.1 large file?

When given an argument that is the path to a Solaris 2.5.1 file, enable for large file operations with the O_LARGEFILE open(2) option, lsof complains that it can't stat(2) the file. That's because lsof isn't using a stat(2) call and associated
structure enabled for large files.

This error has been fixed, starting at lsof revision 4.58 for Solaris 2.6 and above. That fix won't work on Solaris 2.5.1 and I no longer have access to a Solaris 2.5.1 test system to develop a separate fix.

The work-around is to avoid specifying a O_LARGEFILE path as an argument to lsof on Solaris 2.5.1. Instead use a combination of lsof and grep to achieve the same results, albeit more clumsily.

17.20 Why does lsof get a segmentation fault on 64 bit Solaris 8 using NIS+?

I have received a report from Gary Craig that lsof produces a segmentation fault on his 64 bit Solaris 8 system using NIS+. Via an independent test program we have exonerated lsof and tracked the fault to the NIS+ __nis_server_name() function in the C name server library, -lnsl.

Lsof causes the __nis_server_name() NIS+ function to be called by calling getservent() to read entries of the port number to service name map.

The only Sun bug ID that
appears to describe the problem
is 4304244, although its text is unclear enough to leave room for doubt.

Until Sun eliminates the __nis_server_name() segmentation fault cause, a work-around for lsof is to use its "-P" option, causing lsof to avoid port to service name lookups.

17.21 Will lsof crash the Solaris kernel?

I've received and investigated one report that it has when the Sun hardware (a QME interface) was faulty. Today (May 23, 2002) I've learned that Sun has reports of kernel crashes caused by adb, lsof, and mdb.

The Sun investigation pinpointed a problem in the /dev/kmem kernel driver and there is a Sun bug report, 4344513, about the problem. There is a fix in Solaris 9, and patches for Solaris 7 and 8 (SPARC and x86).

To see if your Solaris system is fixed, look for a /devices/pseudo/*allkmem node.

Extensive address filtering was added to lsof revision 4.50 to forestall what I then (July 2001) believed to be only the possibility that lsof might crash Solaris. However, the filtering isn't perfect, since a filtered address might become invalid after lsof has filtered it but before lsof has delivered it to /dev/kmem. That filtering work is described in .../dialects/sun/solaris_kaddr_filters, also available at:

ftp://lsof.itap.purdue.edu/pub/tools/unix/lsof/solaris_kaddr_filters

The best and safest work-around is to upgrade to Solaris 9 or install an appropriate patch or its equivalent from this list:

Solaris Version	SPARC Patch	x86 Patch
7	106541-20	106542-20
8	108528-14	108529-14

17.22 Why does lsof on Solaris 7, 8, or 9 report a kvm_open() failure?

When lsof is started on some Solaris 7, 8, and 9 systems it may report:

```
lsof: kvm_open(namelist=default, corefile=default): \
No such file or directory
```

Lsof revisions 4.65 and later will first report:

```
lsof: cannot stat /dev/allkmem
```

The second message, not delivered in lsof revisions below 4.65,
explains the cause of the kvm_open() failure; it
can't find /dev/allkmem.

/dev/allkmem is a device added to Solaris 7 and 8 in patches and in the Solaris 9 FCS. See the preceding "Will lsof crash the Solaris kernel?" section for more information on /dev/allkmem and the patches.

The kvm_open(3KVM) function in the KVM library of patched Solaris 7 and 8 systems and in Solaris 9 expects to find /dev/allkmem and exits on error when it does not.

If you have installed the patch that updated your KVM library to a version that expects /dev/allkmem to be present and it is not, you may need to reconfigure your system's devices with devfsadm(1M) or enter "boot -r" to the OpenBoot monitor's prompt (usually "ok").

17.23 Solaris and SAM-FS

17.23.1 Why does Solaris lsof report "(limited SAM-FS info)"?

Lsof 4.68 and above report "(limited SAM-FS info)" on Solaris in the NAME column after the path or file system name for all files it finds on SAM-FS file systems.

That's because
no more information is known about the
composition of the nodes that follow SAM-FS vnodes. If you can provide that information, please contact me via e-mail at <abe@purdue.edu>. Make sure "lsof" appears in the "Subject:" line so my e-mail filter won't classify your letter as Spam.

17.23.2 Why can't lsof locate named SAM-GS files?

Solaris lsof 4.68 and above can't locate files on SAM-FS file systems when the files are named as lsof arguments because lsof doesn't know how to locate open SAM-FS file

device and node number information. (See also 'Why does Solaris lsof report "(limited SAM-FS info)?')

17.24 Lsof and Solaris 10 zones

17.24.1 How can I make lsof list the Solaris zone?

Use the lsof "-z [z]" option.

17.24.2 Why doesn't lsof work in a Solaris 10 zone?

When run from within a Solaris 10 zone, lsof will usually report:

```
lsof: can't stat(/devices): No such file or directory
```

That's because a Solaris zone usually has no /devices subdirectory, a restriction
of the zone implementation intended
to limit the ability of zone processes to control global system resources, including physical devices.

While a zone may have a /dev subdirectory, that subdirectory usually lacks the /dev/allkmem, /dev/mem and /dev/kmem devices lsof and the KVM library it uses require.

The work-around is to run lsof in the global zone. When it is run in a global zone lsof will be able to report on processes running in any zone, including the global zone.

17.24.3 Why does lsof complain it can't stat() Solaris 10 zone file systems?

When run from the global zone on Solaris 10 lsof may complain:

```
lsof: WARNING: can't stat() 15 zone file systems;
 using dev= options
```

The warning message means lsof found the reported number of file system entries in the mount table for which it didn't have permission to get stat(2) results, but which had "zone=" and "dev=" mount table options.

That is a normal restriction of Solaris 10 zones. Since
the
lsof warning message indicates it was able to find "dev=" options for the file systems, lsof will probably work
correctly.

One work-around is to relax the restrictions on zone mount points, so that lsof can stat() them. While that may be possible by changing directory modes or group ownerships, it is probably not a good idea, because it weakens the restrictions zones are intended to provide.

Another work-around is to suppress the warning message with lsof's "-w" option. The down side of that is that it causes the suppression of all warning messages, leading to the possibility that some non-stat() warning messages will be suppressed.

17.25 Solaris 10 problems

17.25.1 Why does Solaris 10 lsof sometimes report the wrong path name?

When a path name component is renamed -- e.g., with mv(1) -- Solaris 10 lsof may report the old component for an open file that used the component in its path before the rename. That's because Solaris 10 lsof reports the path name cached in the
open file's vnode and the Solaris 10 kernel doesn't update the open vnode's cached path name when a component of it is changed.

When an open file is deleted -- e.g., with rm(1) -- the path name by which it was opened remains cached in the vnode. Lsof can be instructed to display that path name with the -X option. The path name might be incorrect because of the rename problem described above. See the answer to the 'What does "(deleted)" mean in the NAME column of a Solaris 10 open file?' question for more information.

Lsof is sometimes able to detect that cached path name is incorrect. In that case lsof may report only the mounted-on directory and device of the file system or it may report that the path name is of questionable accuracy by appending a trailing "(?)" to it in the NAME column.

See the answer to the "Why does Solaris 10 lsof sometimes report only the mounted-on directory and device?" and 'What does "(?)" mean in the NAME column of a Solaris 10 open file?'
questions for more information.

17.25.2 Why does Solaris 10 lsof sometimes report only the mounted-on directory and device?

For some regular open files lsof may report only the mounted-on directory and device of the file system on which the file resides. That's because lsof was able to determine that the path name cached in the open file's vnode is incorrect.

Lsof detects the cached path name is incorrect by applying stat(2) to it, provided that no error was detected when stat(2) was applied to the file system mounted-on directory during lsof setup. If a mounted-on directory stat(2) error was detected during setup, lsof does no cached path name analysis and simply reports it.

When the application of stat(2) to the cached path name returns a no-entry reply (the ENOENT error number), lsof concludes the path no longer exists (i.e., has been unlinked) and reports the mounted-on directory and device of the file system. That behavior can be modified with
the -X option in lsof revisions
4.77 and above. See the answer to the 'What does "(deleted)" mean in the NAME column of a Solaris 10 open file?' for more information.

When the application of stat(2) to the cached path name returns a permission error reply (the EACCES or EPERM error numbers), lsof reports the cached path name and adds a trailing "(?)" to indicate the reported path name is of questionable accuracy. See the answer to the question 'What does "(?)" mean in the NAME column of a Solaris 10 open file?' for more information.

If the application of stat(2) to the cached path name yields any other error reply, lsof reports the mounted-on directory and device of the file system.

When the application of stat(2) to the cached path name succeeds, lsof compares the reported device and node numbers to what it has obtained for the open file from kernel structures. If they match, lsof reports the cached path name. If they don't match, lsof instead reports the mounted-on
directory and
device of the file system.

A work-around that allows lsof to apply stat(2) successfully to cached path names is to give lsof sufficient permission to do it -- i.e., run lsof as the root user.

17.25.3 What does "(deleted)" mean in the NAME column of a Solaris 10 open file?

When the -X option is specified to Solaris 10 lsof, it will report in its NAME column the path name cached for a deleted file in its vnode. The path name will be followed by "(deleted)".

Note that the path name cached in a file's vnode is the path name by which the file was opened. It is not updated by the Solaris kernel when any path name component is changed. Hence, it may not represent the final path name the open file had.

See the answer to the "Why does Solaris 10 lsof sometimes report the wrong path name?" question for more information on how changing a path name component affects the correctness of a what lsof reports.

17.25.4 What does "(?)" mean in the NAME column of a Solaris 10 open file?

When lsof encounters a path name cached in the open file's vnode that stat(2) reports lsof lacks permission to access, lsof adds "(?)" to the path name reported in the NAME column to indicate the path name is of questionable accuracy.

See the answers to the "Why does Solaris 10 lsof sometimes report the wrong path name?" and "Why does Solaris 10 lsof sometimes report only the mounted-on directory and device?" questions for more information on why lsof may report a path name of questionable accuracy.

A work-around that allows lsof to apply stat(2) successfully to cached path names is to give lsof sufficient permission to do it -- i.e., run lsof as the root user.

17.26 Solaris contract file problems

17.26.1 Why doesn't lsof report size, link count and node number for Solaris 10 contract files?

Lsof doesn't report size, link count or node number for Solaris 10 contract files because I don't know how to obtain them from contract file kernel structures.

17.26.2 Why can't lsof locate a Solaris 10 contract file by path name?

Because lsof can't find the node number of Solaris contract files, it can't match the device and node numbers it gets from

applying stat(2) to the contract file path name with what it finds in kernel data.

17.27 Solaris 10 ZFS probblems

17.27.1 Why does Configure ask for the location of ZFS header files?

To provide ZFS support when lsof is compiled it needs to have access to the definitions of ZFS structures used by the kernel. Those definitions are contained in header files that Sun does not distribute with Solaris 10.

When the Configure script detects the system might support ZFS by finding the <sys/fs/zfs.h> header file, it checks for the required ZFS kernel structure definition header files. When they are not found, it asks if ZFS support should be included and if so, with what definitions.

Two sources can be declared for definitions: 1) lsof's internal ones; or 2) the necessary header files at some location other than /usr/include/sys.

The necessary header files are:

```
dmu.h  zfs_acl.h      zfs_debug.h  zfs_rlock.h   zil.h
spa.h  zfs_context.h  zfs_dir.h    zfs_vfsops.h  zio.h
txg.h  zfs_ctldir.h   zfs_ioctl.h  zfs_znode.h   zio_impl.h
```

The necessary header files might have been obtained, for example, from the http://src.opensolaris.org Open Solaris source site. However, the Open Solaris header files might not be adequate -- see the answer to the "Why don't the Open Solaris ZFS header files provide correct ZFS kernel structure definitions?' question for information on why the Open Solaris ZFS header files might not provide correct ZFS kernel structure definitions.

The supplied header file path must point to a directory that contains a sys/ subdirectory where the matching header files are located -- e.g., if the supplied path is /tmp/zfs, then /tmp/zfs/sys must contain the necessary header files.

See the answer to the "Why do -h and -v output warn about possibly inaccurate ZFS kernel structure definitions?" question for information on the risks associated with using lsof's internal definitions.

17.27.2 Why do -h and -v output warn about possibly inaccurate ZFS kernel structure definitions?

When lsof is configured to use its internal ZFS kernel structure definitions, there is the chance that the definitions may be out of date. Hence, an lsof built with them may report incorrect device numbers, file sizes, node numbers and link counts.

Please contact me via e-mail at <abe@purdue.edu> for work-around suggestions. Make sure "lsof" appears in the "Subject:" line so my e-mail filter won't classify your letter as Spam.

17.27.3 Why don't the Open Solaris ZFS header files provide correct ZFS kernel structure definitions?

The Open Solaris ZFS header files may not provide correct ZFS kernel definitions. An lsof built with them may report incorrect device numbers, file sizes, node numbers and link counts.

The definitions may be incorrect because the Open Solaris header files are not synchronized with any particular Solaris 10 release. Consequently they might contain modifications to the structures not in the structure definitions used to build the running kernel. It may be that only Sun has header files that match the kernel structures of the running Solaris 10 kernel.

Please contact me via e-mail at <abe@purdue.edu> for work-around suggestions. Make sure "lsof" appears in the "Subject:" line so my e-mail filter won't classify your letter as Spam.

17.28 Problems with Solaris 9 and above

17.28.1 Why does the compiler complain about lgrp_root on Solaris 9 and above?

When compiling lsof 4.84 on later Solaris 9 and 10 systems, the compiler may report the following error:

```
/usr/include/sys/lgrp.h", line ...: identifier redeclared: lgrp_root
```

This error results from a conflict between usage of lgrp_root in both <sys/lgrp.h> and <sys/lgrp_user.h> when

_KMEMUSER or
_KERNEL is #define'd before <sys/lgrp.h> is #include'd. This problem is noted in Sunsolve bug ID 5064229.

The work-around is to use lsof revision 4.85 sources.

18.0 Lsof Features

18.1 Why doesn't lsof doesn't report on /proc entries on my system?

/proc file system support is generally available only for BSD, SYSV R4 dialects, and Tru64 UNIX (Digital UNIX, DEC OSF/1). It's also available for Linux, and Pyramid DC/OSx and Reliant UNIX.

Even on some SYSV R4 dialects I encountered many problems while trying to incorporate /proc file system support. The chief problem is that some vendors don't distribute the header file that describes the /proc file system node -- usually called prdata.h.

18.2 How do I disable the device cache file feature or alter it's behavior?

To disable the device cache file feature for a dialect, remove the HASDCACHE definition from the machine.h file of the dialect's machine.h header file. You can also use HASDCACHE to change the default prefix (``.lsof") of the device cache file.

Be sure you consider disabling the device cache file feature carefully. Having a device cache file significantly reduces lsof startup overhead by eliminating a full scan of /dev (or /devices) once the device cache file has been created. That full scan also overloads the kernel's name cache with the names of the /dev (or /devices) nodes, reducing the opportunity for lsof to find path name components of open files.

If you're worried about the presence of mode 0600 device cache files in the home directories of the real user IDs that execute lsof, consider these checks that lsof makes on the file before using it:

1. To read the device cache file, lsof must gain

permission from access(2).

2. The device cache file's modes must be 0600 (0644 if lsof is reading a system-wide device cache file) and its size non-zero.

3. There must be a correctly formatted section count line at the beginning
of the file.

4. Each section must have a header line with a count that properly numbers the lines in the section. Legal sections are device, clone, pseudo-device, and CRC.

5. The lines of a section must have the proper format.

6. All lines are included in a 16 bit CRC, and it is recorded in a non-checksummed section line at the end of the file.

7. The checksum computed when the file is read must match the checksum recorded when the file was written.

8. The checksum section line must be followed by end-of-information.

9. Lsof must be able to get matching results from stat(2) on a randomly chosen entry of the device section.

For more information on the device cache file, read the 00DCACHE file of the lsof distribution.

18.2.1 What's the risk with a perverted device cache file?

Even with the checks that lsof makes on the device cache file, it's conceivable that an intruder could modify it so it would pass lsof's
tests.

The only serious consequence I know of this change is the removal of a file whose major device number identifies a socket from some user ID's device cache file. When such a device has been removed from the device cache file, and when lsof doesn't detect the removal, lsof may not be able to identify socket files when executed by the affected user

ID. Only certain dialects are at risk to this attack --
e.g., SCO OpenServer and Solaris 2.x, 7, 8, and 9.

If you're tracking a network intruder with lsof, that could
be important to you. If you suspect that someone has
corrupted the device cache file you're using, I recommend
you use lsof's -Di option to tell it to ignore it and use
the contents of /dev (or /devices) instead; or remove the
device cache file (usually .lsof_hostname, where hostname
is the first component of the host's name returned by
gethostname(2)) from the user ID's home directory and let
lsof create a new one for you.

18.2.2 How do I put the full host name in a personal device cache file path?

Lsof constructs the personal device cache file path name
from a format specified in the HASPERSDC #define in the
dialect's machine.h header file. As distributed HASPERSDC
declares the path to be ``.lsof_'' plus the first component
of the host name with the format ``.lsof_%L''.

If you want to change the way lsof constructs the personal
device cache file path name, you can change the HASPERSDC
#define and recompile lsof. If, for example, you #define
HASPERSDC to be ``.lsof_%l'' (note the lower case `l'),
Configure and remake lsof, then the personal device cache
file path will be ``.lsof_'' plus the host name returned
by gethostname(2).

See the 00DCACHE file of the lsof distribution for more
information on the formation of the personal device cache
file path and the use of the HASPERSDC #define.

18.2.3 How do I put the personal device cache file in /tmp?

Change the HASPERSDC definition in your dialect's machine.h
header
file.

When you redefine HASPERSDC, make sure you put at least
one user identification conversion in it to keep separate
the device cache files for each user of lsof. Also give
some thought to including the ``%0'' conversion to define
an alternate path for setuid-root and root processes.

Here's a definition that puts a personal device cache file

in /tmp with the name ``.lsof_login_hostname_pers".

```
#define HASPERSDC "/tmp/.lsof_%u_%l_pers"
```

Thus the /tmp personal device cache file path for login
"abe" on host "lsof.itap.purdue.edu" would be:

```
/tmp/.lsof_abe_lsof.itap.purdue.edu_pers
```

You can add the User ID (UID) with the "%U" conversion and
the first host name component with the ``%L" conversion.

CAUTION: be careful using absolute paths like /tmp lest
lsof processes that are setuid-root or whose real UID is
root be used to exploit some security weakness via /tmp.
Elect instead to add an alternate path for those processes
with the ``%0" conversion.
Here's an extension of the
previous HASPERSDC format for /tmp that declares an alternate
path:

```
#define HASPERSDC "/tmp/.lsof_%u_%l_pers%0%h/.lsof_%L"
```

When the lsof process is setuid-root or its real UID is
root, presuming root's home directory is `/' and the host's
name is ``lsof.itap.purdue.edu", the extended format yields:

```
/.lsof_vic
```

18.3 Why doesn't lsof know about AFS files on my favorite dialect?

Lsof currently supports AFS for these dialects:

```
AIX 4.1.4 (AFS 3.4a)
Linux 1.2.13 (AFS 3.3)
NEXTSTEP 3.2 (AFS 3.3)
Solaris 2.[56] (AFS 3.4a)
```

It may recognize AFS files on other versions of these
dialects, but I have no way to test that. Lsof may report
correct information for AFS files on other dialects, but
I can't test that either.

AFS support must be custom crafted for each UNIX dialect
and then tested. If lsof supports your favorite dialect,
but doesn't recognize its AFS files, probably I don't have
access to a test system. If

you want AFS support badly
for your dialect, consider helping me do the development
and testing.

18.3.1 Why doesn't lsof report node numbers for all AFS volume files,
or how do I reveal dynamic module addresses to lsof?

When AFS is implemented via dynamic kernel modules -- e.g.,
in NEXTSTEP -- lsof can't obtain the addresses of AFS
variables in the kernel that it uses to identify AFS vnodes.
It can guess that a vnode is assigned to an AFS file and
it can obtain other information about AFS files, but it
has trouble computing AFS volume node numbers.

To determine node numbers for AFS volumes other than the
root volume, /afs, lsof needs access to a hashed volume
structure pointer table. When it can't find the address
of that table, because AFS support is implemented via
dynamic kernel modules, lsof will return blanks in the
INODE column for AFS volume files. Lsof can identify the
root volume's node number (0), and can compute the node
numbers for all other AFS files.

If
you have a name list file that contains the addresses
of the AFS dynamic modules -- e.g., you saved module symbols
when you created a loadable module kernel with modload(8)
by specifying -sym -- lsof may be able to find the kernel
addresses it needs in that file.

Lsof looks up AFS dynamic kernel addresses for these dialects
at these default paths:

NEXTSTEP 3.2 /usr/vice/etc/afs_loadable

A different path to a name list file with AFS dynamic kernel
addresses may be specified with the -A option, when the -A
option description appears in lsof's -h or -? (help) output.

If any addresses appear in the -A name list file that also
appear in the regular kernel name list file -- e.g., /vmunix
-- they must match, or lsof will silently ignore the -A
addresses on the presumption that they are out of date.

Found in path(s):
* /lsof-4-85-zip/00FAQ
No license file was found, but licenses were detected in source scan.

```
/*
* Copyright 2005 Purdue Research Foundation, West Lafayette, Indiana
* 47907.  All rights reserved.
*
* Written by Victor A. Abell
*
* This software is not subject to any license of the American Telephone
* and Telegraph Company or the Regents of the University of California.
*
* Permission is granted to anyone to use this software for any purpose on
* any computer system, and to alter it and redistribute it freely, subject
* to the following restrictions:
*
* 1. Neither the authors nor Purdue University are responsible for any
*    consequences of the use of this software.
*
* 2. The origin of this software must not be misrepresented, either by
*    explicit claim or by omission.  Credit to the authors and Purdue
*    University must appear in documentation and sources.
*
* 3. Altered versions must be plainly marked as such, and must not be
*    misrepresented as being the original software.
 *
* 4. This notice may not be removed or altered.
*/
```

Found in path(s):
* /lsof-4-85-zip/dialects/darwin/kmem/dfile.c
No license file was found, but licenses were detected in source scan.

```
/*
* Copyright 2003 Purdue Research Foundation, West Lafayette, Indiana
* 47907.  All rights reserved.
*
* Written by Victor A. Abell
*
* This software is not subject to any license of the American Telephone
* and Telegraph Company or the Regents of the University of California.
*
* Permission is granted to anyone to use this software for any purpose on
* any computer system, and to alter it and redistribute it freely, subject
* to the following restrictions:
*
* 1. Neither the authors nor Purdue University are responsible for any
*    consequences of the use of this software.
*
* 2. The origin of this software must not be misrepresented, either by
*    explicit claim or by omission.  Credit to the authors and Purdue
```

* University must appear in documentation and sources.
*
* 3. Altered versions must be plainly marked as such, and must not be
* misrepresented as being the original software.
 *
* 4. This notice may not be removed or altered.
*/

Found in path(s):
* /lsof-4-85-zip/dialects/aix/dnode2.c
No license file was found, but licenses were detected in source scan.

Making and Installing lsof 4

****
| The latest release of lsof is always available via anonymous ftp |
| from lsof.itap.purdue.edu. Look in pub/tools/unix/lsof. |
****

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  AIX
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Auspex LFS (no longer maintained)

BSDI BSD/OS
DEC OSF/1, Digital UNIX, Tru64 UNIX
FreeBSD
HP-UX
IPv6
Linux
NetBSD
NEXTSTEP and OPENSTEP
OpenBSD
Pyramid DC/OSx and Reliant UNIX (no longer available)
Caldera OpenUNIX
SCO OpenServer
SCO|Caldera UnixWare
Solaris 2.x, 7, 8, 9 and 10
Ultrix (no longer available)
Veritas VxFS and VxVM
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Installing Lsof
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Cross-configuring Lsof
Environment Variables Affecting the Configure Script

==========
Pre-built Lsof Binaries
==========

Avoid using pre-built lsof binaries if you can; build your own instead.

I do not support lsof binaries built and packaged by third parties nor lsof binaries built from anything but the latest lsof revision. (See the Bug Reports section for more information on the details of lsof support.)

One important reasone for those support restrictions is that when lsof is built its Configure script tunes lsof to the features available on the building system, often embodied in supporting header files and libraries. If the building system doesn't have support for a particular feature, lsof won't be built to support the feature on any system.

The Veritas VxFS file system is a good example of a feature that
requires build-time support.

UNIX dialect version differences -- Solaris 8 versus 9, AIX 4.3.3
vesus 5.2, etc. -- can also render a pre-built lsof binary useless
on a different version. So can kernel bit size.

There are so many potential pitfalls to using an lsof binary
improperly that I strongly recommend lsof be used only where it is
built.

==========
Making Lsof
==========

$ cd <lsof source directory>
$ ./Configure <your dialect's abbreviation>
$ make

(Consult the 00FAQ and 00XCONFIG files of the lsof distribution
for information about
using make command invocations and environment
variables to override lsof default Makefile strings.)

This lsof distribution can be used with many UNIX dialects. However,
it must be configured specifically for each dialect. Configuration
is done in three ways: 1) by changing definitions in the machine.h
header file of the UNIX dialect of interest; 2) by defining
environment variable values prior to calling Configure (see the
00XCONFIG file, the Environment Variabls and Environment Variables
Affecting the Configure Script sections of this file); and 3) by
running the Configure shell script found in the top level of the
distribution directory.

You may not need to change any machine.h definitions, but you might
want to look at them anyway. Pay particular attention to the
definitions that are discussed in the Security section of this
file. Please read that section.

The Configure script calls three other scripts in the lsof
distribution: AFSConfig; Inventory; and Customize. The
AFSConfig
script is called for selected dialects (AIX, HP-UX, NEXTSTEP, and
Solaris) to locate AFS header files and determine the AFS version.
See The AFSConfig Script section of this file for more information.

The Inventory script checks the completeness of the lsof distribution.
Configure calls Inventory after it has accepted the dialect
abbreviation, but before it configures the top-level directory for
the dialect. See The Inventory Script section of this file for
more information.

Configure calls the Customize script after it has configured the
top-level lsof directory for the declared dialect. Customize helps
you modify some of the important compile-time definitions of
machine.h. See the The Customize Script section.

You should also think about where you will install lsof and its
man page, and whom you will let execute lsof. Please read the
Installing Lsof section of this file for information on installation
considerations.

Once you have inspected the machine.h file for the
 dialect for
which you want to build lsof, and made any changes you need, run
the Configure script, supplying it with the abbreviation for the
dialect. (See the following table.) Configure selects the
appropriate options for the dialect and runs the Mksrc shell script
in the dialect sub-directory to construct the appropriate source
files in the top-level distribution directory.

Configure may also run the MkKernOpts script in the dialect
sub-directory to propagate kernel build options to the dialect
Makefile. This is done for only a few dialects -- e.g., DC/OSx,
and Reliant UNIX.

Configure creates a dialect-specific Makefile. You may want to
inspect or edit this Makefile to make it conform to local conventions.
If you want the Makefile to install lsof and its man page, you will
have to create an appropriate install rule.

Lsof may be configured using UNIX dialect abbreviations from the
following table. Alternative abbreviations are indicated by a
separating `|'. For example, for
 SCO OpenServer you can use either
the ``osr'' or the ``sco'' abbreviation:

```
 $ Configure osr
   or
 $ Configure sco
```

Abbreviations UNIX Dialect
------------- ------------

aix IBM AIX 5.[23] and 5.3-ML1 using IBM's C Compiler
aixgcc IBM AIX 5.[12] and 5.3-ML1 using gcc
darwin Apple Darwin 7.x and 8.x for Power Macintosh systems
decosf DEC OSF/1, Digital UNIX, Tru64 UNIX 4.0 and 5.1
digital_unix Digital UNIX, DEC OSF/1, Tru64 UNIX 4.0 and 5.1
du Digital UNIX, DEC OSF/1, Tru64 UNIX 4.0 and 5.1
freebsd FreeBSD 4.x, 4.1x, 5.x and [67].x
hpux HP-UX 11.00, 11.11 and 11.23, using HP's C
Compiler, both /dev/kmem-based and PSTAT-based
hpuxgcc HP-UX 11.00, 11.11 and 11.23, using gcc, both
/dev/kmem-based and PSTAT-based
linux Linux 2.1.72 and above for x86-based systems
netbsd NetBSD 1.[456], 2.x and 3.x
next NEXTSTEP 3.[13]
nextstep NEXTSTEP 3.[13]
ns NEXTSTEP 3.[13]
nxt NEXTSTEP 3.[13]
openbsd OpenBSD
2.[89] and 3.[0-9]
openstep OPENSTEP 4.x
os OPENSTEP 4.x
osr SCO OpenServer Release 5.0.6, using the C compiler
from the SCO developer's kit
osrgcc SCO OpenServer Release 5.0.6, using gcc
osr6 SCO Openserver 6.0.0, using the SCO C compiler
sco SCO OpenServer Release 5.0.6, using the C compiler
from the SCO developer's kit
scogcc SCO OpenServer Release 5.0.6, using gcc
solaris Solaris 2.x, 7, 8, 9 and 10 using gcc
solariscc Solaris 2.x, 7, 8, 9 and 10 using Sun's cc
tru64 Tru64 UNIX, DEC OSF/1, Digital UNIX 4.0 and 5.1
unixware SCO|Caldera UnixWare 7.1.4
uw SCO|Caldera UnixWare 7.1.4

If you have an earlier version of a dialect not named in the above list, lsof may still work on your system. I have no way of testing that myself. Try configuring for the named dialect -- e.g., if you're using Solaris 2.1, try configuring for Solaris 2.5.1.

After you have configured lsof for your UNIX dialect and have selected options
via the Customize script (See the The Customize
Script section.) , use the make command to build lsof -- e.g.,

$ make

Other Configure Script Options

==========

There are three other useful options to the Configure script besides
the dialect abbreviation:

-clean may be specified to remove all traces of
a dialect configuration, including the
Makefile, symbolic links, and library files.

-h may be specified to obtain a list of
-help Configure options, including dialect
abbreviations.

-n may be specified to stop the Configure
script from calling the Customize and
Inventory scripts.

Caution: -n also suppresses the AFSConfig
step.

Environment Variables
==========

Lsof configuration, building, and execution may be affected by
environment variable settings. See the Definitions That Affect
Compilation section in the 00PORTING file, the General Environment
Variables section in the 00XCONFIG
file, the Dialect-Specific
Environment Variables section in the 00XCONFIG file, and the
Environment Variables Affecting the Configure Script section of
this file for more information.

Note in the General Environment Variables section of the 00XCONFIG
file that there are five environment variables that can be used to
pre-define values in lsof's -v output: LSOF_BLDCMT, LSOF_HOST,
LSOF_LOGNAME, LSOF_SYSINFO, and LSOF_USER.

Security
========

If the symbol HASSECURITY is defined, a security mode is enabled,
and lsof will allow only the root user to list all open files.
Non-root users may list only open files whose processes have the
same user ID as the real user ID of the lsof process (the one that
its user logged on with).

However, if HASNOSOCKSECURITY is also defined, anyone may list anyone else's open socket files, provided their listing is enabled with the "-i" option.

Lsof is distributed with the security mode disabled -- HASSECURITY is not defined. (When HASSECURITY is not defined, the definition of HASNOSOCKSECURITY has no meaning.) You can enable the security mode by defining HASSECURITY in the Makefile or in the machine.h header file for the specific dialect you're using -- e.g. dialects/aix/machine.h.

The Customize script, run by Configure when it has finished its work, gives you the opportunity to define HASSECURITY and HASNOSOCKSECURITY. (See the The Customize Script section.)

The lsof -h output indicates the state HASSECURITY and HASNOSOCKSECURITY had when lsof was built, reporting:

"Only root can list all files;"
if HASSECURITY was defined and HASNOSOCKSECURITY wasn't defined;

"Only root can list all files, but anyone can list socket files."
if HASSECURITY and HASNOSOCKSECURITY were both defined;

"Anyone can list all files;"
if HASSECURITY wasn't defined. (The definition of HASNOSOCKSECURITY doesn't matter when HASSECURITY isn't defined.)

You should carefully consider the implications of using the default security mode.
When lsof is compiled in the absence of the HASSECURITY definition, anyone who can execute lsof may be able to see the presence of all open files. This may allow the lsof user to observe open files -- e.g., log files used to track intrusions -- whose presence you would rather not disclose.

All pre-compiled binaries on lsof.itap.purdue.edu and mirrored from it were constructed without the HASSECURITY definition.

As distributed, lsof writes a user-readable and user-writable device cache file in the home directory of the real user ID executing lsof. There are other options for constructing the device cache file path, and they each have security implications.

The 00DCACHE file in the lsof distribution discusses device cache file path construction in great detail. It tells how to disable the various device cache file path options, or how to disable the entire device cache file feature by removing the HASDCACHE definition from the dialect's machine.h file. There is also information on the device cache file feature in the 00FAQ file. (The 00DCACHE and 00FAQ files are part of the lsof distribution package.)

The Customize script, run by Configure after it has finished its work, gives you the opportunity to change the compile-time options related to the device cache file. (See The Customize Script section.)

Since lsof may need setgid or setuid-root permission (See the Setgid Lsof Dialects and Setuid-root Lsof Dialects sections.), its security should always be viewed with skepticism. Lest the setgid and setuid-root permissions allow lsof to read kernel name list or memory files, declared with the -k and -m options, that the lsof user can't normally access, lsof uses access(2) to establish its real user's authority to read such files when it can't surrender its power before opening them. This change was added at the suggestion of Tim Ramsey.

Lsof surrenders setgid permission on most dialects when it has gained access to the kernel's memory devices. There are exceptions to this rule, and some lsof implementations need to run setuid-root. (The Setgid Lsof Dialects and Setuid-root Lsof Dialects sections contains a list of lsof implementations and the permissions recommended in the distribution's Makefiles.)

The surrendering of setgid permission is controlled by the WILLDROPGID definition in the dialect machine.h header files.

In the end you must judge for yourself and your installation the risks that lsof presents and restrict access to it according to your circumstances and judgement.

Run-time Warnings

Lsof can issue warning messages when it runs -- e.g., about the state of the device cache file, about an inability to access an NFS file system, etc. Issuance of warnings are enabled by default in the lsof distribution.

Issuance or warnings may be disabled by default by defining
WARNINGSTATE in the dialect's machine.h. The Customize script may
also be used to change the default warning message issuance state.
(See The
Customize Script section.)

The ``-w'' option description of the ``-h'' option (help) output
will indicate the default warning issuance state. Whatever the
state may be, it can be reversed with ``-w''.

Device Access Warnings
======================

When lsof encounters a /dev (or /devices) directory, one of its
sub-directories, or one of their files that it cannot access with
opendir(3) or stat(2), it issues a warning message and continues.
Lsof will be more likely to issue such a warning when it has been
installed with setgid(<some group name>) permission; it won't have
trouble if it has been installed with setuid(root) permission or
is being run under the root login.

The lsof caller can inhibit or enable the warning with the -w
option, depending on the issuance state of run-time warnings. (See
the Run-time Warnings section.)

The warning messages do not appear when lsof obtains device
information from a device cache file that it has built and believes
to be current or when warning
message issuance is disabled by
default. (See the "Caches -- Name and Device" section for more
information on the device cache file.)

The lsof builder can inhibit the warning by disabling the definition
of WARNDEVACCESS in the dialect's machine.h or disable all warnings
by defining WARNINGSTATE. WARNDEVACCESS is defined by default for
most dialects. However, some dialects have some device directory
elements that are private -- e.g., HP-UX -- and it is more convenient
for the lsof user if warning messages about them are inhibited.

Output from lsof's -h option indicates the status of WARNDEVACCESS.
If it was defined when lsof was compiled, this message will appear:

  /dev warnings = enabled

If WARNDEVACCESS was not defined when lsof was compiled, this
message will appear instead:

/dev warnings = disabled

The Customize script, run by Configure after it has finished its
work, gives you the opportunity to change the WARNDEVACCESS
definition. (See The Customize Script section.)

NFS
Blocks
==========

Lsof is susceptible to NFS blocks when it tries to lstat() mounted
file systems and when it does further processing -- lstat() and
readlink() -- on its optional file and file system arguments.

Lsof tries to avoid being stopped completely by NFS blocks by doing
the lstat() and readlink() functions in a child process, which
returns the function response via a pipe. The lsof parent limits
the wait for data to arrive in the pipe with a SIGALRM, and, if
the alarm trips, terminates the child process with a SIGINT and a
SIGKILL.

This is as reliable and portable a method for breaking NFS deadlocks
as I have found, although it still fails under some combinations
of NFS version, UNIX dialect, and NFS file system mount options.
It generally succeeds when the "intr" or "soft" mount options are
used; it generally fails when the "hard" mount option is used.

When lsof cannot kill the child process, a second timeout causes
it to stop waiting for the killed child to complete.
While the
second timeout allows lsof to complete, it may leave behind a hung
child process. Unless warnings are inhibited by default or with
the -w option, lsof reports the possible hung child.

NFS block handling was updated with suggestions made by Andreas
Stolcke. Andreas suggested using the alternate device numbers that
appear in the mount tables of some dialects when it is not possible
to stat(2) the mount points.

The -b option was added to direct lsof to avoid the stat(2) and
readlink(2) calls that might block on NFS mount points and always
use the alternate device numbers. If warning message issuance is
enabled and you don't want warning messages about what lsof is
doing, use the -w option, too.

The -O option directs lsof to avoid doing the potentially blocking
operations in child processes. Instead, when -O is specified, lsof

does them directly. While this consumes far less system overhead, it can cause lsof to hang, so I advise you to use -O sparingly.

Caches
 -- Name and Device
==========

Robert Ehrlich suggested that lsof obtain path name components for open files from the kernel's name cache. Where possible, lsof dialect implementations do that. The -C option inhibits kernel name cache examination.

Since AFS apparently does not use the kernel's name cache, where lsof supports AFS it is unable to identify AFS files with path name components.

Robert also suggested that lsof cache the information it obtains via stat(2) for nodes in /dev (or /devices) to reduce subsequent running time. Lsof does that, too.

In the default distribution the device cache file is stored in .lsof_hostname, mode 0600, in the home directory of the login of the user ID that executes lsof. The suffix, hostname, is the first component of the host's name returned by gethostname(2). If lsof is executed by a user ID whose home directory is NFS-mounted from several hosts, the user ID's home directory may collect several device cache files, one for
 each host from which it was executed.

Lsof senses accidental or malicious damage to the device cache file with extensive integrity checks, including the use of a 16 bit CRC. It also tries to sense changes in /dev (or /devices) that indicate the device cache file is out of date.

There are other options for forming the device cache file path. Methods the lsof builder can use to control and employ them are documented in the separate 00DCACHE file of the lsof distribution.

Raw Sockets
==========

On many UNIX systems raw sockets use a separate network control block structure. Display of files for applications using raw sockets -- ping, using ICMP, for example -- need special support for displaying their information. This support is so dialect-specific and information to provide it so difficult to find that not all

dialect revisions of lsof handle raw sockets completely.

Other Compile-time Definitions

The machine.h and dlsof.h header files for each
dialect contains
definitions that affect the compilation of lsof. Check the
Definitions That Affect Compilation section of the 00PORTING file
of the lsof distribution for their descriptions. (Also see The
Customize Script section.)

The AFSConfig Script

Lsof supports AFS on some combinations of UNIX dialect and AFS
version. See the AFS section of this document for a list of
supported combinations.

When configuring for dialects where AFS is supported, the Configure
script calls the AFSConfig script to determine the location of AFS
header files and the AFS version. Configure will not call AFSConfig,
even for the selected dialects, unless the file /usr/vice/etc/ThisCell
exists.

The AFS header file location is recorded in the AFSHeaders file;
version, AFSVersion. Once these values have been recorded, Configure
can be told to skip the calling of AFSConfig by specifying its
(Configure's) -n option.

The Inventory Script

The lsof distribution
contains a script, called Inventory, that
checks the distribution for completeness. It uses the file 00MANIFEST
in the distribution as a reference point.

After the Configure script has accepted the dialect abbreviation,
it normally calls the Inventory script to make sure the distribution
is complete.

After Inventory has run, it creates the file ".ck00MAN" in the
top-level directory to record for itself the fact that the inventory
has been check. Should Inventory be called again, it senses this

file and asks the caller if another check is in order, or if the
check should be skipped.

The -n option may be supplied to Configure to make it bypass the
calling of the Inventory script. (The option also causes Configure
to avoid calling the Customize script.)

The lsof power user may want to define (touch) the file ".neverInv".
Configure avoids calling the Inventory script when ".neverInv"
exists.

The Customize Script
====================

Normally when the Configure script has finished
 its work, it calls
another shell script in the lsof distribution called Customize.
(You can tell Configure to bypass Customize with its -n option.)

Customize leads you through the specification of these important
compile-time definitions for the dialect's machine.h header file:

 HASDCACHE device cache file control
    HASENVDC device cache file environment
   variable name
    HASPERSDC personal device cache file path
   format
    HASPERSDCPATH name of environment variable that
   provides an additional component
   of the personal device cache file
   path
    HASSYSDC system-wide device cache file path
 HASKERNIDCK the build-time to run-time kernel
   identity check
 HASSECURITY the security option
 HASNOSOCKSECURITY the open socket listing option whe
   HASSECURITY is defined
 WARNDEVACCESS /dev (or /devices) warning message
   control
 WARNINGSTATE warning message issuance state

The Customize script accompanies its prompting for entry of new
values for these
 definitions with brief descriptions of each of
them. More information on these definitions may be found in this
file or in the 00DCACHE and 00FAQ files of the lsof distribution.

You don't need to run Customize after Configure. You can run it later or you can edit machine.h directly.

The -n option may be supplied to Configure to make it bypass the calling of the Customize script. (The option also causes Configure to avoid calling the Inventory script.)

The lsof power user may want to define (touch) the file ".neverCust". Configure avoids calling the Customize script when ".neverCust" exists.

Customize CAUTION: the Customize script works best when it is applied to a newly configured lsof source base -- i.e., the machine.h header file has not been previously modified by the Customize script. If you have previously configured lsof, and want to rerun the Customize script, I recommend you clean out the previous configuration and create a new one:

```
$ Configure -clean
$ Configure
<dialect_abbreviation>
...
Customize in response to the Customize script prompts.
```

Cautions
========

Lsof is a tool that is closely tied to the UNIX operating system version. It uses header files that describe kernel structures and reads kernel structures that typically change from OS version to OS version, and even within a version as vendor patches are applied.

DON'T TRY TO USE AN LSOF BINARY, COMPILED FOR ONE UNIX OS VERSION, ON ANOTHER. VENDOR PATCHES INFLUENCE THE VERSION IDENTITY.

On some UNIX dialects lsof versions may be even more restricted by architecture type.

The bottom line is use lsof where you built it. If you intend to use a common lsof binary on multiple systems, make sure all systems run exactly the same OS version and have exactly the same patches.

Warranty
========

Lsof is provided as-is without any warranty of any kind, either

expressed or implied, including, but not limited to, the implied warranties of merchantability and fitness for a particular purpose. The
entire risk as to the quality and performance of lsof is with you. Should lsof prove defective, you assume the cost of all necessary servicing, repair, or correction.

License
=======

Lsof has no license. Its use and distribution are subject to these terms and conditions, found in each lsof source file. (The copyright year in or format of the notice may vary slightly.)

```
/*
 * Copyright 2002 Purdue Research Foundation, West Lafayette,
 * Indiana 47907.  All rights reserved.
 *
 * Written by Victor A. Abell
 *
 * This software is not subject to any license of the American
 * Telephone and Telegraph Company or the Regents of the
 * University of California.
 *
 * Permission is granted to anyone to use this software for
 * any purpose on any computer system, and to alter it and
 * redistribute it freely, subject to the following
 * restrictions:
 *
 * 1. Neither the authors nor Purdue University are responsible
 *    for any consequences of the use of this software.
 *
 * 2. The origin of this software must not be misrepresented,
 *    either by explicit claim or by omission.  Credit to the
 *    authors and Purdue University must appear in documentation
 *    and sources.
 *
 * 3. Altered versions must be plainly marked as such, and must
 *    not be misrepresented as being the original software.
 *
 * 4. This notice may not be removed or altered.
 */
```

Bug Reports
===========

Now that the obligatory disclaimer is out of the way, let me hasten to add that I accept lsof bug reports and try hard to respond to them. I will also consider and discuss requests for new features, ports to new dialects, or ports to new OS versions.

PLEASE DON'T SEND BUG REPORTS ABOUT LSOF TO THE UNIX DIALECT OR DIALECT OPTION VENDOR.

At worst such bug reports will confuse the vendor; at best, the vendor will forward the bug report to me.

PLEASE DON'T SEND BUG REPORTS
ABOUT LSOF BINARIES BUILT OR DISTRIBUTED
BY SOMEONE ELSE, BECAUSE I CAN'T SUPPORT THEM.

I do support binaries I built, obtained ONLY from lsof.itap.purdue.edu. Before reporting a problem with a lsof.itap.purdue.edu binary, please verify the correctness of the signatures found in its associated CHECKSUMS file.

Before you send me a bug report, please do these things:

* Make sure you try the latest lsof revision.

  + Download the latest revision from:

  ftp://lsof.itap.purdue.edu/pub/tools/unix/lsof

  + Verify the signatures of what you have downloaded;

  + While connected to lsof.itap.purdue.edu, check for patches:

  ftp://lsof.itap.purdue.edu/pub/tools/unix/lsof/patches

  + If patches exist, install them in the latest revision you just downloaded. Then build the latest revision and see if it fixes your bug.

* If you're having trouble compiling lsof with gcc, try the UNIX dialect vendor's compiler. I don't have access to gcc on all test systems, so my support for it is hit-and-miss, and so is my ability to respond to gcc compilation problem reports.

* Check the lsof frequently asked questions file, 00FAQ, to see if there's a question and answer relevant to your problem.

* Make sure you're running the lsof you think you are by checking the path to it with which(1). When in doubt, use an absolute path to lsof. Make sure that lsof binary has sufficient permissions to do what you ask, including internal permissions given it (e.g., restrictions on what files lsof may report for whom) during its build.

When you send a bug report, make sure you include output from your running of lsof's Configure script. If you were able to compile a running lsof, please also include:

* Output from which(1) that shows the absolute path to the lsof binary in question;

* Output from running lsof with its -h and -v options at

lsof's absolute path;

* Output from "ls -l" directed to lsof's absolute path.

If you weren't able to compile a running lsof, please send me: the compiler error output; identification of the lsof revision you're using (contents of the lsof version.c file); identification of your system (full uname output or output from whatever other tool identifies the system); and compiler identification (e.g., gcc -v output).

Either set of output will help me understand how lsof was configured and what UNIX dialect and lsof revision is involved.

Please send all bug reports, requests, etc. to me via e-mail at <abe@purdue.edu>. Make sure "lsof" appears in the "Subject:" line so my e-mail filter won't classify your letter as Spam.

The 00FAQ File
==============

The lsof distribution contains an extensive frequently asked questions file on lsof features and problems. I recommend you consult it before sending me e-mail. Use your favorite editor or pager to search 00FAQ -- e.g., supplying
as a search argument some
fixed text from an lsof error message.

The lsof-l Mailing List
=======================

Information about lsof, including notices about the availability
of new revisions, may be found in mailings of the lsof-l listserv.
For more information about it, including instructions on how to
subscribe, read the 00LSOF-L file of the lsof distribution.

Field Output Example Scripts
==========

Example AWK and Perl 4 or 5 scripts for post-processing lsof field
output are locate in the scripts sub-directory of the lsof distribution.
The scripts sub-directory contains a 00README file with information
about the scripts.

Field Output C Library
==========

The lsof test suite (See "Testing Lsof."), checks basic lsof
operations using field output. The test suite has its own library
of C functions for common test program operations, including
processing of field output. The library or selections of its
functions could be adapted for use by C
programs that want to
process lsof field output. See the library in the file LTlib.c
in the tests/ sub-directory

Testing Lsof
==========

Lsof has an automated test suite in the tests/ sub-directory that
can be used to test some basic lsof features -- once lsof has been
configured and made. Tests are arranged in three groups: basic
tests that should run on all dialects; standard tests that should
run on all dialects; and optional tests that may not run on all
dialects or may need special resources to run. See 00TEST for more
information.)

CAUTION!!! Before you attempt to use the test suite make sure that
the lsof you want to test can access the necessary kernel resources
-- e.g., /dev/mem, /dev/kmem, /proc, etc. Usually you want to test
the lsof you just built, so this is an important check. (See
00TEST.)

To run the basic and standard tests, using the lsof in the parent
directory of tests/, do this:

```
$ cd tests
$ make test
  or $ make std
  or $ make standard
```

The basic
and standard tests may be run as silently as possible,
using the lsof in the parent directory of tests/, with:

```
$ cd tests
$ make auto
```

This is the "automatic" test mode, designed for use by scripts that
build lsof. The caller is expected to test the make exit code to
determine if the tests succeeded. The caller should divert standard
output and standard error to /dev/null to suppress make's error
exit message.

The optional tests may be run, using the lsof in the parent directory
of tests/, with:

```
$ cd tests
$ make opt
  or $ make optional
```

It's possible to excute individual tests, too. See the 00TEST file
of this distribution for more informaiton on the tests, what they
do, and how to run and possibly customize each test.

It's possible to run the tests, using an lsof other than the one
in the parent directory of /tests, too. See 00TEST for information
about using the LT_LSOF_PATH environment variable to do that.

==========
Dialect Notes
==========

AFS
===

Lsof
recognizes AFS files on the following combinations of UNIX
dialect and AFS versions:

AIX 4.1.4 (AFS 3.4a)
Linux 1.2.13 (AFS 3.3)

NEXTSTEP 3.2 (AFS 3.3) (untested on recent lsof revisions)
Solaris 2.6 (AFS 3.4a)
Ultrix 4.2 RISC (AFS 3.2b) (no longer available)

Lsof has not been tested under other combinations -- e.g. HP-UX 10.10 and AFS 3.4a -- and probably won't even compile there. Often when a UNIX dialect version or AFS version changes, the new header files come into conflict, causing compiler objections.

AIX
===

Specify the aix Configure abbreviation for AIX 4.1.[45], 4.2[.1], 4.3[.123], 5L, and 5.[123].

Specify aixgcc on AIX above 4.1 to use the gcc compiler. (Gcc can't be used to compile lsof on AIX 4.1 and below because of kernel structure alignment differences between it and xlc.) Gcc results sometimes depend on the version of the gcc compiler that is used.

Compilation of lsof with gcc on AIX 4.3[.123], 5L, and 5.[123] has been sparsely tested with varying degrees
of success: it has been reported
to succeed on AIX 4.3.3 and 32 bit Power AIX 5.1; to fail on ia64 AIX 5.1 and 64 bit Power AIX 5.1; and to succeed on 32 and 64 bit Power AIX 5.2. Lsof compilation with gcc hasn't been tested on AIX 5.3.

At revision 4.61 and above lsof is configured and built to match the bit size of the kernel of Power architecture AIX 5.1 systems. Lsof binaries built for 32 and 64 bit kernels are not interchangeable. See 00FAQ for more information.

The Configure script uses /usr/bin/oslevel to determine the AIX version for AIX less than 5 and ``uname -rv'' for AIX 5 and higher. If /usr/bin/oslevel isn't executable on AIX less than 5, the Configure script issues a warning message and uses ``uname -rv'' to determine the AIX version.

When Configure must use ``uname -rv'' on AIX less than 5 to determine the AIX version, the result will lack a correct third component -- e.g., the `4' of ``4.1.4''. If your AIX less than 5 system lacks lacks an executable oslevel,
I suggest you edit the Configure-produced
Makefile and complete the _AIXV definition in the CFGF string.

By default lsof avoids using the kernel's readx() function, causing it to be unable to report information on some text and library file

references. The ``-X" option allows the lsof user to ask for the
information readx() supplies.

Lsof avoids readx() to avoid the possibility of triggering a kernel
problem, known as the Stale Segment ID kernel bug. Kevin Ruderman
reported this bug to me. The bug shows up when the kernel's
dir_search() function hangs, hanging the application process that
called it so completely that the application process can neither
be killed nor stopped. The hang is the consequence of another
process (perhaps lsof) making legitimate use of the kernel's readx()
function to access the kernel memory that dir_search() is examining.
IBM has indicated they have no plans to fix the bug.

A fuller discussion of this bug may be found in the 00FAQ file of
the lsof distribution.
 There you will find a description of the
Stale Segment ID bug, the APAR on it, and a discussion of the
sequence of events that exposes it.

I added the ``-X" function so you can tell lsof to use readx(),
but if you use ``-X", you should be alert to its possibly serious
side effects. Although readx() is normally disabled, its state is
controlled with the HASXOPT, HASXOPT_ROOT, and HASXOPT_VALUE
definitions in dialects/aix/machine.h, and you can change its
default state by changing those definitions. You can also change
HASXOPT_ROOT via the Customize script.

You can also compile lsof with readx() use permanently enabled or
disabled -- see the comments about the definitions in the
dialects/aix/machine.h header file. You may want to permanently
disable lsof's use of readx() if you plan to make lsof publicly
executable. You can also restrict -X to processes whose real UID
is root by defining HASXOPT_ROOT.

I have never seen lsof cause the Stale Segment ID bug to occur and
haven't
 had a report that it has, but I believe there is a possibility
it could.

AFS support for AIX was added with help help from Bob Cook and Jan
Tax who provided test systems.

Henry Grebler and David J. Wilson helped with lsof for AIX 4.2.

Bill Pemberton provided an AIX 4.3 test system. Andrew Kephart
and Tom Weaver provided AIX 4.3 technical assistance. Niklas
Edmundsson did 4.3.1 testing. Doug Crabill provided an AIX 4.3.2
test system. Jeff W. Stewart provided an AIX 4.3.3 test system.

The SMT file type for AIX 4.1.[45], 4.2[.1], and 4.3[.12] is my
fabrication. See the 00FAQ file more information on it.

Loc Le and Nasser Momtaheni of IBM provided test systems for AIX 5L and
5.1. Lsof for AIX 5L and 5.1 needs setuid-root permission to process
the -X option on systems whose architecture type is ia64.

Dale Talcott of Purdue provided AIX 5.1 and 5.2 test systems. Dale and
John Jackson of Purdue provided an AIX 5.3 test system.

Apple Darwin
============

The Apple Darwin
 port was provided by Allan Nathanson for version
1.2. Allan also arranged for access to a test system for maintenance
and regression testing. Dale Talcott provided a test system, too.

Allan supplied patches for updates to 1.4, 5.x, 6.x, 7.x and 8.x.

BSDI BSD/OS
===========

As of lsof revision 4.77 support for BSDI BSD/OS has been
discontinued. Lsof revision 4.76 with BSDI BSD/OS support may be found
on lsof.itap.purdue.edu in pub/tools/unix/lsof/src.

DEC OSF/1, Digital UNIX, Tru64 UNIX
===================================

Robert Benites, Dean Brock, Angel Li, Dwight McKay, Berkley Shands,
Ron Young and Steve Wilson have kindly provided test systems.
Jeffrey Mogul has provided technical assistance. Dave Morrison
and Lawrence MacIntyre did Digital UNIX V3.2 testing.

Lsof supports the ADVFS/MSFS layered file system product. Lsof
can locate all the open files of an ADVFS/MSFS file system when
its path is specified, provided the file system is listed in
/etc/fstab with an ``advfs"
 type. (This /etc/fstab caveat applies
only to Digital UNIX 2.0.) At Digital UNIX 4.0 and Tru64 UNIX,
using code provided by David Brock, lsof 4.20 and above can locate
ADVFS file paths.

Testing of lsof on DEC OSF/1 and Digital UNIX 4.0 ended with lsof revision 4.74. Hence, the lsof documentation has dropped the claim that it works there. For a distribution of lsof 4.74 that was tested on DEC OSF/1 and Digital UNIX 4.0, check pub/tools/unix/lsof/OLD/src on the lsof ftp home, lsof.itap.purdue.edu.

Lsof revisions past 4.74 have only been tested on Tru64 UNIX 5.1.

FreeBSD
=======

Bill Bormann of Purdue University provided access to several FreeBSD test systems. Ade Barkah, John Clear, Ralph Forsythe, Michael Haro, Kurt Jaeger, and William McVey have also provided FreeBSD test systems.

The FreeBSD distribution header files are augmented by header files in the dialects/freebsd/include directory.

David O'Brien maintains the lsof FreeBSD port package.

HP-UX
=====

Lsof has
two HP-UX bases: /dev/kmem for HP-UX 11.0 and earlier;
and PSTAT for HP-UX 11.11 and later. The lsof Configure script will pick the appropriate base.

To use the CCITT x.25 socket support for HP-UX, you must have the x.25 header files in /etc/conf/x25

Pasi Kaara helped with the HP-UX port, especially with its CCITT x.25 socket support.

Richard Allen provided HP-UX 10.x and 11.x test systems, as did Mark Bixby, and Elias Halldor Agustsson. Marc Winkler helped test the 10.20 port. Richard J. Rauenzahn provided a 64 bit HP-UX 11 test system and an HP-UX 11.11 development system.

AFS support for HP-UX was added thanks to help from Chaskiel Moses Grundman, who provided a test system.

The /dev/kmem-based HP-UX 11.00 support is extremely fragile. It depends on privately developed kernel structure definitions. (See .../dialects/hpux/hpux11 for the header files making the definitions.)

Those header files and their definitions will not be updated by
HP-UX 11.00 patches, making it likely
 that any patch changing a
kernel structure critical to lsof will break lsof in some way.

It's possible to build a 64 bit lsof for 64 bit HP-UX 11.00 with
gcc, but you must have a gcc compiler capable of producing 64 bit
executables. See the 00FAQ file for more information.

The PSTAT-based lsof for HP-UX 11.11 and later is much more solid.
I am indebted to the vision of HP for providing an lsof kernel API
through the PSTAT implementation. Specifically I appreciate the
help of HP staff members Carl Davidson, Louis Huemiller, Rich
Rauenzahn, and Sailu Yallapragada that made PSTAT-based HP-UX lsof
possible.

IPv6
====

Lsof has IPv6 support that has been tested for these UNIX dialects:
AIX 4.3.x; Apple Darwin 5.[12] and 6.0; the INRIA and KAME FreeBSD IPv6
implementations; PSTAT-based HP-UX; /proc-based Linux; the INRIA and
KAME NetBSD implementations; and Solaris 8 and 9. Lsof has IPv6
support that hasn't been tested for: OpenBSD (KAME); OpenUNIX 8; Tru64
Unix 5.[01]; and UnixWare
 7.1.[34].

Please let me know if your UNIX dialect has IPv6 support and I'll
see if it can be supported by lsof.

Linux
=====

Tim Korb, Steve Logue, Joseph J. Nuspl Jr., and Jonathan Sergent
have provided Linux test systems.

Michael Shields helped add and test automatic handling of ELF/COFF
form names in /System.map, Marty Leisner and Keith Parks have helped
test many lsof revisions. Marty has provided valuable suggestions,
Linux hints, and code, too.

The 00FAQ file gives some Linux tips, including information on
coping with system map file problems.

To determine the state of the Linux 2.1.x C library lseek() function,
the lsof Configure script runs a test program that must have

permission to read /dev/kmem. The test determines if the lseek()
function properly handles kernel offsets, which appear to be negative
because their high order bit is set. If the lseek() test reveals
a faulty lseek(), Configure activates the use of a private lseek()
function for kernel offset positioning.
See the Linux problems
section of the 00FAQ file of the lsof distribution for more
information.

NetBSD
======

Greg Earle and Paul Kranenburg have assisted with the NetBSD ports.
Paul has provided test systems. Ray Phillips provided a NetBSA
Alpha test system. Andrew Brown also provided a test system.

The NetBSD dialect version of lsof is compiled using the dialect
sources it shares with OpenBSD in the n+obsd dialect sub-directory.

NEXTSTEP and OPENSTEP
=====================

Virtual memory header files that allow lsof to display text references
were derived from the contents of /usr/include/vm of NEXTSTEP 2.0.
NeXT did not ship the virtual memory header files with other NEXTSTEP
or OPENSTEP versions.

You may use the RC_FLAGS environment variable to declare compiler
options outside the Makefile. A common use of this variable is to
define the architecture types to be included in a "fat" executable.
See the comments in dialects/next/Makefile for an example.

OpenBSD
=======

David
Mazieres has provided OpenBSD test systems. The OpenBSD
dialect version of lsof is compiled using the dialect sources it
shares with NetBSD in the n+obsd dialect sub-directory.

Kenneth Stailey has provided OpenBSD testing and advice.

John Dzubera (Zube) reports, "lsof 4.33 compiles and runs on OpenBSD
2.3 for the pmax architecture (decstation 3100)."

I have not tested lsof on OpenBSD 3.8, but David Mazieres reports
revision 4.76 worked on OpenBSD 3.8.

Pyramid DC/OSx and Reliant UNIX
==========

As of lsof revision 4.52 support for all Pyramid dialects has been
discontinued. Lsof revision 4.51 with Pyramid support may be
obtained upon request. Send the request to abe@purdue.edu.

These two UNIX dialects are very similar and share dialect-specific
source files from the pyramid sub-directory.

The Reliant Unix Pyramid C compiler issues warning messages that
I haven't found a convenient way to suppress. You can ignore
warning messages about casts
 and conversions that lose bits. The
message "warning: undefining __STDC__" is intentionally caused by
the lsof MkKernOpts configuration script to suppress warning messages
about cast and conversion problems in standard system header files,
such as <stdio.h> and <string.h>.

Bruce Beare and Kevin Smith provided test systems.

Caldera OpenUNIX
==========

Larry Rosenman provided an OpenUNIX 8 test system. Matthew Thurmaier
provided technical assistance, along with these people from Caldera:
Jack Craig, Robert Lipe, and Bela Lubkin.

Robert Lipe supplied changes to lsof for OpenUNIX 8.0.1. Those
changes were also incorporated in UnixWare 7.1.3 when it became
the release name for OpenUNIX 8.0.1.

Support for lsof on OpenUNIX ended at lsof revision 4.74. The last
lsof revision, 4.74, tested on OpenUNIX, may be found at the lsof
"home" ftp site, lsof.itap.purdue.edu, in pub/tools/unix/lsof/OLD/src.

SCO OpenServer
==========

Dion Johnson, Bela Lubkin, and Nathan Peterson of
 SCO gave me copies
of SCO OpenServer and the SCO OpenServer Development System 3.0

and provided technical advice for the lsof port.

Hugh Dickins, Bela Lubkin, Craig B. Olofson, and Nathan Peterson
provided version 5.0 and gave technical advice for porting lsof to
it. Bela provided the 5.0.4 changes. D. Chris Daniels provided
a 5.0.4 test system, Lee Penn provided one for 5.0.5, and John
Dubois for 5.0.6.

The <netdb.h> header file was accidentally omitted from some SCO
OpenServer Development System releases. The Configure script will
sense its absence and substitute an equivalent from the BSD
distribution. The BSD <netdb.h> and the <sys/cdefs.h> header file
it includes are located in the dialects/os/include sub-directory
tree.

To compile lsof from its distribution sources you must have the
TCP/IP and NSF headers in /usr/include. While those are optional
OpenServer packages, I have access to no system that doesn't have
them, so I'm unable to build lsof for such a configuration.
However,
it should be possible to modify the lsof Configure script and
sources so lsof would compile and work without those optional
packages.

If you have an OpenServer system configured without the TCP/IP and
NFS packages, and want to tackle the job of building lsof for it,
contact me via e-mail at <abe@purdue.edu>. I'll identify the
Configure script, header file, and source file changes you will
need to make. (Caution: this is not a simple task, or I would have
already done it.)

The optional osrgcc and scogcc Configure abbreviations construct
Makefiles for compiling lsof with gcc.

The UnixWare 7.1.4 sources are used for OpenServer Release 6.0.0.
Hence there is a separate Configure abbreviation for it, "osr6".
Richard of SCO provided a test system and technical assistance.

SCO|Caldera UnixWare
==========

D. Chris Daniels, John Hughes, Ken Laing, Andrew Merril, Lee Penn, and
Matthew Thurmaier provided test systems. Bela Lubkin provided
technical assistance. Larry Rosenman provided
7.1.[34] test systems.

Solaris 2.x, 7, 8, 9 and 10
==========

SEE THE CAUTIONS SECTION OF THIS DOCUMENT.

The latest Solaris revision of lsof 4 might work under Solaris
2.[1-4] and 2.5[.1] and 7 but hasn't been tested there. I have no
test systems for those Solaris versions.

Lsof will compile with gcc and the Sun C compiler under Solaris.
If you want to use the Sun compiler, use the solariscc Configure
abbreviation. If you use a gcc version less than 2.8 on Solaris,
make sure the gcc-specific includes have been updated for your
version of Solaris -- i.e., run the gcc fixincludes script.

Solaris 7, 8, 9 and 10 support for 64 bit kernels depends on a Sun
WorkShop or Forte C compiler version that supports the "-xarch=v9"
flag -- usually 5.0 or greater. Gcc versions 2.95 and above *may*
be configured and built for 64 bit support, but it takes some extra
work, the resulting compiler may be fragile, and the gcc developers
discourage it. I've built 64 bit capable
gcc compilers for Solaris
7, 8 and 9 from gcc versions 2.95 through 3.0.1 and produced working
lsof executables with them. More information on 64 bit gcc for
Solaris may be found in the 00FAQ file.

Solaris 10 ZFS support is questionable, because Sun does not distribute
the ZFS kernel structure definition header files. The lsof Configure
script and source code use some risky work-arounds. ZFS file system
support was made possible with help from Horst Scheuermann.

Dave Curry and Steve Kirsch provided resources for Solaris 2.x
ports. Casper Dik and Gerry Singleton consulted and provided
valuable assistance.

Henry Katz, Joseph Kowalski, Charles Stephens, Mike Sullivan, and
Mike Tracy provided technical assistance.

AFS support was added to Solaris lsof with help from Curt Freeland,
Heidi Hornstein, Michael L. Lewis, Terry McCoy, Phillip Moore, and
Sushila R. Subramanian.

Casper Dik provided valuable assistance for the Solaris 8 support.

Sun has graciously provided me access to
BETA versions of Solaris
2.5, 2.6, 7, 8, and 9.

John Dzubera provided Solaris 7 and 8 test systems.

Mike Miscevic provided Solaris 10 test systems.

Ultrix
======

As of lsof revision 4.52 support for Ultrix is no longer available,
because I no longer have an Ultrix test system.

Terry Friedrichsen, Dwight McKay, and Jeffrey Mogul helped me with
this port.

DECnet support was added to Ultrix lsof with the help of John
Beacom, who kindly provided a test system. The Configure script
decides that DECnet support is available if /usr/lib/libdnet.a and
/usr/include/netdnet/dn.h exist and are readable.

Veritas VxFS and VxVM
=====================

Lsof supports some versions of Veritas VxFS and VxVM on some UNIX
dialects. Consult the lsof Configure script for the specific
dialect, and consult the lsof dialect-specific source files for
the UNIX dialect of interest. Veritas support will usually be
found in a source file named dnode[1-9].c.

Since Veritas rarely has a version number that
 can be extracted
with shell commands, lsof doesn't use it. Instead, when lsof
supports Veritas, the Configure script will form compile-time
definitions starting with HASVXFS.   Check the lsof 00PORTING
documentation file for more information.

Lsof Veritas support requires that the supporting Veritas header
files be installed -- e.g., in /usr/include/sys/fs. (The location
will depend in the dialect's header file conventions.)

Some information on lsof support for Veritas extensions may be
found in the lsof 00DIST file.

Chris Kordish and Andy Thomas have provided Solaris VxFS test
systems.

==============================

User-contributed Dialect Support
==========

There are some user-contributed dialect versions of lsof; more
information on them can be found at:

ftp://lsof.itap.purdue.edu/pub/tools/unix/lsof/contrib

Check the 00INDEX file there for details.

==========
Dialects No Longer Supported
==========

Because
I don't have access to test systems, these UNIX dialects
are no longer supported by lsof:

CDC EP/IX
/dev/kmem-based Linux
MIPS RISC/os
Motorola V/88
Pyramid DC/OSx
Pyramid Reliant UNIX
Sequent DYNIX
SGI IRIX
SunOS 4.x
Ultrix
UnixWare below 7.0

Remnants of the support lsof once provided for these dialects may
be found in:

ftp://lsof.itap.purdue.edu/pub/tools/unix/lsof/OLD/binaries
and
ftp://lsof.itap.purdue.edu/pub/tools/unix/lsof/OLD/dialects

==========
Installing Lsof
==========

The distributed Makefiles do not have actions that will install
lsof. I've come to the conclusion there is no standard for installing
lsof or its man page, so I no longer distribute make rules for
installing them. You should adjust the Makefile for your local
preferences.

The Makefile does have an install rule that will cause lsof to compile by virtue of its dependency clause. Some Makefiles also have a dependency that causes the production of a man page that is ready to install.
However, the actions of the install rule will not cause the lsof executable or its man page to be installed in any UNIX system-wide directory.

Instead, after the compilation and optional man page production are completed, the install rule will produce a brief description of what actions you might add to the install rule. The description will suggest the possible modes, ownerships, permissions, and destinations your install rule might employ to install the lsof executable and man page.

As you form your install rule, keep in mind that lsof usually needs some type of special permission to do its job. That may be permission to read memory devices such as /dev/kmem, /dev/mem, or /dev/swap, or it may be authorization to read entries in the /proc file system.

Memory device access can usually be provided by setting the modes of the lsof executable so that it's effective group identifier when it runs is the same as the group that has permission to read the memory devices -- i.e., it is setgid-group. The privileged group is usually kmem, sys, or system.

Don't overlook using ACLs -- e.g., on AIX or Solaris 8 -- to give lsof permission to access memory devices. ACLs, coupled to a separate group like kmem, can be safer than giving lsof setgid authorization to a commonly used system group.

When lsof needs to read /proc file system entries, it must be installed with modes that make its effective user identifier root when it runs -- i.e., it must be setuid-root. If lsof must be installed setuid-root (only the AIX 5L, PSTAT-based HPUX, and /proc-based Linux, ports need such power.), then access to memory devices is automatic (or not needed in the case of /proc-based Linux).

Your choice of permissions for lsof may also be affected by your desire to allow anyone to use it or your need to restrict its usage to specific individuals. You will have to be guided by local policy and convention in this case.

The next two sections, Setgid Lsof Dialect Versions and Setuid-root Lsof

Dialect Versions, list recommended install permissions.

The system directory where you install the lsof executable is also
open to choice. A traditional place for a tool like lsof is
/usr/local/etc, but recent changes in directory structure organization
suggest that somewhere in /opt may be more suitable.

Bear one other factor in mind when choosing a location for the lsof
executable -- it usually is a shared executable, requiring access
to shared libraries. Thus, locations like /sbin or /usr/sbin are
probably unsuitable.

Once you've chosen a location for the executable you may find that
the location for the man page follows -- e.g., if the executable
goes in /usr/local/etc, then the man page goes in /usr/local/man.
If the executable location doesn't imply a location for the man
page, you'll have to let local custom guide you.

Setuid-root Lsof Dialect Versions
==========

These dialect versions should be installed with setuid-root
permission -- i.e.,
 the lsof binary should be owned by root and
its setuid execution bit (04000) should be set.

 AIX 5L and above for full use of the -X option
 Apple Darwin 8.x for Power Macintosh systems
 PSTAT-based HP-UX 11.11 and 11.23
 /proc-based Linux (generally 2.1.72 and above)

Setgid Lsof Dialect Versions
==========

These dialect versions should be installed with setgid permission,
owned by the group that can read kernel memory devices such as
/dev/drum, /dev/kmem, /dev/ksyms, /dev/mem, /dev/swap. ACLs may
be another mechanism (e.g., under AIX or Solaris 8) you can use to
grant read permission to the kernel memory devices.

 AIX 4.1.[45], 4.2[.1], and 4.3[.123]
 Apple Darwin 7.x for Power Macintosh systems
 DEC OSF/1, Digital UNIX, Tru64 UNIX 2.0, 3.2, 4.0, and 5.[01]
 FreeBSD 2.1.6, 2.2[.x], 3.x, 4.x, 5.x and [67].x
 /dev/kmem-based 11.00
 NetBSD 1.[456], 2.x and 3.x

NEXTSTEP 3.[13]
OpenBSD 2.[89] and 3.[0-9]
OPENSTEP 4.x
Caldera OpenUNIX 8
SCO OpenServer 5.0.[46]
SCO
UnixWare 7.0 and 7.1.[0134]
Solaris 2.6, 8, 9 and 10
Ultrix 4.2 (no longer available)

==========
Porting lsof 4 to a New UNIX Dialect
==========

If you're brave enough to consider this, look at the 00PORTING file. Please contact me before you start. I might be able to help you or even do the port myself.

Don't overlook the contrib/ directory in pub/tools/unix/lsof on my ftp server, lsof.itap.purdue.edu. It contains user-contributed ports of lsof to dialects I don't distribute, because I can't test new revisions of lsof on them.

==========
Quick Start to Using lsof
==========

For information on how to get started quickly using lsof, consult the 00QUICKSTART file of the lsof distribution. It cuts past the formal density of the lsof man page to provide quick examples of using lsof to solve common open file display problems.

==========
Cross-configuring Lsof
==========

Using
environment variables it is possible to Configure (and possibly build) lsof for one UNIX dialect on a different one -- e.g., you are running Configure on a Linux 2.3 system and you want to Configure and build lsof for Linux 2.4.

See the 00XCONFIG file of the lsof distribution for a discussion of how to do this.

```
================================================
Environment Variables Affecting the Configure Script
================================================

Configure script actions can be modified by introducing values to
the script via environment variables.  In many cases the environment
variable values take the place of test operations the Configure
script makes.

For more information on environment variables that can affect
Configure, consult the 00XCONFIG file of the lsof distribution.
See the General Environment Variables sections for descriptions of
ones that affect all dialects.  Consult the Dialect-Specific
Environment Variables section for ones that might
 affect the dialect
you are trying to configure.


Vic Abell <abe@purdue.edu>
April 24, 2007

Found in path(s):
* /lsof-4-85-zip/00README
No license file was found, but licenses were detected in source scan.

/*
* Copyright 2002 Purdue Research Foundation, West Lafayette, Indiana
* 47907.  All rights reserved.
*
* Written by V. Abell.
*
* This software is not subject to any license of the American Telephone
* and Telegraph Company or the Regents of the University of California.
*
* Permission is granted to anyone to use this software for any purpose on
* any computer system, and to alter it and redistribute it freely, subject
* to the following restrictions:
*
* 1. Neither the authors nor Purdue University are responsible for any
*    consequences of the use of this software.
*
* 2. The origin of this software must not be misrepresented, either by
*    explicit claim or by omission.  Credit to the authors and Purdue
*    University must appear in documentation and sources.
*
* 3. Altered versions must be plainly marked as such, and must not be
*    misrepresented as being the original software.
*
```

*
4. This notice may not be removed or altered.
*/
/*
* If this is a regular file with a non-numeric FD, it may be the
* executable.
*/

Found in path(s):
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/*
* GetOpt() -- Local get option
*
* Borrowed from lsof's main.c source file.
*
* Liberally adapted from the public domain AT&T getopt() source,
* distributed at the 1985 UNIFORM conference in Dallas

*
* The modifications allow `?' to be an option character and allow
* the caller to decide that an option that may be followed by a
* value doesn't have one -- e.g., has a default instead.
*/

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* @(#)cdefs.h 8.2 (Berkeley) 10/4/93
*/

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1.147 syslinux 6.03

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1.149 libglib2 2.48.1

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1.150 openssl 1.1.1t

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`Gnomovision' (which makes passes at compilers) written by James Hacker.

<signature of Ty Coon>, 1 April 1989
Ty Coon, President of Vice

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1.151 boost 1.80.0

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Julian Seward, jseward@acm.org
bzip2/libbzip2 version 1.0.8 of 13 July 2019

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////

[#mpl]
MPL Support, <boost/mp11/mpl.hpp>
:toc:
:toc-title:
:idprefix:

The header `<boost/mp11/mpl.hpp>`, when included, defines the
necessary support infrastructure for `mp_list` and `std::tuple`
to be valid link:../../../../libs/mpl[MPL] sequences.

NOTE: `mpl.hpp` is not included by `<boost/mp11.hpp>`.

It's also possible to only enable support for `mp_list` by
including `<boost/mp11/mpl_list.hpp>`, and for `std::tuple`
by including `<boost/mp11/mpl_tuple.hpp>`. This may be required
because some libraries, such as Boost.Fusion, contain their own MPL
support for `std::tuple`, which conflicts with Mp11's one.

.Converting an existing MPL Sequence into an mp_list
```
using L = mpl::copy<Sequence, mpl::back_inserter<mp11::mp_list<>>>::type;
```
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  <h3>
   Copyright Test
  </h3>
  <p class="copyright">
   1963, 1964, 1965 Jane Doe
  </p>
  <p class="copyright">
   2018 Joe Blow, John Coe
  </p>
  <p class="copyright">
   1977, 1985 Someone else
  </p>
 </body>
</html>
```

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<article id="copyright_test" last-revision="DEBUG MODE Date: 2000/12/20 12:00:00 $"
xmlns:xi="http://www.w3.org/2001/XInclude">
 <title>Copyright Test</title>
 <articleinfo>
   <copyright>
     <year>1963</year> <year>1964</year> <year>1965</year> <holder>Jane Doe</holder>
   </copyright>
   <copyright>
     <year>2018</year> <holder>Joe Blow, John Coe</holder>
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   </copyright>
 </articleinfo>
</article>
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/**
* NCSA HTTPd Server
* Software Development Group
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* University of Illinois at Urbana-Champaign
* 605 E. Springfield, Champaign, IL 61820
* httpd@ncsa.uiuc.edu
*
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****
 *
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*
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For the test\zb.c component:

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   Written by Adam Twiss (adam@zeus.co.uk). March 1996

Thanks to the following people for their input:
 Mike Belshe (mbelshe@netscape.com)
 Michael Campanella (campanella@stevms.enet.dec.com)

*/
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Strict//EN" "http://www.w3.org/TR/xhtml1/DTD/xhtml1-strict.dtd">
<html xmlns="http://www.w3.org/1999/xhtml" lang="en" xml:lang="en"><head>
<meta content="text/html; charset=UTF-8" http-equiv="Content-Type" />
<!--
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
X
          This file is generated from xml source: DO NOT EDIT
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
X
    -->
<title>The Apache License, Version 2.0 - Apache HTTP Server Version 2.4</title>
<link href="./style/css/manual.css" rel="stylesheet" media="all" type="text/css" title="Main stylesheet" />

<link href="./style/css/manual-loose-100pc.css" rel="alternate stylesheet" media="all" type="text/css" title="No Sidebar - Default font size" />
<link href="./style/css/manual-print.css" rel="stylesheet" media="print" type="text/css" /><link rel="stylesheet" type="text/css" href="./style/css/prettify.css"
/>
<script src="./style/scripts/prettify.min.js" type="text/javascript">
</script>

<link href="./images/favicon.ico" rel="shortcut icon" /></head>
<body id="manual-page" class="no-sidebar">
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var comments_identifier = 'http://httpd.apache.org/docs/2.4/license.html';
(function(w, d) {
  if (w.location.hostname.toLowerCase() == "httpd.apache.org") {
    d.write(' <\/div>');
    var s = d.createElement('script');
    s.type = 'text/javascript';
    s.async = true;
    s.src = 'https://comments.apache.org/show_comments.lua?site=' + comments_shortname + '&page=' + comments_identifier;
     (d.getElementsByTagName('head')[0] || d.getElementsByTagName('body')[0]).appendChild(s);
  }
  else {
    d.write(' Comments are disabled for this page at the moment.<\/div>');
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1.155 libnss-nis 2.31

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(For example, a function in a library to compute square roots has a purpose that is entirely well-defined independent of the application. Therefore, Subsection 2d requires that any application-supplied function or table used by this function must be optional: if the application does not supply it, the square root function must still compute square roots.)

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1.158 spring-security 5.4.11

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1.159 apr 1.7.4

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file_io/unix/mktemp.c, strings/apr_strings.c:

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From strings/apr_strnatcmp.c,
include/apr_strings.h:

strnatcmp.c -- Perform 'natural order' comparisons of strings in C.
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1.160 cairo 1.17.6

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1.162 fontconfig 2.14.2

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fontconfig/fc-case/CaseFolding.txt

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---

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* Mutex operations. Originally copied from HarfBuzz.
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---

fontconfig/src/fcfoundry.h

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*/

---

fontconfig/src/fcmd5.h

/*

* This code implements the MD5 message-digest algorithm.
* The algorithm is due to Ron Rivest. This code was
* written by Colin Plumb in 1993, no copyright is claimed.
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*
* Equivalent code is available from RSA Data Security, Inc.
* This code has been tested against that, and is equivalent,
* except that you don't need to include two pages of legalese
* with every copy.
*
* To compute the message digest of a chunk of bytes, declare an
* MD5Context structure, pass it to MD5Init, call MD5Update
 as
* needed on buffers full of bytes, and then call MD5Final, which
* will fill a supplied 16-byte array with the digest.
*/

---

fontconfig/src/fcmutex.h

/*
* Atomic int and pointer operations. Originally copied from HarfBuzz.
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* Red Hat Author(s): Behdad Esfahbod
* Google Author(s): Behdad Esfahbod
*/

---

fontconfig/src/ftglue.[ch]

```
/* ftglue.c: Glue code for compiling the OpenType code from
*          FreeType 1 using only the public API of FreeType 2
*
* By David Turner, The FreeType Project (www.freetype.org)
*
* This code is explicitely put in the public domain
*
* ================================================================================
*
* the OpenType
 parser codes was originally written as an extension to
* FreeType 1.x. As such, its source code was embedded within the library,
* and used many internal FreeType functions to deal with memory and
* stream i/o.
*
* When it was 'salvaged' for Pango and Qt, the code was "ported" to FreeType 2,
* which basically means that some macro tricks were performed in order to
* directly access FT2 _internal_ functions.
*
* these functions were never part of FT2 public API, and _did_ change between
* various releases. This created chaos for many users: when they upgraded the
* FreeType library on their system, they couldn't run Gnome anymore since
* Pango refused to link.
*
* Very fortunately, it's possible to completely avoid this problem because
* the FT_StreamRec and FT_MemoryRec structure types, which describe how
* memory and stream implementations interface with the rest of the font
* library, have always been part of the public API, and never changed.
*
* What we do
 thus is re-implement, within the OpenType parser, the few
* functions that depend on them. This only adds one or two kilobytes of
* code, and ensures that the parser can work with _any_ version
* of FreeType installed on your system. How sweet... !
*
* Note that we assume that Pango doesn't use any other internal functions
* from FreeType. It used to in old versions, but this should no longer
* be the case. (crossing my fingers).
*
```

* - David Turner
* - The FreeType Project (www.freetype.org)
*
* PS: This "glue" code is explicitely put in the public domain
*/

1.163 sse-starlette 1.6.1

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1.164 libmspack 0.10.1

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1.170 host-ninja 1.7.1

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This code is derived from section 17.1 of Applied Cryptography, second edition, which describes a stream cipher allegedly compatible with RSA Labs "RC4" cipher (the actual description of which is a trade secret). The same algorithm is used as a stream cipher called "arcfour" in Tatu Ylonen's ssh package.

Here the stream cipher has been modified always to include the time when initializing the state. That makes it impossible to regenerate the same random sequence twice, so this can't be used for encryption, but will generate good random numbers.

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This code implements the MD5 message-digest algorithm. The algorithm is due to Ron Rivest. This code was written by Colin Plumb in 1993, no copyright is claimed. This code is in the public domain; do with it what you wish.

Equivalent code is available from RSA Data Security, Inc. This code has been tested against that, and is equivalent, except that you don't need to include two pages of legalese with every copy.

To compute the message digest of a chunk of bytes, declare an MD5Context structure, pass it to MD5Init, call MD5Update as needed on buffers full of bytes, and then call MD5Final, which will fill a supplied 16-byte array with the digest.

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1.175 lua 5.4.6

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@Ci{$Id: manual.of $}
@C{[(--}
@manual{

@sect1{@title{Introduction}

Lua is a powerful, efficient, lightweight, embeddable scripting language.

It supports procedural programming,
object-oriented programming, functional programming,
data-driven programming, and data description.

Lua combines simple procedural syntax with powerful data description
constructs based on associative arrays and extensible semantics.
Lua is dynamically typed,
runs by interpreting bytecode with a register-based
virtual machine,
and has automatic memory management with
a generational garbage collection,
making it ideal for configuration, scripting,
and rapid prototyping.

Lua is implemented as a library, written in @emphx{clean C},
the common subset of @N{standard C} and C++.
The Lua distribution includes a host program called @id{lua},
which uses the Lua library to offer
a complete,
standalone Lua interpreter,
for interactive or batch use.
Lua is intended to be used both as a powerful, lightweight,
embeddable scripting language for any program that needs one,
and as a powerful but lightweight and efficient stand-alone language.

As an extension language, Lua has no notion of a @Q{main} program:
it works @emph{embedded} in a host client,
called the @emph{embedding program} or simply the @emphx{host}.
(Frequently, this host is the stand-alone @id{lua} program.)
The host program can invoke functions to execute a piece of Lua code,
can write and read Lua variables,
and can register @N{C functions} to be called by Lua code.
Through the use of @N{C functions}, Lua can be augmented to cope with
a wide range of different domains,
thus creating customized programming languages sharing a syntactical framework.

Lua is free software,
and is provided as usual with no guarantees,
as stated in its license.
The implementation described in this manual is available
at
Lua's official web site, @id{www.lua.org}.

Like any other reference manual,
this document is dry in places.
For a discussion of the decisions behind the design of Lua,
see the technical papers available at Lua's web site.
For a detailed introduction to programming in Lua,

see Roberto's book, @emphx{Programming in Lua}.

}

@C{--}
@sect1{basic| @title{Basic Concepts}

@simplesect{

This section describes the basic concepts of the language.

}

@sect2{TypesSec| @title{Values and Types}

Lua is a dynamically typed language.
This means that
variables do not have types; only values do.
There are no type definitions in the language.
All values carry their own type.

All values in Lua are first-class values.
This means that all values can be stored in variables,
passed as arguments to other functions, and returned as results.

There are eight @x{basic types} in Lua:
@def{nil}, @def{boolean}, @def{number},
@def{string},
 @def{function}, @def{userdata},
@def{thread}, and @def{table}.
The type @emph{nil} has one single value, @nil,
whose main property is to be different from any other value;
it often represents the absence of a useful value.
The type @emph{boolean} has two values, @false and @true.
Both @nil and @false make a condition false;
they are collectively called @def{false values}.
Any other value makes a condition true.
Despite its name,
@false is frequently used as an alternative to @nil,
with the key difference that @false behaves
like a regular value in a table,
while a @nil in a table represents an absent key.

The type @emph{number} represents both
integer numbers and real (floating-point) numbers,
using two @x{subtypes}: @def{integer} and @def{float}.
Standard Lua uses 64-bit integers and double-precision (64-bit) floats,

but you can also compile Lua so that it
uses 32-bit integers and/or single-precision (32-bit) floats.
The option with 32 bits for both integers and floats
is particularly
attractive
for small machines and embedded systems.
(See macro @id{LUA_32BITS} in file @id{luaconf.h}.)

Unless stated otherwise,
any overflow when manipulating integer values @def{wrap around},
according to the usual rules of two-complement arithmetic.
(In other words,
the actual result is the unique representable integer
that is equal modulo @M{2@sp{n}} to the mathematical result,
where @M{n} is the number of bits of the integer type.)

Lua has explicit rules about when each subtype is used,
but it also converts between them automatically as needed @see{coercion}.
Therefore,
the programmer may choose to mostly ignore the difference
between integers and floats
or to assume complete control over the representation of each number.

The type @emph{string} represents immutable sequences of bytes.
@index{eight-bit clean}
Lua is 8-bit clean:
strings can contain any 8-bit value,
including @x{embedded zeros} (@Char{\0}).
Lua is also encoding-agnostic;
it makes no assumptions about the contents
of a string.
The length of any string in Lua must fit in a Lua integer.

Lua can call (and manipulate) functions written in Lua and
functions written in C @see{functioncall}.
Both are represented by the type @emph{function}.

The type @emph{userdata} is provided to allow arbitrary @N{C data} to
be stored in Lua variables.
A userdata value represents a block of raw memory.
There are two kinds of userdata:
@emphx{full userdata},
which is an object with a block of memory managed by Lua,
and @emphx{light userdata},
which is simply a @N{C pointer} value.
Userdata has no predefined operations in Lua,
except assignment and identity test.
By using @emph{metatables},

the programmer can define operations for full userdata values
@see{metatable}.
Userdata values cannot be created or modified in Lua,
only through the @N{C API}.
This guarantees the integrity of data owned by
the host program and @N{C libraries}.

The type @def{thread} represents independent threads of execution
and it is used to
implement coroutines @see{coroutine}.
Lua threads are not related to operating-system threads.
Lua supports coroutines on all systems,
even those that do not support threads natively.

The type @emph{table} implements @x{associative arrays},
that is, @x{arrays} that can have as indices not only numbers,
but any Lua value except @nil and @x{NaN}.
(@emphx{Not a Number} is a special floating-point value
used by the @x{IEEE 754} standard to represent
undefined numerical results, such as @T{0/0}.)
Tables can be @emph{heterogeneous};
that is, they can contain values of all types (except @nil).
Any key associated to the value @nil is not considered part of the table.
Conversely, any key that is not part of a table has
an associated value @nil.

Tables are the sole data-structuring mechanism in Lua;
they can be used to represent ordinary arrays, lists,
symbol tables, sets, records, graphs, trees, etc.
To represent @x{records}, Lua uses the field name as an index.
The language supports this representation
by
providing @id{a.name} as syntactic sugar for @T{a["name"]}.
There are several convenient ways to create tables in Lua
@see{tableconstructor}.

Like indices,
the values of table fields can be of any type.
In particular,
because functions are first-class values,
table fields can contain functions.
Thus tables can also carry @emph{methods} @see{func-def}.

The indexing of tables follows
the definition of raw equality in the language.
The expressions @T{a[i]} and @T{a[j]}
denote the same table element
if and only if @id{i} and @id{j} are raw equal

(that is, equal without metamethods).
In particular, floats with integral values
are equal to their respective integers
(e.g., @T{1.0 == 1}).
To avoid ambiguities,
any float used as a key that is equal to an integer
is converted to that integer.
For instance, if you write @T{a[2.0] = true},
the actual key inserted into the table will be the integer @T{2}.

Tables, functions, threads, and (full) userdata values are @emph{objects}:
variables
do not actually @emph{contain} these values,
only @emph{references} to them.
Assignment, parameter passing, and function returns
always manipulate references to such values;
these operations do not imply any kind of copy.

The library function @Lid{type} returns a string describing the type
of a given value @seeF{type}.

}

@sect2{globalenv| @title{Environments and the Global Environment}

As we will discuss further in @refsec{variables} and @refsec{assignment},
any reference to a free name
(that is, a name not bound to any declaration) @id{var}
is syntactically translated to @T{_ENV.var}.
Moreover, every chunk is compiled in the scope of
an external local variable named @id{_ENV} @see{chunks},
so @id{_ENV} itself is never a free name in a chunk.

Despite the existence of this external @id{_ENV} variable and
the translation of free names,
@id{_ENV} is a completely regular name.
In particular,
you can define new variables and parameters with that name.
Each reference to a free
name uses the @id{_ENV} that is
visible at that point in the program,
following the usual visibility rules of Lua @see{visibility}.

Any table used as the value of @id{_ENV} is called an @def{environment}.

Lua keeps a distinguished environment called the @def{global environment}.
This value is kept at a special index in the C registry @see{registry}.

In Lua, the global variable @Lid{_G} is initialized with this same value.
(@Lid{_G} is never used internally,
so changing its value will affect only your own code.)

When Lua loads a chunk,
the default value for its @id{_ENV} variable
is the global environment @seeF{load}.
Therefore, by default,
free names in Lua code refer to entries in the global environment
and, therefore, they are also called @def{global variables}.
Moreover, all standard libraries are loaded in the global environment
and some functions there operate on that environment.
You can use @Lid{load} (or @Lid{loadfile})
to load a chunk with a different environment.
(In C,
you have to load the chunk and then change the value
of its first upvalue; see @See{lua_setupvalue}.)

}

@sect2{error| @title{Error Handling}

Several operations in Lua can @emph{raise} an error.
An error interrupts the normal flow of the program,
which can continue by @emph{catching} the error.

Lua code can explicitly raise an error by calling the
@Lid{error} function.
(This function never returns.)

To catch errors in Lua,
you can do a @def{protected call},
using @Lid{pcall} (or @Lid{xpcall}).
The function @Lid{pcall} calls a given function in @def{protected mode}.
Any error while running the function stops its execution,
and control returns immediately to @id{pcall},
which returns a status code.

Because Lua is an embedded extension language,
Lua code starts running by a call
from @N{C code} in the host program.
(When you use Lua standalone,
the @id{lua} application is the host program.)
Usually, this call is protected;
so, when an otherwise unprotected error occurs during
the compilation
or execution of a Lua chunk,
control returns to the host,

which can take appropriate measures,
such as printing an error message.

Whenever there is an error,
an @def{error object}
is propagated with information about the error.
Lua itself only generates errors whose error object is a string,
but programs may generate errors with
any value as the error object.
It is up to the Lua program or its host to handle such error objects.
For historical reasons,
an error object is often called an @def{error message},
even though it does not have to be a string.

When you use @Lid{xpcall} (or @Lid{lua_pcall}, in C)
you may give a @def{message handler}
to be called in case of errors.
This function is called with the original error object
and returns a new error object.
It is called before the error unwinds the stack,
so that it can gather more information about the error,
for instance by inspecting the stack and creating a stack traceback.
This message handler is still protected by the
protected call;
so, an error inside the message handler
will call the message handler again.
If this loop goes on for too long,
Lua breaks it and returns an appropriate message.
The message handler is called only for regular runtime errors.
It is not called for memory-allocation errors
nor for errors while running finalizers or other message handlers.

Lua also offers a system of @emph{warnings} @seeF{warn}.
Unlike errors, warnings do not interfere
in any way with program execution.
They typically only generate a message to the user,
although this behavior can be adapted from C @seeC{lua_setwarnf}.

}

@sect2{metatable| @title{Metatables and Metamethods}

Every value in Lua can have a @emph{metatable}.
This @def{metatable} is an ordinary Lua table
that defines the behavior of the original value
under certain events.
You can change several aspects of the behavior

of a value by setting specific fields in its metatable.
For instance, when a non-numeric value is the operand of an addition,
Lua
checks for a function in the field @idx{__add} of the value's metatable.
If it finds one,
Lua calls this function to perform the addition.

The key for each event in a metatable is a string
with the event name prefixed by two underscores;
the corresponding value is called a @def{metavalue}.
For most events, the metavalue must be a function,
which is then called a @def{metamethod}.
In the previous example, the key is the string @St{__add}
and the metamethod is the function that performs the addition.
Unless stated otherwise,
a metamethod may in fact be any @x{callable value},
which is either a function or a value with a @idx{__call} metamethod.

You can query the metatable of any value
using the @Lid{getmetatable} function.
Lua queries metamethods in metatables using a raw access @seeF{rawget}.

You can replace the metatable of tables
using the @Lid{setmetatable} function.
You cannot change the metatable of other types from Lua code,
except by using the @link{debuglib|debug library}.

Tables
and full userdata have individual metatables,
although multiple tables and userdata can share their metatables.
Values of all other types share one single metatable per type;
that is, there is one single metatable for all numbers,
one for all strings, etc.
By default, a value has no metatable,
but the string library sets a metatable for the string type @see{strlib}.

A detailed list of operations controlled by metatables is given next.
Each event is identified by its corresponding key.
By convention, all metatable keys used by Lua are composed by
two underscores followed by lowercase Latin letters.

@description{

@item{@idx{__add}|
the addition (@T{+}) operation.
If any operand for an addition is not a number,
Lua will try to call a metamethod.
It starts by checking the first operand (even if it is a number);

if that operand does not define a metamethod for @idx{__add},
then Lua will check the second operand.
If Lua can find a metamethod,
it calls the metamethod with the two
 operands as arguments,
and the result of the call
(adjusted to one value)
is the result of the operation.
Otherwise, if no metamethod is found,
Lua raises an error.
}

@item{@idx{__sub}|
the subtraction (@T{-}) operation.
Behavior similar to the addition operation.
}

@item{@idx{__mul}|
the multiplication (@T{*}) operation.
Behavior similar to the addition operation.
}

@item{@idx{__div}|
the division (@T{/}) operation.
Behavior similar to the addition operation.
}

@item{@idx{__mod}|
the modulo (@T{%}) operation.
Behavior similar to the addition operation.
}

@item{@idx{__pow}|
the exponentiation (@T{^}) operation.
Behavior similar to the addition operation.
}

@item{@idx{__unm}|
the negation (unary @T{-}) operation.
Behavior similar to the addition operation.
}

@item{@idx{__idiv}|
the floor division (@T{//}) operation.
Behavior similar to the addition operation.
}

@item{@idx{__band}|

the bitwise AND (@T{&}) operation.
Behavior similar to the addition operation,
except that Lua will
try a metamethod
if any operand is neither an integer
nor a float coercible to an integer @see{coercion}.
}

@item{@idx{__bor}|
the bitwise OR (@T{|}) operation.
Behavior similar to the bitwise AND operation.
}

@item{@idx{__bxor}|
the bitwise exclusive OR (binary @T{~}) operation.
Behavior similar to the bitwise AND operation.
}

@item{@idx{__bnot}|
the bitwise NOT (unary @T{~}) operation.
Behavior similar to the bitwise AND operation.
}

@item{@idx{__shl}|
the bitwise left shift (@T{<<}) operation.
Behavior similar to the bitwise AND operation.
}

@item{@idx{__shr}|
the bitwise right shift (@T{>>}) operation.
Behavior similar to the bitwise AND operation.
}

@item{@idx{__concat}|
the concatenation (@T{..}) operation.
Behavior similar to the addition operation,
except that Lua will try a metamethod
if any operand is neither a string nor a number
(which is always coercible to a string).
}

@item{@idx{__len}|
the length (@T{#}) operation.
If the object is not a string,
Lua will try its
metamethod.
If there is a metamethod,
Lua calls it with the object as argument,

and the result of the call
(always adjusted to one value)
is the result of the operation.
If there is no metamethod but the object is a table,
then Lua uses the table length operation @see{len-op}.
Otherwise, Lua raises an error.
}

@item{@idx{__eq}|
the equal (@T{==}) operation.
Behavior similar to the addition operation,
except that Lua will try a metamethod only when the values
being compared are either both tables or both full userdata
and they are not primitively equal.
The result of the call is always converted to a boolean.
}

@item{@idx{__lt}|
the less than (@T{<}) operation.
Behavior similar to the addition operation,
except that Lua will try a metamethod only when the values
being compared are neither both numbers nor both strings.
Moreover, the result of the call is always converted to a boolean.
}

@item{@idx{__le}|
the less equal (@T{<=}) operation.
Behavior similar to the less than operation.
}

@item{@idx{__index}|
The
 indexing access operation @T{table[key]}.
This event happens when @id{table} is not a table or
when @id{key} is not present in @id{table}.
The metavalue is looked up in the metatable of @id{table}.

The metavalue for this event can be either a function, a table,
or any value with an @idx{__index} metavalue.
If it is a function,
it is called with @id{table} and @id{key} as arguments,
and the result of the call
(adjusted to one value)
is the result of the operation.
Otherwise,
the final result is the result of indexing this metavalue with @id{key}.
This indexing is regular, not raw,
and therefore can trigger another @idx{__index} metavalue.

}

@item{@idx{__newindex}|
The indexing assignment @T{table[key] = value}.
Like the index event,
this event happens when @id{table} is not a table or
when @id{key} is not present in @id{table}.
The metavalue is looked up in the metatable of @id{table}.

Like with indexing,
the metavalue for this event can be either a function,
 a table,
or any value with an @idx{__newindex} metavalue.
If it is a function,
it is called with @id{table}, @id{key}, and @id{value} as arguments.
Otherwise,
Lua repeats the indexing assignment over this metavalue
with the same key and value.
This assignment is regular, not raw,
and therefore can trigger another @idx{__newindex} metavalue.

Whenever a @idx{__newindex} metavalue is invoked,
Lua does not perform the primitive assignment.
If needed,
the metamethod itself can call @Lid{rawset}
to do the assignment.
}

@item{@idx{__call}|
The call operation @T{func(args)}.
This event happens when Lua tries to call a non-function value
(that is, @id{func} is not a function).
The metamethod is looked up in @id{func}.
If present,
the metamethod is called with @id{func} as its first argument,
followed by the arguments of the original call (@id{args}).
All results of the call
are the results of the operation.
This is the only metamethod that allows multiple results.
}

}

In addition to
 the previous list,
the interpreter also respects the following keys in metatables:
@idx{__gc} @see{finalizers},
@idx{__close} @see{to-be-closed},

@idx{__mode} @see{weak-table},
and @idx{__name}.
(The entry @idx{__name},
when it contains a string,
may be used by @Lid{tostring} and in error messages.)

For the unary operators (negation, length, and bitwise NOT),
the metamethod is computed and called with a dummy second operand,
equal to the first one.
This extra operand is only to simplify Lua's internals
(by making these operators behave like a binary operation)
and may be removed in future versions.
For most uses this extra operand is irrelevant.

Because metatables are regular tables,
they can contain arbitrary fields,
not only the event names defined above.
Some functions in the standard library
(e.g., @Lid{tostring})
use other fields in metatables for their own purposes.

It is a good practice to add all needed metamethods to a table
before setting it as a metatable of some object.
In
particular, the @idx{__gc} metamethod works only when this order
is followed @see{finalizers}.
It is also a good practice to set the metatable of an object
right after its creation.

}

@sect2{GC| @title{Garbage Collection}

@simplesect{

Lua performs automatic memory management.
This means that
you do not have to worry about allocating memory for new objects
or freeing it when the objects are no longer needed.
Lua manages memory automatically by running
a @def{garbage collector} to collect all @emph{dead} objects.
All memory used by Lua is subject to automatic management:
strings, tables, userdata, functions, threads, internal structures, etc.

An object is considered @def{dead}
as soon as the collector can be sure the object
will not be accessed again in the normal execution of the program.
(@Q{Normal execution} here excludes finalizers,

which can resurrect dead objects @see{finalizers},
and excludes also operations using the debug library.)
Note that the time when the collector can
be sure that an object
is dead may not coincide with the programmer's expectations.
The only guarantees are that Lua will not collect an object
that may still be accessed in the normal execution of the program,
and it will eventually collect an object
that is inaccessible from Lua.
(Here,
@emph{inaccessible from Lua} means that neither a variable nor
another live object refer to the object.)
Because Lua has no knowledge about @N{C code},
it never collects objects accessible through the registry @see{registry},
which includes the global environment @see{globalenv}.

The garbage collector (GC) in Lua can work in two modes:
incremental and generational.

The default GC mode with the default parameters
are adequate for most uses.
However, programs that waste a large proportion of their time
allocating and freeing memory can benefit from other settings.
Keep in mind that the GC behavior is non-portable
both across platforms and across different Lua releases;
therefore, optimal settings
are also non-portable.

You can change the GC mode and parameters by calling
@Lid{lua_gc} @N{in C}
or @Lid{collectgarbage} in Lua.
You can also use these functions to control
the collector directly (e.g., to stop and restart it).

}

@sect3{incmode| @title{Incremental Garbage Collection}

In incremental mode,
each GC cycle performs a mark-and-sweep collection in small steps
interleaved with the program's execution.
In this mode,
the collector uses three numbers to control its garbage-collection cycles:
the @def{garbage-collector pause},
the @def{garbage-collector step multiplier},
and the @def{garbage-collector step size}.

The garbage-collector pause
controls how long the collector waits before starting a new cycle.
The collector starts a new cycle when the use of memory
hits @M{n%} of the use after the previous collection.
Larger values make the collector less aggressive.
Values equal to or less than 100 mean the collector will not wait to
start a new cycle.
A value of 200 means that
the collector waits for the total memory in use
to double before starting a new cycle.
The default value is 200; the maximum value is 1000.

The garbage-collector step multiplier
controls the speed of the collector relative to
memory allocation,
that is,
how many elements it marks or sweeps for each
kilobyte of memory allocated.
Larger values make the collector more aggressive but also increase
the size of each incremental step.
You should not use values less than 100,
because they make the collector too slow and
can result in the collector never finishing a cycle.
The default value is 100; the maximum value is 1000.

The garbage-collector step size controls the
size of each incremental step,
specifically how many bytes the interpreter allocates
before performing a step.
This parameter is logarithmic:
A value of @M{n} means the interpreter will allocate @M{2@sp{n}}
bytes between steps and perform equivalent work during the step.
A large value (e.g., 60) makes the collector a stop-the-world
(non-incremental)
collector.
The default value is 13,
which means steps of approximately @N{8 Kbytes}.

}

@sect3{genmode| @title{Generational Garbage Collection}

In generational mode,
the collector does frequent @emph{minor} collections,
which traverses only objects recently created.
If after a minor collection the use of memory is still above a limit,
the collector does a stop-the-world @emph{major} collection,
which traverses all objects.

The generational mode uses two parameters:
the @def{minor multiplier} and the @def{the major multiplier}.

The minor multiplier controls the frequency of minor collections.
For a minor multiplier @M{x},
a new minor collection will be done when memory
grows @M{x%} larger than the memory in use after the previous major
collection.
For instance, for a multiplier of 20,
the collector will do a minor collection when the use of memory
gets 20% larger than the use after the previous major collection.
The default value is 20; the maximum value is 200.

The
major multiplier controls the frequency of major collections.
For a major multiplier @M{x},
a new major collection will be done when memory
grows @M{x%} larger than the memory in use after the previous major
collection.
For instance, for a multiplier of 100,
the collector will do a major collection when the use of memory
gets larger than twice the use after the previous collection.
The default value is 100; the maximum value is 1000.

}

@sect3{finalizers| @title{Garbage-Collection Metamethods}

You can set garbage-collector metamethods for tables
and, using the @N{C API},
for full userdata @see{metatable}.
These metamethods, called @def{finalizers},
are called when the garbage collector detects that the
corresponding table or userdata is dead.
Finalizers allow you to coordinate Lua's garbage collection
with external resource management such as closing files,
network or database connections,
or freeing your own memory.

For an object (table or userdata) to be finalized when collected,
you
must @emph{mark} it for finalization.
@index{mark (for finalization)}
You mark an object for finalization when you set its metatable
and the metatable has a @idx{__gc} metamethod.
Note that if you set a metatable without a @idx{__gc} field
and later create that field in the metatable,
the object will not be marked for finalization.

When a marked object becomes dead,
it is not collected immediately by the garbage collector.
Instead, Lua puts it in a list.
After the collection,
Lua goes through that list.
For each object in the list,
it checks the object's @idx{__gc} metamethod:
If it is present,
Lua calls it with the object as its single argument.

At the end of each garbage-collection cycle,
the finalizers are called in
the reverse order that the objects were marked for finalization,
among those collected in that cycle;
that is, the first finalizer to be called is the one associated
with the object marked last in the program.
The execution of each finalizer may occur at any
point during
the execution of the regular code.

Because the object being collected must still be used by the finalizer,
that object (and other objects accessible only through it)
must be @emph{resurrected} by Lua.@index{resurrection}
Usually, this resurrection is transient,
and the object memory is freed in the next garbage-collection cycle.
However, if the finalizer stores the object in some global place
(e.g., a global variable),
then the resurrection is permanent.
Moreover, if the finalizer marks a finalizing object for finalization again,
its finalizer will be called again in the next cycle where the
object is dead.
In any case,
the object memory is freed only in a GC cycle where
the object is dead and not marked for finalization.

When you close a state @seeF{lua_close},
Lua calls the finalizers of all objects marked for finalization,
following the reverse order that they were marked.
If any finalizer marks objects for collection during that phase,
these marks have no effect.

Finalizers
cannot yield nor run the garbage collector.
Because they can run in unpredictable times,
it is good practice to restrict each finalizer
to the minimum necessary to properly release
its associated resource.

Any error while running a finalizer generates a warning;
the error is not propagated.

}

@sect3{weak-table| @title{Weak Tables}

A @def{weak table} is a table whose elements are
@def{weak references}.
A weak reference is ignored by the garbage collector.
In other words,
if the only references to an object are weak references,
then the garbage collector will collect that object.

A weak table can have weak keys, weak values, or both.
A table with weak values allows the collection of its values,
but prevents the collection of its keys.
A table with both weak keys and weak values allows the collection of
both keys and values.
In any case, if either the key or the value is collected,
the whole pair is removed from the table.
The weakness of a table is controlled by the
@idx{__mode}
field of its metatable.
This metavalue, if present, must be one of the following strings:
@St{k}, for a table with weak keys;
@St{v}, for a table with weak values;
or @St{kv}, for a table with both weak keys and values.

A table with weak keys and strong values
is also called an @def{ephemeron table}.
In an ephemeron table,
a value is considered reachable only if its key is reachable.
In particular,
if the only reference to a key comes through its value,
the pair is removed.

Any change in the weakness of a table may take effect only
at the next collect cycle.
In particular, if you change the weakness to a stronger mode,
Lua may still collect some items from that table
before the change takes effect.

Only objects that have an explicit construction
are removed from weak tables.
Values, such as numbers and @x{light @N{C functions}},
are not subject to garbage collection,

and therefore are not removed from weak tables
(unless their associated values are collected).
Although strings
are subject to garbage collection,
they do not have an explicit construction and
their equality is by value;
they behave more like values than like objects.
Therefore, they are not removed from weak tables.

Resurrected objects
(that is, objects being finalized
and objects accessible only through objects being finalized)
have a special behavior in weak tables.
They are removed from weak values before running their finalizers,
but are removed from weak keys only in the next collection
after running their finalizers, when such objects are actually freed.
This behavior allows the finalizer to access properties
associated with the object through weak tables.

If a weak table is among the resurrected objects in a collection cycle,
it may not be properly cleared until the next cycle.

}

}

@sect2{coroutine| @title{Coroutines}

Lua supports coroutines,
also called @emphx{collaborative multithreading}.
A coroutine in Lua represents an independent thread of execution.
Unlike threads in multithread
systems, however,
a coroutine only suspends its execution by explicitly calling
a yield function.

You create a coroutine by calling @Lid{coroutine.create}.
Its sole argument is a function
that is the main function of the coroutine.
The @id{create} function only creates a new coroutine and
returns a handle to it (an object of type @emph{thread});
it does not start the coroutine.

You execute a coroutine by calling @Lid{coroutine.resume}.
When you first call @Lid{coroutine.resume},
passing as its first argument
a thread returned by @Lid{coroutine.create},
the coroutine starts its execution by

calling its main function.
Extra arguments passed to @Lid{coroutine.resume} are passed
as arguments to that function.
After the coroutine starts running,
it runs until it terminates or @emph{yields}.

A coroutine can terminate its execution in two ways:
normally, when its main function returns
(explicitly or implicitly, after the last instruction);
and abnormally, if there is an unprotected
error.
In case of normal termination,
@Lid{coroutine.resume} returns @true,
plus any values returned by the coroutine main function.
In case of errors, @Lid{coroutine.resume} returns @false
plus the error object.
In this case, the coroutine does not unwind its stack,
so that it is possible to inspect it after the error
with the debug API.

A coroutine yields by calling @Lid{coroutine.yield}.
When a coroutine yields,
the corresponding @Lid{coroutine.resume} returns immediately,
even if the yield happens inside nested function calls
(that is, not in the main function,
but in a function directly or indirectly called by the main function).
In the case of a yield, @Lid{coroutine.resume} also returns @true,
plus any values passed to @Lid{coroutine.yield}.
The next time you resume the same coroutine,
it continues its execution from the point where it yielded,
with the call to @Lid{coroutine.yield} returning any extra
arguments passed to @Lid{coroutine.resume}.

Like @Lid{coroutine.create},
the
@Lid{coroutine.wrap} function also creates a coroutine,
but instead of returning the coroutine itself,
it returns a function that, when called, resumes the coroutine.
Any arguments passed to this function
go as extra arguments to @Lid{coroutine.resume}.
@Lid{coroutine.wrap} returns all the values returned by @Lid{coroutine.resume},
except the first one (the boolean error code).
Unlike @Lid{coroutine.resume},
the function created by @Lid{coroutine.wrap}
propagates any error to the caller.
In this case,
the function also closes the coroutine @seeF{coroutine.close}.

As an example of how coroutines work,
consider the following code:
@verbatim{
```
function foo (a)
 print("foo", a)
 return coroutine.yield(2*a)
end

co = coroutine.create(function (a,b)
    print("co-body", a, b)
    local r = foo(a+1)
    print("co-body", r)
    local r, s = coroutine.yield(a+b, a-b)
    print("co-body", r, s)
    return b, "end"
end)

print("main", coroutine.resume(co, 1, 10))
print("main", coroutine.resume(co,
 "r"))
print("main", coroutine.resume(co, "x", "y"))
print("main", coroutine.resume(co, "x", "y"))
```
}
When you run it, it produces the following output:
@verbatim{
```
co-body 1       10
foo     2
main    true    4
co-body r
main    true    11      -9
co-body x       y
main    true    10      end
main    false   cannot resume dead coroutine
```
}

You can also create and manipulate coroutines through the C API:
see functions @Lid{lua_newthread}, @Lid{lua_resume},
and @Lid{lua_yield}.

}

}

@C{---}
@sect1{language| @title{The Language}

@simplesect{

This section describes the lexis, the syntax, and the semantics of Lua.
In other words,
this section describes
which tokens are valid,
how they can be combined,
and what their combinations mean.

Language constructs will be explained using the usual extended BNF notation,
in which
@N{@bnfrep{@rep{a}} means 0} or more @rep{a}'s, and
@N{@bnfopt{@rep{a}} means} an
optional @rep{a}.
Non-terminals are shown like @bnfNter{non-terminal},
keywords are shown like @rw{kword},
and other terminal symbols are shown like @bnfter{=}.
The complete syntax of Lua can be found in @refsec{BNF}
at the end of this manual.

}

@sect2{lexical| @title{Lexical Conventions}

Lua is a @x{free-form} language.
It ignores spaces and comments between lexical elements (@x{tokens}),
except as delimiters between two tokens.
In source code,
Lua recognizes as spaces the standard ASCII whitespace
characters space, form feed, newline,
carriage return, horizontal tab, and vertical tab.

@def{Names}
(also called @def{identifiers})
in Lua can be any string of Latin letters,
Arabic-Indic digits, and underscores,
not beginning with a digit and
not being a reserved word.
Identifiers are used to name variables, table fields, and labels.

The following @def{keywords} are reserved
and cannot be used as names:
@index{reserved words}
@verbatim{
and break do else elseif
end
false for function goto if in
local nil not or repeat return
then true until while

}

Lua is a case-sensitive language:
@id{and} is a reserved word, but @id{And} and @id{AND}
are two different, valid names.
As a convention,
programs should avoid creating
names that start with an underscore followed by
one or more uppercase letters (such as @Lid{_VERSION}).

The following strings denote other @x{tokens}:
@verbatim{
+ - * / % ^ #
& ~ | << >> //
== ~= <= >= < > =
( ) { } [ ] ::
; : , ...
}

A @def{short literal string}
can be delimited by matching single or double quotes,
and can contain the following C-like escape sequences:
@Char{\a} (bell),
@Char{\b} (backspace),
@Char{\f} (form feed),
@Char{\n} (newline),
@Char{\r} (carriage return),
@Char{\t} (horizontal tab),
@Char{\v} (vertical tab),
@Char{\\} (backslash),
@Char{\"}
(quotation mark [double quote]),
and @Char{\'} (apostrophe [single quote]).
A backslash followed by a line break
results in a newline in the string.
The escape sequence @Char{\z} skips the following span
of whitespace characters,
including line breaks;
it is particularly useful to break and indent a long literal string
into multiple lines without adding the newlines and spaces
into the string contents.
A short literal string cannot contain unescaped line breaks
nor escapes not forming a valid escape sequence.

We can specify any byte in a short literal string,
including @x{embedded zeros},
by its numeric value.
This can be done

with the escape sequence @T{\x@rep{XX}},
where @rep{XX} is a sequence of exactly two hexadecimal digits,
or with the escape sequence @T{\@rep{ddd}},
where @rep{ddd} is a sequence of up to three decimal digits.
(Note that if a decimal escape sequence is to be followed by a digit,
it must be expressed using exactly three digits.)

The @x{UTF-8} encoding
of a @x{Unicode} character
can be inserted in a literal string with
the escape sequence @T{\u{@rep{XXX}}}
(with mandatory enclosing braces),
where @rep{XXX} is a sequence of one or more hexadecimal digits
representing the character code point.
This code point can be any value less than @M{2@sp{31}}.
(Lua uses the original UTF-8 specification here,
which is not restricted to valid Unicode code points.)

Literal strings can also be defined using a long format
enclosed by @def{long brackets}.
We define an @def{opening long bracket of level @rep{n}} as an opening
square bracket followed by @rep{n} equal signs followed by another
opening square bracket.
So, an opening long bracket of @N{level 0} is written as @T{[[}, @C{]]}
an opening long bracket of @N{level 1} is written as @T{[=[}, @C{]]}
and so on.
A @emph{closing long bracket} is defined similarly;
for instance,
a closing long bracket of @N{level 4} is written as @C{]]} @T{]====]}.
A @def{long literal} starts with an opening long bracket
of any level and
ends at the first closing long bracket of the same level.
It can contain any text except a closing bracket of the same level.
Literals in this bracketed form can run for several lines,
do not interpret any escape sequences,
and ignore long brackets of any other level.
Any kind of end-of-line sequence
(carriage return, newline, carriage return followed by newline,
or newline followed by carriage return)
is converted to a simple newline.
When the opening long bracket is immediately followed by a newline,
the newline is not included in the string.

As an example, in a system using ASCII
(in which @Char{a} is coded @N{as 97},
newline is coded @N{as 10}, and @Char{1} is coded @N{as 49}),
the five literal strings below denote the same string:
@verbatim{

```
a = 'alo\n123"'
a = "alo\n123\""
a = '\97lo\10\04923"'
a = [[alo
123"]]
a = [==[
alo
123"]==]
}
```

Any byte in a literal string not
explicitly affected by the previous rules represents itself.
However, Lua opens files for
parsing in text mode,
and the system's file functions may have problems with
some control characters.
So, it is safer to represent
binary data as a quoted literal with
explicit escape sequences for the non-text characters.

A @def{numeric constant} (or @def{numeral})
can be written with an optional fractional part
and an optional decimal exponent,
marked by a letter @Char{e} or @Char{E}.
Lua also accepts @x{hexadecimal constants},
which start with @T{0x} or @T{0X}.
Hexadecimal constants also accept an optional fractional part
plus an optional binary exponent,
marked by a letter @Char{p} or @Char{P} and written in decimal.
(For instance, @T{0x1.fp10} denotes 1984,
which is @M{0x1f / 16} multiplied by @M{2@sp{10}}.)

A numeric constant with a radix point or an exponent
denotes a float;
otherwise,
if its value fits in an integer or it is a hexadecimal constant,
it denotes an integer;
otherwise (that is, a decimal integer numeral that overflows),
it denotes a float.
Hexadecimal numerals
with neither a radix point nor an exponent
always denote an integer value;
if the value overflows, it @emph{wraps around}
to fit into a valid integer.

Examples of valid integer constants are
@verbatim{
3   345   0xff   0xBEBADA

}
Examples of valid float constants are
@verbatim{
3.0   3.1416   314.16e-2   0.31416E1   34e1
0x0.1E 0xA23p-4   0X1.921FB54442D18P+1
}

A @def{comment} starts with a double hyphen (@T{--})
anywhere outside a string.
If the text immediately after @T{--} is not an opening long bracket,
the comment is a @def{short comment},
which runs until the end of the line.
Otherwise, it is a @def{long comment},
which runs until the corresponding closing long bracket.

}

@sect2{variables| @title{Variables}

Variables are places that store values.
There are three kinds of variables in Lua:
global variables, local variables, and table fields.

A single name can denote a global variable or a local variable
(or a function's formal parameter,
which is a particular kind of
 local variable):
@Produc{
@producname{var}@producbody{@bnfNter{Name}}
}
@bnfNter{Name} denotes identifiers @see{lexical}.

Any variable name is assumed to be global unless explicitly declared
as a local @see{localvar}.
@x{Local variables} are @emph{lexically scoped}:
local variables can be freely accessed by functions
defined inside their scope @see{visibility}.

Before the first assignment to a variable, its value is @nil.

Square brackets are used to index a table:
@Produc{
@producname{var}@producbody{prefixexp @bnfter{[} exp @bnfter{]}}
}
The meaning of accesses to table fields can be changed via metatables
@see{metatable}.

The syntax @id{var.Name} is just syntactic sugar for

@T{var["Name"]}:
@Produc{
@producname{var}@producbody{prefixexp @bnfter{.} @bnfNter{Name}}
}

An access to a global variable @id{x}
is equivalent to @id{_ENV.x}.
Due to the way that chunks are compiled,
the variable @id{_ENV} itself is never global @see{globalenv}.

}

@sect2{stats| @title{Statements}

@simplesect{

Lua
 supports an almost conventional set of @x{statements},
similar to those in other conventional languages.
This set includes
blocks, assignments, control structures, function calls,
and variable declarations.

}

@sect3{@title{Blocks}

A @x{block} is a list of statements,
which are executed sequentially:
@Produc{
@producname{block}@producbody{@bnfrep{stat}}
}
Lua has @def{empty statements}
that allow you to separate statements with semicolons,
start a block with a semicolon
or write two semicolons in sequence:
@Produc{
@producname{stat}@producbody{@bnfter{;}}
}

Both function calls and assignments
can start with an open parenthesis.
This possibility leads to an ambiguity in Lua's grammar.
Consider the following fragment:
@verbatim{
a = b + c
(print or io.write)('done')
}

The grammar could see this fragment in two ways:
@verbatim{
a = b + c(print or io.write)('done')

a = b + c; (print or io.write)('done')
}
The current parser always sees such constructions
in the first way,
interpreting
the open parenthesis
as the start of the arguments to a call.
To avoid this ambiguity,
it is a good practice to always precede with a semicolon
statements that start with a parenthesis:
@verbatim{
;(print or io.write)('done')
}

A block can be explicitly delimited to produce a single statement:
@Produc{
@producname{stat}@producbody{@Rw{do} block @Rw{end}}
}
Explicit blocks are useful
to control the scope of variable declarations.
Explicit blocks are also sometimes used to
add a @Rw{return} statement in the middle
of another block @see{control}.

}

@sect3{chunks| @title{Chunks}

The unit of compilation of Lua is called a @def{chunk}.
Syntactically,
a chunk is simply a block:
@Produc{
@producname{chunk}@producbody{block}
}

Lua handles a chunk as the body of an anonymous function
with a variable number of arguments
@see{func-def}.
As such, chunks can define local variables,
receive arguments, and return values.
Moreover, such anonymous function is compiled as in the
scope of
an external local variable called @id{_ENV} @see{globalenv}.
The resulting function always has @id{_ENV} as its only external variable,

even if it does not use that variable.

A chunk can be stored in a file or in a string inside the host program.
To execute a chunk,
Lua first @emph{loads} it,
precompiling the chunk's code into instructions for a virtual machine,
and then Lua executes the compiled code
with an interpreter for the virtual machine.

Chunks can also be precompiled into binary form;
see the program @idx{luac} and the function @Lid{string.dump} for details.
Programs in source and compiled forms are interchangeable;
Lua automatically detects the file type and acts accordingly @seeF{load}.

}

@sect3{assignment| @title{Assignment}

Lua allows @x{multiple assignments}.
Therefore, the syntax for assignment
defines a list of variables on the left side
and a list of expressions on the right side.
The elements in both lists are separated by commas:
@Produc{
@producname{stat}@producbody{varlist
 @bnfter{=} explist}
@producname{varlist}@producbody{var @bnfrep{@bnfter{,} var}}
@producname{explist}@producbody{exp @bnfrep{@bnfter{,} exp}}
}
Expressions are discussed in @See{expressions}.

Before the assignment,
the list of values is @emph{adjusted} to the length of
the list of variables @see{multires}.

If a variable is both assigned and read
inside a multiple assignment,
Lua ensures that all reads get the value of the variable
before the assignment.
Thus the code
@verbatim{
i = 3
i, a[i] = i+1, 20
}
sets @T{a[3]} to 20, without affecting @T{a[4]}
because the @id{i} in @T{a[i]} is evaluated (to 3)
before it is @N{assigned 4}.
Similarly, the line

@verbatim{
x, y = y, x
}
exchanges the values of @id{x} and @id{y},
and
@verbatim{
x, y, z = y, z, x
}
cyclically permutes the values of @id{x}, @id{y}, and @id{z}.

Note that this guarantee covers only accesses
syntactically inside the assignment statement.
If a function or a metamethod called during the assignment
changes
the value of a variable,
Lua gives no guarantees about the order of that access.

An assignment to a global name @T{x = val}
is equivalent to the assignment
@T{_ENV.x = val} @see{globalenv}.

The meaning of assignments to table fields and
global variables (which are actually table fields, too)
can be changed via metatables @see{metatable}.

}

@sect3{control| @title{Control Structures}
The control structures
@Rw{if}, @Rw{while}, and @Rw{repeat} have the usual meaning and
familiar syntax:
@index{while-do statement}
@index{repeat-until statement}
@index{if-then-else statement}
@Produc{
@producname{stat}@producbody{@Rw{while} exp @Rw{do} block @Rw{end}}
@producname{stat}@producbody{@Rw{repeat} block @Rw{until} exp}
@producname{stat}@producbody{@Rw{if} exp @Rw{then} block
@bnfrep{@Rw{elseif} exp @Rw{then} block}
@bnfopt{@Rw{else} block} @Rw{end}}
}
Lua also has a @Rw{for} statement, in two flavors @see{for}.

The @x{condition expression} of a
control structure can return any value.
Both
@false and @nil test false.
All values different from @nil and @false test true.

In particular, the number 0 and the empty string also test true.

In the @Rw{repeat}@En@Rw{until} loop,
the inner block does not end at the @Rw{until} keyword,
but only after the condition.
So, the condition can refer to local variables
declared inside the loop block.

The @Rw{goto} statement transfers the program control to a label.
For syntactical reasons,
labels in Lua are considered statements too:
@index{goto statement}
@index{label}
@Produc{
@producname{stat}@producbody{@Rw{goto} Name}
@producname{stat}@producbody{label}
@producname{label}@producbody{@bnfter{::} Name @bnfter{::}}
}

A label is visible in the entire block where it is defined,
except inside nested functions.
A goto may jump to any visible label as long as it does not
enter into the scope of a local variable.
A label should not be declared
where a label with the same name is visible,
even if this other label has been declared in an
enclosing block.

The @Rw{break} statement terminates the execution of a
@Rw{while}, @Rw{repeat}, or @Rw{for} loop,
skipping to the next statement after the loop:
@index{break statement}
@Produc{
@producname{stat}@producbody{@Rw{break}}
}
A @Rw{break} ends the innermost enclosing loop.

The @Rw{return} statement is used to return values
from a function or a chunk
(which is handled as an anonymous function).
@index{return statement}
Functions can return more than one value,
so the syntax for the @Rw{return} statement is
@Produc{
@producname{stat}@producbody{@Rw{return} @bnfopt{explist} @bnfopt{@bnfter{;}}}
}

The @Rw{return} statement can only be written

as the last statement of a block.
If it is necessary to @Rw{return} in the middle of a block,
then an explicit inner block can be used,
as in the idiom @T{do return end},
because now @Rw{return} is the last statement in its (inner) block.

}

@sect3{for| @title{For Statement}

@index{for statement}
The @Rw{for} statement has two forms:
one
numerical and one generic.

@sect4{@title{The numerical @Rw{for} loop}

The numerical @Rw{for} loop repeats a block of code while a
control variable goes through an arithmetic progression.
It has the following syntax:
@Produc{
@producname{stat}@producbody{@Rw{for} @bnfNter{Name} @bnfter{=}
exp @bnfter{,} exp @bnfopt{@bnfter{,} exp} @Rw{do} block @Rw{end}}
}
The given identifier (@bnfNter{Name}) defines the control variable,
which is a new variable local to the loop body (@emph{block}).

The loop starts by evaluating once the three control expressions.
Their values are called respectively
the @emph{initial value}, the @emph{limit}, and the @emph{step}.
If the step is absent, it defaults @N{to 1}.

If both the initial value and the step are integers,
the loop is done with integers;
note that the limit may not be an integer.
Otherwise, the three values are converted to
floats and the loop is done with floats.
Beware of floating-point accuracy in this case.

After that initialization,
the
loop body is repeated with the value of the control variable
going through an arithmetic progression,
starting at the initial value,
with a common difference given by the step.
A negative step makes a decreasing sequence;
a step equal to zero raises an error.
The loop continues while the value is less than

or equal to the limit
(greater than or equal to for a negative step).
If the initial value is already greater than the limit
(or less than, if the step is negative),
the body is not executed.

For integer loops,
the control variable never wraps around;
instead, the loop ends in case of an overflow.

You should not change the value of the control variable
during the loop.
If you need its value after the loop,
assign it to another variable before exiting the loop.

}

@sect4{@title{The generic @Rw{for} loop}

The generic @Rw{for} statement works over functions,
called @def{iterators}.
On each iteration, the iterator function is called to produce a new value,
stopping when this new
 value is @nil.
The generic @Rw{for} loop has the following syntax:
@Produc{
@producname{stat}@producbody{@Rw{for} namelist @Rw{in} explist
		@Rw{do} block @Rw{end}}
@producname{namelist}@producbody{@bnfNter{Name} @bnfrep{@bnfter{,} @bnfNter{Name}}}
}
A @Rw{for} statement like
@verbatim{
for @rep{var_1}, @Cdots, @rep{var_n} in @rep{explist} do @rep{body} end
}
works as follows.

The names @rep{var_i} declare loop variables local to the loop body.
The first of these variables is the @emph{control variable}.

The loop starts by evaluating @rep{explist}
to produce four values:
an @emph{iterator function},
a @emph{state},
an initial value for the control variable,
and a @emph{closing value}.

Then, at each iteration,

Lua calls the iterator function with two arguments:
the state and the control variable.
The results from this call are then assigned to the loop variables,
following the rules of multiple assignments @see{assignment}.
If the control variable becomes @nil,
the
loop terminates.
Otherwise, the body is executed and the loop goes
to the next iteration.

The closing value behaves like a
to-be-closed variable @see{to-be-closed},
which can be used to release resources when the loop ends.
Otherwise, it does not interfere with the loop.

You should not change the value of the control variable
during the loop.

}

}

@sect3{funcstat| @title{Function Calls as Statements}
To allow possible side-effects,
function calls can be executed as statements:
@Produc{
@producname{stat}@producbody{functioncall}
}
In this case, all returned values are thrown away.
Function calls are explained in @See{functioncall}.

}

@sect3{localvar| @title{Local Declarations}
@x{Local variables} can be declared anywhere inside a block.
The declaration can include an initialization:
@Produc{
@producname{stat}@producbody{@Rw{local} attnamelist @bnfopt{@bnfter{=} explist}}
@producname{attnamelist}@producbody{
@bnfNter{Name} attrib @bnfrep{@bnfter{,} @bnfNter{Name} attrib}}
}
If
present, an initial assignment has the same semantics
of a multiple assignment @see{assignment}.
Otherwise, all variables are initialized with @nil.

Each variable name may be postfixed by an attribute
(a name between angle brackets):

@Produc{
@producname{attrib}@producbody{@bnfopt{@bnfter{<} @bnfNter{Name} @bnfter{>}}}
}
There are two possible attributes:
@id{const}, which declares a @x{constant variable},
that is, a variable that cannot be assigned to
after its initialization;
and @id{close}, which declares a to-be-closed variable @see{to-be-closed}.
A list of variables can contain at most one to-be-closed variable.

A chunk is also a block @see{chunks},
and so local variables can be declared in a chunk outside any explicit block.

The visibility rules for local variables are explained in @See{visibility}.

}

@sect3{to-be-closed| @title{To-be-closed Variables}

A to-be-closed variable behaves like a constant local variable,
except that its value is @emph{closed} whenever the variable
goes
out of scope, including normal block termination,
exiting its block by @Rw{break}/@Rw{goto}/@Rw{return},
or exiting by an error.

Here, to @emph{close} a value means
to call its @idx{__close} metamethod.
When calling the metamethod,
the value itself is passed as the first argument
and the error object that caused the exit (if any)
is passed as a second argument;
if there was no error, the second argument is @nil.

The value assigned to a to-be-closed variable
must have a @idx{__close} metamethod
or be a false value.
(@nil and @false are ignored as to-be-closed values.)

If several to-be-closed variables go out of scope at the same event,
they are closed in the reverse order that they were declared.

If there is any error while running a closing method,
that error is handled like an error in the regular code
where the variable was defined.
After an error,
the other pending closing methods will still be called.

If a coroutine yields and is never resumed again,
some variables may
never go out of scope,
and therefore they will never be closed.
(These variables are the ones created inside the coroutine
and in scope at the point where the coroutine yielded.)
Similarly, if a coroutine ends with an error,
it does not unwind its stack,
so it does not close any variable.
In both cases,
you can either use finalizers
or call @Lid{coroutine.close} to close the variables.
However, if the coroutine was created
through @Lid{coroutine.wrap},
then its corresponding function will close the coroutine
in case of errors.

}

}

@sect2{expressions| @title{Expressions}

@simplesect{

The basic expressions in Lua are the following:
@Produc{
@producname{exp}@producbody{prefixexp}
@producname{exp}@producbody{@Rw{nil} @Or @Rw{false} @Or @Rw{true}}
@producname{exp}@producbody{@bnfNter{Numeral}}
@producname{exp}@producbody{@bnfNter{LiteralString}}
@producname{exp}@producbody{functiondef}
@producname{exp}@producbody{tableconstructor}
@producname{exp}@producbody{@bnfter{...}}
@producname{exp}@producbody{exp
binop exp}
@producname{exp}@producbody{unop exp}
@producname{prefixexp}@producbody{var @Or functioncall @Or
@bnfter{(} exp @bnfter{)}}
}

Numerals and literal strings are explained in @See{lexical};
variables are explained in @See{variables};
function definitions are explained in @See{func-def};
function calls are explained in @See{functioncall};
table constructors are explained in @See{tableconstructor}.
Vararg expressions,
denoted by three dots (@Char{...}), can only be used when

directly inside a variadic function;
they are explained in @See{func-def}.

Binary operators comprise arithmetic operators @see{arith},
bitwise operators @see{bitwise},
relational operators @see{rel-ops}, logical operators @see{logic},
and the concatenation operator @see{concat}.
Unary operators comprise the unary minus @see{arith},
the unary bitwise NOT @see{bitwise},
the unary logical @Rw{not} @see{logic},
and the unary @def{length operator} @see{len-op}.

}

@sect3{arith|
 @title{Arithmetic Operators}
Lua supports the following @x{arithmetic operators}:
@description{
@item{@T{+}|addition}
@item{@T{-}|subtraction}
@item{@T{*}|multiplication}
@item{@T{/}|float division}
@item{@T{//}|floor division}
@item{@T{%}|modulo}
@item{@T{^}|exponentiation}
@item{@T{-}|unary minus}
}

With the exception of exponentiation and float division,
the arithmetic operators work as follows:
If both operands are integers,
the operation is performed over integers and the result is an integer.
Otherwise, if both operands are numbers,
then they are converted to floats,
the operation is performed following the machine's rules
for floating-point arithmetic
(usually the @x{IEEE 754} standard),
and the result is a float.
(The string library coerces strings to numbers in
arithmetic operations; see @See{coercion} for details.)

Exponentiation and float division (@T{/})
always convert their operands to floats
and the result is always a float.
Exponentiation uses the

@ANSI{pow},
so that it works for non-integer exponents too.

Floor division (@T{//}) is a division
that rounds the quotient towards minus infinity,
resulting in the floor of the division of its operands.

Modulo is defined as the remainder of a division
that rounds the quotient towards minus infinity (floor division).

In case of overflows in integer arithmetic,
all operations @emphx{wrap around}.
}

@sect3{bitwise| @title{Bitwise Operators}
Lua supports the following @x{bitwise operators}:
@description{
@item{@T{&}|bitwise AND}
@item{@T{@VerBar}|bitwise OR}
@item{@T{~}|bitwise exclusive OR}
@item{@T{>>}|right shift}
@item{@T{<<}|left shift}
@item{@T{~}|unary bitwise NOT}
}

All bitwise operations convert its operands to integers
@see{coercion},
operate on all bits of those integers,
and result in an integer.

Both right and left shifts fill the vacant bits with zeros.
Negative displacements shift to the other direction;
displacements with absolute values equal to or higher than
the
number of bits in an integer
result in zero (as all bits are shifted out).

}

@sect3{coercion| @title{Coercions and Conversions}
Lua provides some automatic conversions between some
types and representations at run time.
Bitwise operators always convert float operands to integers.
Exponentiation and float division
always convert integer operands to floats.
All other arithmetic operations applied to mixed numbers
(integers and floats) convert the integer operand to a float.
The C API also converts both integers to floats and

floats to integers, as needed.
Moreover, string concatenation accepts numbers as arguments,
besides strings.

In a conversion from integer to float,
if the integer value has an exact representation as a float,
that is the result.
Otherwise,
the conversion gets the nearest higher or
the nearest lower representable value.
This kind of conversion never fails.

The conversion from float to integer
checks whether the float has an exact representation as an integer
(that
is, the float has an integral value and
it is in the range of integer representation).
If it does, that representation is the result.
Otherwise, the conversion fails.

Several places in Lua coerce strings to numbers when necessary.
In particular,
the string library sets metamethods that try to coerce
strings to numbers in all arithmetic operations.
If the conversion fails,
the library calls the metamethod of the other operand
(if present) or it raises an error.
Note that bitwise operators do not do this coercion.

It is always a good practice not to rely on the
implicit coercions from strings to numbers,
as they are not always applied;
in particular, @T{"1"==1} is false and @T{"1"<1} raises an error
@see{rel-ops}.
These coercions exist mainly for compatibility and may be removed
in future versions of the language.

A string is converted to an integer or a float
following its syntax and the rules of the Lua lexer.
The string may have also leading and trailing whitespaces and a sign.
All
conversions from strings to numbers
accept both a dot and the current locale mark
as the radix character.
(The Lua lexer, however, accepts only a dot.)
If the string is not a valid numeral,
the conversion fails.
If necessary, the result of this first step is then converted

to a specific number subtype following the previous rules
for conversions between floats and integers.

The conversion from numbers to strings uses a
non-specified human-readable format.
To convert numbers to strings in any specific way,
use the function @Lid{string.format}.

}

@sect3{rel-ops| @title{Relational Operators}
Lua supports the following @x{relational operators}:
@description{
@item{@T{==}|equality}
@item{@T{~=}|inequality}
@item{@T{<}|less than}
@item{@T{>}|greater than}
@item{@T{<=}|less or equal}
@item{@T{>=}|greater or equal}
}
These operators always result in @false or @true.

Equality (@T{==}) first compares the type of its operands.
If the types are different, then the result is @false.
Otherwise,
the values of the operands are compared.
Strings are equal if they have the same byte content.
Numbers are equal if they denote the same mathematical value.

Tables, userdata, and threads
are compared by reference:
two objects are considered equal only if they are the same object.
Every time you create a new object
(a table, a userdata, or a thread),
this new object is different from any previously existing object.
A function is always equal to itself.
Functions with any detectable difference
(different behavior, different definition) are always different.
Functions created at different times but with no detectable differences
may be classified as equal or not
(depending on internal caching details).

You can change the way that Lua compares tables and userdata
by using the @idx{__eq} metamethod @see{metatable}.

Equality comparisons do not convert strings to numbers
or vice versa.
Thus, @T{"0"==0} evaluates to @false,

and @T{t[0]} and @T{t["0"]} denote different
entries in a table.

The
operator @T{~=} is exactly the negation of equality (@T{==}).

The order operators work as follows.
If both arguments are numbers,
then they are compared according to their mathematical values,
regardless of their subtypes.
Otherwise, if both arguments are strings,
then their values are compared according to the current locale.
Otherwise, Lua tries to call the @idx{__lt} or the @idx{__le}
metamethod @see{metatable}.
A comparison @T{a > b} is translated to @T{b < a}
and @T{a >= b} is translated to @T{b <= a}.

Following the @x{IEEE 754} standard,
the special value @x{NaN} is considered neither less than,
nor equal to, nor greater than any value, including itself.

}

@sect3{logic| @title{Logical Operators}
The @x{logical operators} in Lua are
@Rw{and}, @Rw{or}, and @Rw{not}.
Like the control structures @see{control},
all logical operators consider both @false and @nil as false
and anything else as true.

The negation operator @Rw{not} always returns @false or @true.
The conjunction
operator @Rw{and} returns its first argument
if this value is @false or @nil;
otherwise, @Rw{and} returns its second argument.
The disjunction operator @Rw{or} returns its first argument
if this value is different from @nil and @false;
otherwise, @Rw{or} returns its second argument.
Both @Rw{and} and @Rw{or} use @x{short-circuit evaluation};
that is,
the second operand is evaluated only if necessary.
Here are some examples:
@verbatim{
10 or 20 --> 10
10 or error() --> 10
nil or "a" --> "a"
nil and 10 --> nil
false and error() --> false

false and nil --> false
false or nil --> nil
10 and 20 --> 20
}

}

@sect3{concat| @title{Concatenation}
The string @x{concatenation} operator in Lua is
denoted by two dots (@Char{..}).
If both operands are strings or numbers,
then the numbers are converted to strings
in a non-specified format @see{coercion}.
Otherwise, the @idx{__concat} metamethod is called @see{metatable}.

}

@sect3{len-op|
@title{The Length Operator}

The length operator is denoted by the unary prefix operator @T{#}.

The length of a string is its number of bytes.
(That is the usual meaning of string length when each
character is one byte.)

The length operator applied on a table
returns a @x{border} in that table.
A @def{border} in a table @id{t} is any non-negative integer
that satisfies the following condition:
@verbatim{
(border == 0 or t[border] ~= nil) and
(t[border + 1] == nil or border == math.maxinteger)
}
In words,
a border is any positive integer index present in the table
that is followed by an absent index,
plus two limit cases:
zero, when index 1 is absent;
and the maximum value for an integer, when that index is present.
Note that keys that are not positive integers
do not interfere with borders.

A table with exactly one border is called a @def{sequence}.
For instance, the table @T{{10, 20, 30, 40, 50}} is a sequence,
as it has only one border (5).
The table @T{{10, 20, 30, nil, 50}} has

two borders (3 and 5),
and therefore it is not a sequence.
(The @nil at index 4 is called a @emphx{hole}.)
The table @T{{nil, 20, 30, nil, nil, 60, nil}}
has three borders (0, 3, and 6),
so it is not a sequence, too.
The table @T{{}} is a sequence with border 0.

When @id{t} is a sequence,
@T{#t} returns its only border,
which corresponds to the intuitive notion of the length of the sequence.
When @id{t} is not a sequence,
@T{#t} can return any of its borders.
(The exact one depends on details of
the internal representation of the table,
which in turn can depend on how the table was populated and
the memory addresses of its non-numeric keys.)

The computation of the length of a table
has a guaranteed worst time of @M{O(log n)},
where @M{n} is the largest integer key in the table.

A program can modify the behavior of the length operator for
any value but strings through the @idx{__len} metamethod @see{metatable}.

}

@sect3{prec| @title{Precedence}
@x{Operator precedence} in Lua follows
the table below,
from lower to higher priority:
@verbatim{
or
and
< > <= >= ~= ==
|
~
&
<< >>
..
+ -
* / // %
unary operators (not # - ~)
^
}
As usual,
you can use parentheses to change the precedences of an expression.
The concatenation (@Char{..}) and exponentiation (@Char{^})

operators are right associative.
All other binary operators are left associative.

}

@sect3{tableconstructor| @title{Table Constructors}
Table @x{constructors} are expressions that create tables.
Every time a constructor is evaluated, a new table is created.
A constructor can be used to create an empty table
or to create a table and initialize some of its fields.
The general syntax for constructors is
@Produc{
@producname{tableconstructor}@producbody{@bnfter{@Open} @bnfopt{fieldlist} @bnfter{@Close}}
@producname{fieldlist}@producbody{field @bnfrep{fieldsep field} @bnfopt{fieldsep}}
@producname{field}@producbody{@bnfter{[} exp @bnfter{]} @bnfter{=} exp @Or

@bnfNter{Name} @bnfter{=} exp @Or exp}
@producname{fieldsep}@producbody{@bnfter{,} @Or @bnfter{;}}
}

Each field of the form @T{[exp1] = exp2} adds to the new table an entry
with key @id{exp1} and value @id{exp2}.
A field of the form @T{name = exp} is equivalent to
@T{["name"] = exp}.
Fields of the form @id{exp} are equivalent to
@T{[i] = exp}, where @id{i} are consecutive integers
starting with 1;
fields in the other formats do not affect this counting.
For example,
@verbatim{
a = { [f(1)] = g; "x", "y"; x = 1, f(x), [30] = 23; 45 }
}
is equivalent to
@verbatim{
do
 local t = {}
 t[f(1)] = g
 t[1] = "x"   -- 1st exp
 t[2] = "y"   -- 2nd exp
 t.x = 1   -- t["x"] = 1
 t[3] = f(x)   -- 3rd exp
 t[30] = 23
 t[4] = 45   -- 4th exp
 a = t
end
}

The order of the assignments in a constructor is undefined.

(This order would be relevant only when there are repeated keys.)

If the last field in the list has the form @id{exp}
and the expression
 is a multires expression,
then all values returned by this expression enter the list consecutively
@see{multires}.

The field list can have an optional trailing separator,
as a convenience for machine-generated code.

}

@sect3{functioncall| @title{Function Calls}
A @x{function call} in Lua has the following syntax:
@Produc{
@producname{functioncall}@producbody{prefixexp args}
}
In a function call,
first @bnfNter{prefixexp} and @bnfNter{args} are evaluated.
If the value of @bnfNter{prefixexp} has type @emph{function},
then this function is called
with the given arguments.
Otherwise, if present,
the @bnfNter{prefixexp} @idx{__call} metamethod is called:
its first argument is the value of @bnfNter{prefixexp},
followed by the original call arguments
@see{metatable}.

The form
@Produc{
@producname{functioncall}@producbody{prefixexp @bnfter{:} @bnfNter{Name} args}
}
can be used to emulate methods.
A call @T{v:name(@rep{args})}
is syntactic sugar for @T{v.name(v,@rep{args})},
except that @id{v}
 is evaluated only once.

Arguments have the following syntax:
@Produc{
@producname{args}@producbody{@bnfter{(} @bnfopt{explist} @bnfter{)}}
@producname{args}@producbody{tableconstructor}
@producname{args}@producbody{@bnfNter{LiteralString}}
}
All argument expressions are evaluated before the call.
A call of the form @T{f{@rep{fields}}} is
syntactic sugar for @T{f({@rep{fields}})};

that is, the argument list is a single new table.
A call of the form @T{f'@rep{string}'}
(or @T{f"@rep{string}"} or @T{f[[@rep{string}]]})
is syntactic sugar for @T{f('@rep{string}')};
that is, the argument list is a single literal string.

A call of the form @T{return @rep{functioncall}} not in the
scope of a to-be-closed variable is called a @def{tail call}.
Lua implements @def{proper tail calls}
(or @def{proper tail recursion}):
In a tail call,
the called function reuses the stack entry of the calling function.
Therefore, there is no limit on the number of nested tail calls that
a program can execute.
However,
a tail call erases any debug information about the
calling function.
Note that a tail call only happens with a particular syntax,
where the @Rw{return} has one single function call as argument,
and it is outside the scope of any to-be-closed variable.
This syntax makes the calling function return exactly
the returns of the called function,
without any intervening action.
So, none of the following examples are tail calls:
@verbatim{
return (f(x))   -- results adjusted to 1
return 2 * f(x)   -- result multiplied by 2
return x, f(x)   -- additional results
f(x); return   -- results discarded
return x or f(x)   -- results adjusted to 1
}

}

@sect3{func-def| @title{Function Definitions}

The syntax for function definition is
@Produc{
@producname{functiondef}@producbody{@Rw{function} funcbody}
@producname{funcbody}@producbody{@bnfter{(} @bnfopt{parlist} @bnfter{)} block @Rw{end}}
}

The following syntactic sugar simplifies function definitions:
@Produc{
@producname{stat}@producbody{@Rw{function}
funcname funcbody}
@producname{stat}@producbody{@Rw{local} @Rw{function} @bnfNter{Name} funcbody}
@producname{funcname}@producbody{@bnfNter{Name} @bnfrep{@bnfter{.} @bnfNter{Name}}

@bnfopt{@bnfter{:} @bnfNter{Name}}}
}
The statement
@verbatim{
function f () @rep{body} end
}
translates to
@verbatim{
f = function () @rep{body} end
}
The statement
@verbatim{
function t.a.b.c.f () @rep{body} end
}
translates to
@verbatim{
t.a.b.c.f = function () @rep{body} end
}
The statement
@verbatim{
local function f () @rep{body} end
}
translates to
@verbatim{
local f; f = function () @rep{body} end
}
not to
@verbatim{
local f = function () @rep{body} end
}
(This only makes a difference when the body of the function
contains references to @id{f}.)

A function definition is an executable expression,
whose value has type @emph{function}.
When Lua precompiles a chunk,
all its function bodies are precompiled too,
but they are not created yet.
Then, whenever Lua executes the
function definition,
the function is @emph{instantiated} (or @emph{closed}).
This function instance, or @emphx{closure},
is the final value of the expression.

Parameters act as local variables that are
initialized with the argument values:
@Produc{
@producname{parlist}@producbody{namelist @bnfopt{@bnfter{,} @bnfter{...}} @Or

@bnfter{...}}
}
When a Lua function is called,
it adjusts its list of @x{arguments} to
the length of its list of parameters @see{multires},
unless the function is a @def{variadic function},
which is indicated by three dots (@Char{...})
at the end of its parameter list.
A variadic function does not adjust its argument list;
instead, it collects all extra arguments and supplies them
to the function through a @def{vararg expression},
which is also written as three dots.
The value of this expression is a list of all actual extra arguments,
similar to a function with multiple results @see{multires}.

As an example, consider the following definitions:
@verbatim{
function
f(a, b) end
function g(a, b, ...) end
function r() return 1,2,3 end
}
Then, we have the following mapping from arguments to parameters and
to the vararg expression:
@verbatim{
CALL PARAMETERS

f(3) a=3, b=nil
f(3, 4) a=3, b=4
f(3, 4, 5) a=3, b=4
f(r(), 10) a=1, b=10
f(r()) a=1, b=2

g(3) a=3, b=nil, ... --> (nothing)
g(3, 4) a=3, b=4, ... --> (nothing)
g(3, 4, 5, 8) a=3, b=4, ... --> 5 8
g(5, r()) a=5, b=1, ... --> 2 3
}

Results are returned using the @Rw{return} statement @see{control}.
If control reaches the end of a function
without encountering a @Rw{return} statement,
then the function returns with no results.

@index{multiple return}
There is a system-dependent limit on the number of values
that a function may return.

This limit is guaranteed to be greater than 1000.

The @emphx{colon} syntax
is used to emulate @def{methods},
adding an implicit extra parameter @idx{self} to
the function.
Thus, the statement
@verbatim{
function t.a.b.c:f (@rep{params}) @rep{body} end
}
is syntactic sugar for
@verbatim{
t.a.b.c.f = function (self, @rep{params}) @rep{body} end
}

}

@sect3{multires| @title{Lists of expressions, multiple results,
and adjustment}

Both function calls and vararg expressions can result in multiple values.
These expressions are called @def{multires expressions}.

When a multires expression is used as the last element
of a list of expressions,
all results from the expression are added to the
list of values produced by the list of expressions.
Note that a single expression
in a place that expects a list of expressions
is the last expression in that (singleton) list.

These are the places where Lua expects a list of expressions:
@description{

@item{A @rw{return} statement,
for instance @T{return e1, e2, e3} @see{control}.}

@item{A table constructor,
for instance @T{{e1, e2, e3}} @see{tableconstructor}.}

@item{The arguments of a function call,
for
instance @T{foo(e1, e2, e3)} @see{functioncall}.}

@item{A multiple assignment,
for instance @T{a , b, c = e1, e2, e3} @see{assignment}.}

@item{A local declaration,

for instance @T{local a , b, c = e1, e2, e3} @see{localvar}.}

@item{The initial values in a generic @rw{for} loop,
for instance @T{for k in e1, e2, e3 do ... end} @see{for}.}

}
In the last four cases,
the list of values from the list of expressions
must be @emph{adjusted} to a specific length:
the number of parameters in a call to a non-variadic function
@see{func-def},
the number of variables in a multiple assignment or
a local declaration,
and exactly four values for a generic @rw{for} loop.
The @def{adjustment} follows these rules:
If there are more values than needed,
the extra values are thrown away;
if there are fewer values than needed,
the list is extended with @nil's.
When the list of expressions ends with a multires expression,
all results from that expression enter the list of values
before the adjustment.

When
a multires expression is used
in a list of expressions without being the last element,
or in a place where the syntax expects a single expression,
Lua adjusts the result list of that expression to one element.
As a particular case,
the syntax expects a single expression inside a parenthesized expression;
therefore, adding parentheses around a multires expression
forces it to produce exactly one result.

We seldom need to use a vararg expression in a place
where the syntax expects a single expression.
(Usually it is simpler to add a regular parameter before
the variadic part and use that parameter.)
When there is such a need,
we recommend assigning the vararg expression
to a single variable and using that variable
in its place.

Here are some examples of uses of mutlres expressions.
In all cases, when the construction needs
@Q{the n-th result} and there is no such result,
it uses a @nil.
@verbatim{
print(x, f())   -- prints x and all results from f().

```
print(x, (f()))    -- prints
 x and the first result from f().
print(f(), x)      -- prints the first result from f() and x.
print(1 + f())     -- prints 1 added to the first result from f().
local x = ...      -- x gets the first vararg argument.
x,y = ...          -- x gets the first vararg argument,
                   -- y gets the second vararg argument.
x,y,z = w, f()     -- x gets w, y gets the first result from f(),
                   -- z gets the second result from f().
x,y,z = f()        -- x gets the first result from f(),
                   -- y gets the second result from f(),
                   -- z gets the third result from f().
x,y,z = f(), g()   -- x gets the first result from f(),
                   -- y gets the first result from g(),
                   -- z gets the second result from g().
x,y,z = (f())      -- x gets the first result from f(), y and z get nil.
return f()         -- returns all results from f().
return x, ...      -- returns x and all received vararg arguments.
return x,y,f()
    -- returns x, y, and all results from f().
{f()}              -- creates a list with all results from f().
{...}              -- creates a list with all vararg arguments.
{f(), 5}           -- creates a list with the first result from f() and 5.
}

}

}
```

@sect2{visibility| @title{Visibility Rules}

@index{visibility}
Lua is a lexically scoped language.
The scope of a local variable begins at the first statement after
its declaration and lasts until the last non-void statement
of the innermost block that includes the declaration.
(@emph{Void statements} are labels and empty statements.)
Consider the following example:

```
@verbatim{
x = 10                -- global variable
do                    -- new block
 local x = x          -- new 'x', with value 10
 print(x)             --> 10
 x = x+1
 do                   -- another block
   local x = x+1      -- another 'x'
   print(x)           --> 12
 end
```

```
 print(x)          --> 11
end
print(x)           --> 10  (the global one)
}
```

Notice
that, in a declaration like @T{local x = x},
the new @id{x} being declared is not in scope yet,
and so the second @id{x} refers to the outside variable.

Because of the @x{lexical scoping} rules,
local variables can be freely accessed by functions
defined inside their scope.
A local variable used by an inner function is called an @def{upvalue}
(or @emphx{external local variable}, or simply @emphx{external variable})
inside the inner function.

Notice that each execution of a @Rw{local} statement
defines new local variables.
Consider the following example:

```
@verbatim{
a = {}
local x = 20
for i = 1, 10 do
 local y = 0
 a[i] = function () y = y + 1; return x + y end
end
}
```

The loop creates ten closures
(that is, ten instances of the anonymous function).
Each of these closures uses a different @id{y} variable,
while all of them share the same @id{x}.

}

}

```
@C{-----------------------------------------------------------------------}
@sect1{API| @title{The Application Program Interface}

@simplesect{

@index{C
 API}
```

This section describes the @N{C API} for Lua, that is,
the set of @N{C functions} available to the host program to communicate
with Lua.

All API functions and related types and constants
are declared in the header file @defid{lua.h}.

Even when we use the term @Q{function},
any facility in the API may be provided as a macro instead.
Except where stated otherwise,
all such macros use each of their arguments exactly once
(except for the first argument, which is always a Lua state),
and so do not generate any hidden side-effects.

As in most @N{C libraries},
the Lua API functions do not check their arguments
for validity or consistency.
However, you can change this behavior by compiling Lua
with the macro @defid{LUA_USE_APICHECK} defined.

The Lua library is fully reentrant:
it has no global variables.
It keeps all information it needs in a dynamic structure,
called the @def{Lua state}.

Each Lua state has one or more threads,
which correspond to independent,
 cooperative lines of execution.
The type @Lid{lua_State} (despite its name) refers to a thread.
(Indirectly, through the thread, it also refers to the
Lua state associated to the thread.)

A pointer to a thread must be passed as the first argument to
every function in the library, except to @Lid{lua_newstate},
which creates a Lua state from scratch and returns a pointer
to the @emph{main thread} in the new state.

}

@sect2{@title{The Stack}

@simplesect{

Lua uses a @emph{virtual stack} to pass values to and from C.
Each element in this stack represents a Lua value
(@nil, number, string, etc.).
Functions in the API can access this stack through the
Lua state parameter that they receive.

Whenever Lua calls C, the called function gets a new stack,
which is independent of previous stacks and of stacks of

@N{C functions} that are still active.
This stack initially contains any arguments to the @N{C function}
and it is where the @N{C function} can store temporary
Lua values and must push
 its results
to be returned to the caller @seeC{lua_CFunction}.

For convenience,
most query operations in the API do not follow a strict stack discipline.
Instead, they can refer to any element in the stack
by using an @emph{index}:@index{index (API stack)}
A positive index represents an absolute stack position,
starting @N{at 1} as the bottom of the stack;
a negative index represents an offset relative to the top of the stack.
More specifically, if the stack has @rep{n} elements,
then @N{index 1} represents the first element
(that is, the element that was pushed onto the stack first)
and
@N{index @rep{n}} represents the last element;
@N{index @num{-1}} also represents the last element
(that is, the element at @N{the top})
and index @M{-n} represents the first element.

}

@sect3{stacksize| @title{Stack Size}

When you interact with the Lua API,
you are responsible for ensuring consistency.
In particular,
@emph{you are responsible for controlling stack overflow}.
When you call any
 API function,
you must ensure the stack has enough room to accommodate the results.

There is one exception to the above rule:
When you call a Lua function
without a fixed number of results @seeF{lua_call},
Lua ensures that the stack has enough space for all results.
However, it does not ensure any extra space.
So, before pushing anything on the stack after such a call
you should use @Lid{lua_checkstack}.

Whenever Lua calls C,
it ensures that the stack has space for
at least @defid{LUA_MINSTACK} extra elements;
that is, you can safely push up to @id{LUA_MINSTACK} values into it.
@id{LUA_MINSTACK} is defined as 20,

so that usually you do not have to worry about stack space
unless your code has loops pushing elements onto the stack.
Whenever necessary,
you can use the function @Lid{lua_checkstack}
to ensure that the stack has enough space for pushing new elements.

}

@sect3{@title{Valid and Acceptable Indices}

Any function in the API that receives stack indices
works only with @emphx{valid
 indices} or @emphx{acceptable indices}.

A @def{valid index} is an index that refers to a
position that stores a modifiable Lua value.
It comprises stack indices @N{between 1} and the stack top
(@T{1 @leq abs(index) @leq top})
@index{stack index}
plus @def{pseudo-indices},
which represent some positions that are accessible to @N{C code}
but that are not in the stack.
Pseudo-indices are used to access the registry @see{registry}
and the upvalues of a @N{C function} @see{c-closure}.

Functions that do not need a specific mutable position,
but only a value (e.g., query functions),
can be called with acceptable indices.
An @def{acceptable index} can be any valid index,
but it also can be any positive index after the stack top
within the space allocated for the stack,
that is, indices up to the stack size.
(Note that 0 is never an acceptable index.)
Indices to upvalues @see{c-closure} greater than the real number
of upvalues in the current @N{C function} are also acceptable (but invalid).
Except
 when noted otherwise,
functions in the API work with acceptable indices.

Acceptable indices serve to avoid extra tests
against the stack top when querying the stack.
For instance, a @N{C function} can query its third argument
without the need to check whether there is a third argument,
that is, without the need to check whether 3 is a valid index.

For functions that can be called with acceptable indices,
any non-valid index is treated as if it
contains a value of a virtual type @defid{LUA_TNONE},

which behaves like a nil value.

}

@sect3{constchar|@title{Pointers to strings}

Several functions in the API return pointers (@T{const char*})
to Lua strings in the stack.
(See @Lid{lua_pushfstring}, @Lid{lua_pushlstring},
@Lid{lua_pushstring}, and @Lid{lua_tolstring}.
See also @Lid{luaL_checklstring}, @Lid{luaL_checkstring},
and @Lid{luaL_tolstring} in the auxiliary library.)

In general,
Lua's garbage collection can free or move internal memory
and then invalidate pointers to
internal strings.
To allow a safe use of these pointers,
the API guarantees that any pointer to a string in a stack index
is valid while the string value at that index is not removed from the stack.
(It can be moved to another index, though.)
When the index is a pseudo-index (referring to an upvalue),
the pointer is valid while the corresponding call is active and
the corresponding upvalue is not modified.

Some functions in the debug interface
also return pointers to strings,
namely @Lid{lua_getlocal}, @Lid{lua_getupvalue},
@Lid{lua_setlocal}, and @Lid{lua_setupvalue}.
For these functions, the pointer is guaranteed to
be valid while the caller function is active and
the given closure (if one was given) is in the stack.

Except for these guarantees,
the garbage collector is free to invalidate
any pointer to internal strings.

}

}

@sect2{c-closure| @title{C Closures}

When a @N{C function} is created,
it is possible to associate some values with it,
thus creating a @def{@N{C closure}}
@seeC{lua_pushcclosure};
these

values are called @def{upvalues} and are
accessible to the function whenever it is called.

Whenever a @N{C function} is called,
its upvalues are located at specific pseudo-indices.
These pseudo-indices are produced by the macro
@Lid{lua_upvalueindex}.
The first upvalue associated with a function is at index
@T{lua_upvalueindex(1)}, and so on.
Any access to @T{lua_upvalueindex(@rep{n})},
where @rep{n} is greater than the number of upvalues of the
current function
(but not greater than 256,
which is one plus the maximum number of upvalues in a closure),
produces an acceptable but invalid index.

A @N{C closure} can also change the values
of its corresponding upvalues.

}

@sect2{registry| @title{Registry}

Lua provides a @def{registry},
a predefined table that can be used by any @N{C code} to
store whatever Lua values it needs to store.
The registry table is always accessible at pseudo-index
@defid{LUA_REGISTRYINDEX}.
Any @N{C library} can store data into
this table,
but it must take care to choose keys
that are different from those used
by other libraries, to avoid collisions.
Typically, you should use as key a string containing your library name,
or a light userdata with the address of a @N{C object} in your code,
or any Lua object created by your code.
As with variable names,
string keys starting with an underscore followed by
uppercase letters are reserved for Lua.

The integer keys in the registry are used
by the reference mechanism @seeC{luaL_ref}
and by some predefined values.
Therefore, integer keys in the registry
must not be used for other purposes.

When you create a new Lua state,
its registry comes with some predefined values.

These predefined values are indexed with integer keys
defined as constants in @id{lua.h}.
The following constants are defined:
@description{
@item{@defid{LUA_RIDX_MAINTHREAD}| At this index the registry has
the main thread of the state.
(The main thread is the one created together with the state.)
}

@item{@defid{LUA_RIDX_GLOBALS}|
 At this index the registry has
the @x{global environment}.
}
}

}

@sect2{C-error|@title{Error Handling in C}

@simplesect{

Internally, Lua uses the C @id{longjmp} facility to handle errors.
(Lua will use exceptions if you compile it as C++;
search for @id{LUAI_THROW} in the source code for details.)
When Lua faces any error,
such as a @x{memory allocation error} or a type error,
it @emph{raises} an error;
that is, it does a long jump.
A @emphx{protected environment} uses @id{setjmp}
to set a recovery point;
any error jumps to the most recent active recovery point.

Inside a @N{C function} you can raise an error explicitly
by calling @Lid{lua_error}.

Most functions in the API can raise an error,
for instance due to a @x{memory allocation error}.
The documentation for each function indicates whether
it can raise errors.

If an error happens outside any protected environment,
Lua calls a @def{panic function} (see @Lid{lua_atpanic})
and then calls @T{abort},
thus
 exiting the host application.
Your panic function can avoid this exit by
never returning
(e.g., doing a long jump to your own recovery point outside Lua).

The panic function,
as its name implies,
is a mechanism of last resort.
Programs should avoid it.
As a general rule,
when a @N{C function} is called by Lua with a Lua state,
it can do whatever it wants on that Lua state,
as it should be already protected.
However,
when C code operates on other Lua states
(e.g., a Lua-state argument to the function,
a Lua state stored in the registry, or
the result of @Lid{lua_newthread}),
it should use them only in API calls that cannot raise errors.

The panic function runs as if it were a @x{message handler} @see{error};
in particular, the error object is on the top of the stack.
However, there is no guarantee about stack space.
To push anything on the stack,
the panic function must first check the available space @see{stacksize}.

}

@sect3{statuscodes|@title{Status Codes}

Several functions
that report errors in the API use the following
status codes to indicate different kinds of errors or other conditions:
@description{

@item{@defid{LUA_OK} (0)| no errors.}

@item{@defid{LUA_ERRRUN}| a runtime error.}

@item{@defid{LUA_ERRMEM}|
@x{memory allocation error}.
For such errors, Lua does not call the @x{message handler}.
}

@item{@defid{LUA_ERRERR}| error while running the @x{message handler}.}

@item{@defid{LUA_ERRSYNTAX}| syntax error during precompilation.}

@item{@defid{LUA_YIELD}| the thread (coroutine) yields.}

@item{@defid{LUA_ERRFILE}| a file-related error;

e.g., it cannot open or read the file.}

}
These constants are defined in the header file @id{lua.h}.

}

}

@sect2{continuations|@title{Handling Yields in C}

Internally, Lua uses the C @id{longjmp} facility to yield a coroutine.
Therefore, if a @N{C function} @id{foo} calls an API function
and this API function yields
(directly or indirectly by calling another function that yields),
Lua cannot return to
@id{foo} any more,
because the @id{longjmp} removes its frame from the @N{C stack}.

To avoid this kind of problem,
Lua raises an error whenever it tries to yield across an API call,
except for three functions:
@Lid{lua_yieldk}, @Lid{lua_callk}, and @Lid{lua_pcallk}.
All those functions receive a @def{continuation function}
(as a parameter named @id{k}) to continue execution after a yield.

We need to set some terminology to explain continuations.
We have a @N{C function} called from Lua which we will call
the @emph{original function}.
This original function then calls one of those three functions in the C API,
which we will call the @emph{callee function},
that then yields the current thread.
This can happen when the callee function is @Lid{lua_yieldk},
or when the callee function is either @Lid{lua_callk} or @Lid{lua_pcallk}
and the function called by them yields.

Suppose the running thread yields while executing the callee function.
After the thread resumes,
it eventually will finish
running the callee function.
However,
the callee function cannot return to the original function,
because its frame in the @N{C stack} was destroyed by the yield.
Instead, Lua calls a @def{continuation function},
which was given as an argument to the callee function.
As the name implies,
the continuation function should continue the task
of the original function.

As an illustration, consider the following function:
@verbatim{
int original_function (lua_State *L) {
 ...   /* code 1 */
 status = lua_pcall(L, n, m, h); /* calls Lua */
 ...   /* code 2 */
}
}
Now we want to allow
the Lua code being run by @Lid{lua_pcall} to yield.
First, we can rewrite our function like here:
@verbatim{
int k (lua_State *L, int status, lua_KContext ctx) {
 ... /* code 2 */
}

int original_function (lua_State *L) {
 ...   /* code 1 */
 return k(L, lua_pcall(L, n, m, h), ctx);
}
}
In the above code,
the new function @id{k} is a
@emph{continuation function} (with type @Lid{lua_KFunction}),
which
 should do all the work that the original function
was doing after calling @Lid{lua_pcall}.
Now, we must inform Lua that it must call @id{k} if the Lua code
being executed by @Lid{lua_pcall} gets interrupted in some way
(errors or yielding),
so we rewrite the code as here,
replacing @Lid{lua_pcall} by @Lid{lua_pcallk}:
@verbatim{
int original_function (lua_State *L) {
 ...   /* code 1 */
 return k(L, lua_pcallk(L, n, m, h, ctx2, k), ctx1);
}
}
Note the external, explicit call to the continuation:
Lua will call the continuation only if needed, that is,
in case of errors or resuming after a yield.
If the called function returns normally without ever yielding,
@Lid{lua_pcallk} (and @Lid{lua_callk}) will also return normally.
(Of course, instead of calling the continuation in that case,
you can do the equivalent work directly inside the original function.)

Besides the Lua state,

the continuation function has two other parameters:
the final status of the call and the context value
(@id{ctx}) that
was passed originally to @Lid{lua_pcallk}.
Lua does not use this context value;
it only passes this value from the original function to the
continuation function.
For @Lid{lua_pcallk},
the status is the same value that would be returned by @Lid{lua_pcallk},
except that it is @Lid{LUA_YIELD} when being executed after a yield
(instead of @Lid{LUA_OK}).
For @Lid{lua_yieldk} and @Lid{lua_callk},
the status is always @Lid{LUA_YIELD} when Lua calls the continuation.
(For these two functions,
Lua will not call the continuation in case of errors,
because they do not handle errors.)
Similarly, when using @Lid{lua_callk},
you should call the continuation function
with @Lid{LUA_OK} as the status.
(For @Lid{lua_yieldk}, there is not much point in calling
directly the continuation function,
because @Lid{lua_yieldk} usually does not return.)

Lua treats the continuation function as if it were the original function.
The continuation function receives the same Lua stack
from the original
function,
in the same state it would be if the callee function had returned.
(For instance,
after a @Lid{lua_callk} the function and its arguments are
removed from the stack and replaced by the results from the call.)
It also has the same upvalues.
Whatever it returns is handled by Lua as if it were the return
of the original function.

}

@sect2{@title{Functions and Types}

Here we list all functions and types from the @N{C API} in
alphabetical order.
Each function has an indicator like this:
@apii{o,p,x}

The first field, @T{o},
is how many elements the function pops from the stack.
The second field, @T{p},
is how many elements the function pushes onto the stack.

(Any function always pushes its results after popping its arguments.)
A field in the form @T{x|y} means the function can push (or pop)
@T{x} or @T{y} elements,
depending on the situation;
an interrogation mark @Char{?} means that
we cannot know how many elements the function pops/pushes
by looking only at its arguments.
(For
instance, they may depend on what is in the stack.)
The third field, @T{x},
tells whether the function may raise errors:
@Char{-} means the function never raises any error;
@Char{m} means the function may raise only out-of-memory errors;
@Char{v} means the function may raise the errors explained in the text;
@Char{e} means the function can run arbitrary Lua code,
either directly or through metamethods,
and therefore may raise any errors.

@APIEntry{int lua_absindex (lua_State *L, int idx);|
@apii{0,0,-}

Converts the @x{acceptable index} @id{idx}
into an equivalent @x{absolute index}
(that is, one that does not depend on the stack size).

}

@APIEntry{
typedef void * (*lua_Alloc) (void *ud,
                        void *ptr,
                        size_t osize,
                        size_t nsize);|

The type of the @x{memory-allocation function} used by Lua states.
The allocator function must provide a
functionality similar to @id{realloc},
but not exactly the
same.
Its arguments are
@id{ud}, an opaque pointer passed to @Lid{lua_newstate};
@id{ptr}, a pointer to the block being allocated/reallocated/freed;
@id{osize}, the original size of the block or some code about what
is being allocated;
and @id{nsize}, the new size of the block.

When @id{ptr} is not @id{NULL},

@id{osize} is the size of the block pointed by @id{ptr},
that is, the size given when it was allocated or reallocated.

When @id{ptr} is @id{NULL},
@id{osize} encodes the kind of object that Lua is allocating.
@id{osize} is any of
@Lid{LUA_TSTRING}, @Lid{LUA_TTABLE}, @Lid{LUA_TFUNCTION},
@Lid{LUA_TUSERDATA}, or @Lid{LUA_TTHREAD} when (and only when)
Lua is creating a new object of that type.
When @id{osize} is some other value,
Lua is allocating memory for something else.

Lua assumes the following behavior from the allocator function:

When @id{nsize} is zero,
the allocator must behave like @id{free}
and then return @id{NULL}.

When @id{nsize} is not zero,
the allocator must behave
like @id{realloc}.
In particular, the allocator returns @id{NULL}
if and only if it cannot fulfill the request.

Here is a simple implementation for the @x{allocator function}.
It is used in the auxiliary library by @Lid{luaL_newstate}.
@verbatim{
```
static void *l_alloc (void *ud, void *ptr, size_t osize,
                                  size_t nsize) {
 (void)ud;  (void)osize;  /* not used */
 if (nsize == 0) {
   free(ptr);
   return NULL;
 }
 else
   return realloc(ptr, nsize);
}
```
}
Note that @N{ISO C} ensures
that @T{free(NULL)} has no effect and that
@T{realloc(NULL,size)} is equivalent to @T{malloc(size)}.

}

@APIEntry{void lua_arith (lua_State *L, int op);|
@apii{2|1,1,e}

Performs an arithmetic or bitwise operation over the two values

(or one, in the case of negations)
at the top of the stack,
with the value on the top being the second operand,
pops these values, and pushes the result of the operation.
The function follows the semantics of the corresponding Lua
 operator
(that is, it may call metamethods).

The value of @id{op} must be one of the following constants:
@description{

@item{@defid{LUA_OPADD}| performs addition (@T{+})}
@item{@defid{LUA_OPSUB}| performs subtraction (@T{-})}
@item{@defid{LUA_OPMUL}| performs multiplication (@T{*})}
@item{@defid{LUA_OPDIV}| performs float division (@T{/})}
@item{@defid{LUA_OPIDIV}| performs floor division (@T{//})}
@item{@defid{LUA_OPMOD}| performs modulo (@T{%})}
@item{@defid{LUA_OPPOW}| performs exponentiation (@T{^})}
@item{@defid{LUA_OPUNM}| performs mathematical negation (unary @T{-})}
@item{@defid{LUA_OPBNOT}| performs bitwise NOT (@T{~})}
@item{@defid{LUA_OPBAND}| performs bitwise AND (@T{&})}
@item{@defid{LUA_OPBOR}| performs bitwise OR (@T{|})}
@item{@defid{LUA_OPBXOR}| performs bitwise exclusive OR (@T{~})}
@item{@defid{LUA_OPSHL}| performs left shift (@T{<<})}
@item{@defid{LUA_OPSHR}| performs right shift (@T{>>})}

}

}

@APIEntry{lua_CFunction lua_atpanic (lua_State *L, lua_CFunction
 panicf);|
@apii{0,0,-}

Sets a new panic function and returns the old one @see{C-error}.

}

@APIEntry{void lua_call (lua_State *L, int nargs, int nresults);|
@apii{nargs+1,nresults,e}

Calls a function.
Like regular Lua calls,
@id{lua_call} respects the @idx{__call} metamethod.
So, here the word @Q{function}
means any callable value.

To do a call you must use the following protocol:

first, the function to be called is pushed onto the stack;
then, the arguments to the call are pushed
in direct order;
that is, the first argument is pushed first.
Finally you call @Lid{lua_call};
@id{nargs} is the number of arguments that you pushed onto the stack.
When the function returns,
all arguments and the function value are popped
and the call results are pushed onto the stack.
The number of results is adjusted to @id{nresults},
unless @id{nresults} is @defid{LUA_MULTRET}.
In this case, all results from the function are pushed;
Lua takes care that the returned values fit into the stack space,
but
it does not ensure any extra space in the stack.
The function results are pushed onto the stack in direct order
(the first result is pushed first),
so that after the call the last result is on the top of the stack.

Any error while calling and running the function is propagated upwards
(with a @id{longjmp}).

The following example shows how the host program can do the
equivalent to this Lua code:
@verbatim{
a = f("how", t.x, 14)
}
Here it is @N{in C}:
@verbatim{
lua_getglobal(L, "f"); /* function to be called */
lua_pushliteral(L, "how"); /* 1st argument */
lua_getglobal(L, "t"); /* table to be indexed */
lua_getfield(L, -1, "x"); /* push result of t.x (2nd arg) */
lua_remove(L, -2); /* remove 't' from the stack */
lua_pushinteger(L, 14); /* 3rd argument */
lua_call(L, 3, 1); /* call 'f' with 3 arguments and 1 result */
lua_setglobal(L, "a"); /* set global
 'a' */
}
Note that the code above is @emph{balanced}:
at its end, the stack is back to its original configuration.
This is considered good programming practice.

}

@APIEntry{
void lua_callk (lua_State *L,
        int nargs,

```
             int nresults,
             lua_KContext ctx,
             lua_KFunction k);|
@apii{nargs + 1,nresults,e}

This function behaves exactly like @Lid{lua_call},
but allows the called function to yield @see{continuations}.

}

@APIEntry{typedef int (*lua_CFunction) (lua_State *L);|

Type for @N{C functions}.

In order to communicate properly with Lua,
a @N{C function} must use the following protocol,
which defines the way parameters and results are passed:
a @N{C function} receives its arguments from Lua in its stack
in direct order (the first argument is pushed first).
So, when the function starts,
@T{lua_gettop(L)} returns the number of arguments received by the function.
The first argument (if any) is at index 1
and its last argument
 is at index @T{lua_gettop(L)}.
To return values to Lua, a @N{C function} just pushes them onto the stack,
in direct order (the first result is pushed first),
and returns in C the number of results.
Any other value in the stack below the results will be properly
discarded by Lua.
Like a Lua function, a @N{C function} called by Lua can also return
many results.

As an example, the following function receives a variable number
of numeric arguments and returns their average and their sum:
@verbatim{
static int foo (lua_State *L) {
 int n = lua_gettop(L);    /* number of arguments */
 lua_Number sum = 0.0;
 int i;
 for (i = 1; i <= n; i++) {
   if (!lua_isnumber(L, i)) {
     lua_pushliteral(L, "incorrect argument");
     lua_error(L);
   }
   sum += lua_tonumber(L, i);
 }
 lua_pushnumber(L, sum/n);        /* first result */
 lua_pushnumber(L, sum);         /* second result */
```

```
 return 2;                /* number of results */
}
}



}
```

@APIEntry{int lua_checkstack (lua_State
*L, int n);|
@apii{0,0,-}

Ensures that the stack has space for at least @id{n} extra elements,
that is, that you can safely push up to @id{n} values into it.
It returns false if it cannot fulfill the request,
either because it would cause the stack
to be greater than a fixed maximum size
(typically at least several thousand elements) or
because it cannot allocate memory for the extra space.
This function never shrinks the stack;
if the stack already has space for the extra elements,
it is left unchanged.

}

@APIEntry{void lua_close (lua_State *L);|
@apii{0,0,-}

Close all active to-be-closed variables in the main thread,
release all objects in the given Lua state
(calling the corresponding garbage-collection metamethods, if any),
and frees all dynamic memory used by this state.

On several platforms, you may not need to call this function,
because all resources are naturally released when the host program ends.
On the other hand, long-running programs that create multiple states,
such
as daemons or web servers,
will probably need to close states as soon as they are not needed.

}

@APIEntry{void lua_closeslot (lua_State *L, int index);|
@apii{0,0,e}

Close the to-be-closed slot at the given index and set its value to @nil.
The index must be the last index previously marked to be closed

@see{lua_toclose} that is still active (that is, not closed yet).

A @idx{__close} metamethod cannot yield
when called through this function.

(This function was introduced in @N{release 5.4.3}.)

}

@APIEntry{int lua_closethread (lua_State *L, lua_State *from);|
@apii{0,?,-}

Resets a thread, cleaning its call stack and closing all pending
to-be-closed variables.
Returns a status code:
@Lid{LUA_OK} for no errors in the thread
(either the original error that stopped the thread or
errors in closing methods),
or an error status otherwise.
In case of error,
leaves the error object on the top of the stack.

The parameter @id{from} represents the coroutine that is resetting @id{L}.
If
 there is no such coroutine,
this parameter can be @id{NULL}.

(This function was introduced in @N{release 5.4.6}.)

}

@APIEntry{int lua_compare (lua_State *L, int index1, int index2, int op);|
@apii{0,0,e}

Compares two Lua values.
Returns 1 if the value at index @id{index1} satisfies @id{op}
when compared with the value at index @id{index2},
following the semantics of the corresponding Lua operator
(that is, it may call metamethods).
Otherwise @N{returns 0}.
Also @N{returns 0} if any of the indices is not valid.

The value of @id{op} must be one of the following constants:
@description{

@item{@defid{LUA_OPEQ}| compares for equality (@T{==})}
@item{@defid{LUA_OPLT}| compares for less than (@T{<})}
@item{@defid{LUA_OPLE}| compares for less or equal (@T{<=})}

}

}

@APIEntry{void lua_concat (lua_State *L, int n);|
@apii{n,1,e}

Concatenates the @id{n} values at the top of the stack,
pops them, and leaves the result on the top.
If @N{@T{n} is 1}, the result is the single value on the
 stack
(that is, the function does nothing);
if @id{n} is 0, the result is the empty string.
Concatenation is performed following the usual semantics of Lua
@see{concat}.

}

@APIEntry{void lua_copy (lua_State *L, int fromidx, int toidx);|
@apii{0,0,-}

Copies the element at index @id{fromidx}
into the valid index @id{toidx},
replacing the value at that position.
Values at other positions are not affected.

}

@APIEntry{void lua_createtable (lua_State *L, int narr, int nrec);|
@apii{0,1,m}

Creates a new empty table and pushes it onto the stack.
Parameter @id{narr} is a hint for how many elements the table
will have as a sequence;
parameter @id{nrec} is a hint for how many other elements
the table will have.
Lua may use these hints to preallocate memory for the new table.
This preallocation may help performance when you know in advance
how many elements the table will have.
Otherwise you can use the function @Lid{lua_newtable}.

}

@APIEntry{int lua_dump (lua_State *L,

	lua_Writer writer,
		void *data,

int strip);|
@apii{0,0,-}

Dumps a function as a binary chunk.
Receives a Lua function on the top of the stack
and produces a binary chunk that,
if loaded again,
results in a function equivalent to the one dumped.
As it produces parts of the chunk,
@Lid{lua_dump} calls function @id{writer} @seeC{lua_Writer}
with the given @id{data}
to write them.

If @id{strip} is true,
the binary representation may not include all debug information
about the function,
to save space.

The value returned is the error code returned by the last
call to the writer;
@N{0 means} no errors.

This function does not pop the Lua function from the stack.

}

@APIEntry{int lua_error (lua_State *L);|
@apii{1,0,v}

Raises a Lua error,
using the value on the top of the stack as the error object.
This function does a long jump,
and therefore never returns
@seeC{luaL_error}.

}

@APIEntry{int lua_gc (lua_State *L, int what, ...);|
@apii{0,0,-}

Controls
the garbage collector.

This function performs several tasks,
according to the value of the parameter @id{what}.
For options that need extra arguments,
they are listed after the option.
@description{

@item{@id{LUA_GCCOLLECT}|
Performs a full garbage-collection cycle.
}

@item{@id{LUA_GCSTOP}|
Stops the garbage collector.
}

@item{@id{LUA_GCRESTART}|
Restarts the garbage collector.
}

@item{@id{LUA_GCCOUNT}|
Returns the current amount of memory (in Kbytes) in use by Lua.
}

@item{@id{LUA_GCCOUNTB}|
Returns the remainder of dividing the current amount of bytes of
memory in use by Lua by 1024.
}

@item{@id{LUA_GCSTEP} @T{(int stepsize)}|
Performs an incremental step of garbage collection,
corresponding to the allocation of @id{stepsize} Kbytes.
}

@item{@id{LUA_GCISRUNNING}|
Returns a boolean that tells whether the collector is running
(i.e., not stopped).
}

@item{@id{LUA_GCINC} (int pause, int stepmul, stepsize)|
Changes the collector to incremental mode
with the
 given parameters @see{incmode}.
Returns the previous mode (@id{LUA_GCGEN} or @id{LUA_GCINC}).
}

@item{@id{LUA_GCGEN} (int minormul, int majormul)|
Changes the collector to generational mode
with the given parameters @see{genmode}.
Returns the previous mode (@id{LUA_GCGEN} or @id{LUA_GCINC}).
}

}
For more details about these options,
see @Lid{collectgarbage}.

This function should not be called by a finalizer.

}

@APIEntry{lua_Alloc lua_getallocf (lua_State *L, void **ud);|
@apii{0,0,-}

Returns the @x{memory-allocation function} of a given state.
If @id{ud} is not @id{NULL}, Lua stores in @T{*ud} the
opaque pointer given when the memory-allocator function was set.

}

@APIEntry{int lua_getfield (lua_State *L, int index, const char *k);|
@apii{0,1,e}

Pushes onto the stack the value @T{t[k]},
where @id{t} is the value at the given index.
As in Lua, this function may trigger a metamethod
for the @Q{index} event @see{metatable}.

Returns the type of the pushed value.

}

@APIEntry{void
 *lua_getextraspace (lua_State *L);|
@apii{0,0,-}

Returns a pointer to a raw memory area associated with the
given Lua state.
The application can use this area for any purpose;
Lua does not use it for anything.

Each new thread has this area initialized with a copy
of the area of the @x{main thread}.

By default, this area has the size of a pointer to void,
but you can recompile Lua with a different size for this area.
(See @id{LUA_EXTRASPACE} in @id{luaconf.h}.)

}

@APIEntry{int lua_getglobal (lua_State *L, const char *name);|
@apii{0,1,e}

Pushes onto the stack the value of the global @id{name}.

Returns the type of that value.

}

@APIEntry{int lua_geti (lua_State *L, int index, lua_Integer i);|
@apii{0,1,e}

Pushes onto the stack the value @T{t[i]},
where @id{t} is the value at the given index.
As in Lua, this function may trigger a metamethod
for the @Q{index} event @see{metatable}.

Returns the type of the pushed value.

}

@APIEntry{int lua_getmetatable (lua_State *L, int index);|
@apii{0,0|1,-}

If
the value at the given index has a metatable,
the function pushes that metatable onto the stack and @N{returns 1}.
Otherwise,
the function @N{returns 0} and pushes nothing on the stack.

}

@APIEntry{int lua_gettable (lua_State *L, int index);|
@apii{1,1,e}

Pushes onto the stack the value @T{t[k]},
where @id{t} is the value at the given index
and @id{k} is the value on the top of the stack.

This function pops the key from the stack,
pushing the resulting value in its place.
As in Lua, this function may trigger a metamethod
for the @Q{index} event @see{metatable}.

Returns the type of the pushed value.

}

@APIEntry{int lua_gettop (lua_State *L);|
@apii{0,0,-}

Returns the index of the top element in the stack.
Because indices start @N{at 1},

this result is equal to the number of elements in the stack;
in particular, @N{0 means} an empty stack.

}

@APIEntry{int lua_getiuservalue (lua_State *L, int index, int n);|
@apii{0,1,-}

Pushes onto the stack the @id{n}-th
user value associated with the
full userdata at the given index and
returns the type of the pushed value.

If the userdata does not have that value,
pushes @nil and returns @Lid{LUA_TNONE}.

}

@APIEntry{void lua_insert (lua_State *L, int index);|
@apii{1,1,-}

Moves the top element into the given valid index,
shifting up the elements above this index to open space.
This function cannot be called with a pseudo-index,
because a pseudo-index is not an actual stack position.

}

@APIEntry{typedef @ldots lua_Integer;|

The type of integers in Lua.

By default this type is @id{long long},
(usually a 64-bit two-complement integer),
but that can be changed to @id{long} or @id{int}
(usually a 32-bit two-complement integer).
(See @id{LUA_INT_TYPE} in @id{luaconf.h}.)

Lua also defines the constants
@defid{LUA_MININTEGER} and @defid{LUA_MAXINTEGER},
with the minimum and the maximum values that fit in this type.

}

@APIEntry{int lua_isboolean (lua_State *L, int index);|
@apii{0,0,-}

Returns 1

if the value at the given index is a boolean,
and @N{0 otherwise}.

}

@APIEntry{int lua_iscfunction (lua_State *L, int index);|
@apii{0,0,-}

Returns 1 if the value at the given index is a @N{C function},
and @N{0 otherwise}.

}

@APIEntry{int lua_isfunction (lua_State *L, int index);|
@apii{0,0,-}

Returns 1 if the value at the given index is a function
(either C or Lua), and @N{0 otherwise}.

}

@APIEntry{int lua_isinteger (lua_State *L, int index);|
@apii{0,0,-}

Returns 1 if the value at the given index is an integer
(that is, the value is a number and is represented as an integer),
and @N{0 otherwise}.

}

@APIEntry{int lua_islightuserdata (lua_State *L, int index);|
@apii{0,0,-}

Returns 1 if the value at the given index is a light userdata,
and @N{0 otherwise}.

}

@APIEntry{int lua_isnil (lua_State *L, int index);|
@apii{0,0,-}

Returns 1 if the value at the given index is @nil,
and @N{0 otherwise}.

}

@APIEntry{int lua_isnone (lua_State *L, int index);|
@apii{0,0,-}

Returns
1 if the given index is not valid,
and @N{0 otherwise}.

}

@APIEntry{int lua_isnoneornil (lua_State *L, int index);|
@apii{0,0,-}

Returns 1 if the given index is not valid
or if the value at this index is @nil,
and @N{0 otherwise}.

}

@APIEntry{int lua_isnumber (lua_State *L, int index);|
@apii{0,0,-}

Returns 1 if the value at the given index is a number
or a string convertible to a number,
and @N{0 otherwise}.

}

@APIEntry{int lua_isstring (lua_State *L, int index);|
@apii{0,0,-}

Returns 1 if the value at the given index is a string
or a number (which is always convertible to a string),
and @N{0 otherwise}.

}

@APIEntry{int lua_istable (lua_State *L, int index);|
@apii{0,0,-}

Returns 1 if the value at the given index is a table,
and @N{0 otherwise}.

}

@APIEntry{int lua_isthread (lua_State *L, int index);|
@apii{0,0,-}

Returns 1 if the value at the given index is a thread,
and @N{0 otherwise}.

}

@APIEntry{int lua_isuserdata (lua_State *L, int index);|
@apii{0,0,-}

Returns
1 if the value at the given index is a userdata
(either full or light), and @N{0 otherwise}.

}

@APIEntry{int lua_isyieldable (lua_State *L);|
@apii{0,0,-}

Returns 1 if the given coroutine can yield,
and @N{0 otherwise}.

}

@APIEntry{typedef @ldots lua_KContext;|

The type for continuation-function contexts.
It must be a numeric type.
This type is defined as @id{intptr_t}
when @id{intptr_t} is available,
so that it can store pointers too.
Otherwise, it is defined as @id{ptrdiff_t}.

}

@APIEntry{
typedef int (*lua_KFunction) (lua_State *L, int status, lua_KContext ctx);|

Type for continuation functions @see{continuations}.

}

@APIEntry{void lua_len (lua_State *L, int index);|
@apii{0,1,e}

Returns the length of the value at the given index.
It is equivalent to the @Char{#} operator in Lua @see{len-op} and
may trigger a metamethod for the @Q{length} event @see{metatable}.
The result is pushed on the stack.

}

@APIEntry{

int lua_load (lua_State *L,
lua_Reader reader,
void *data,
const char *chunkname,
const char *mode);|
@apii{0,1,-}

Loads a Lua chunk without running it.
If there are no errors,
@id{lua_load} pushes the compiled chunk as a Lua
function on top of the stack.
Otherwise, it pushes an error message.

The @id{lua_load} function uses a user-supplied @id{reader} function
to read the chunk @seeC{lua_Reader}.
The @id{data} argument is an opaque value passed to the reader function.

The @id{chunkname} argument gives a name to the chunk,
which is used for error messages and in debug information @see{debugI}.

@id{lua_load} automatically detects whether the chunk is text or binary
and loads it accordingly (see program @idx{luac}).
The string @id{mode} works as in function @Lid{load},
with the addition that
a @id{NULL} value is equivalent to the string @St{bt}.

@id{lua_load} uses the stack internally,
so the reader function must always leave the stack
unmodified when returning.

@id{lua_load} can return
@Lid{LUA_OK},
@Lid{LUA_ERRSYNTAX}, or @Lid{LUA_ERRMEM}.
The function may also return other values corresponding to
errors raised by the read function @see{statuscodes}.

If the resulting function has upvalues,
its first upvalue is set to the value of the @x{global environment}
stored at index @id{LUA_RIDX_GLOBALS} in the registry @see{registry}.
When loading main chunks,
this upvalue will be the @id{_ENV} variable @see{globalenv}.
Other upvalues are initialized with @nil.

}

@APIEntry{lua_State *lua_newstate (lua_Alloc f, void *ud);|
@apii{0,0,-}

Creates a new independent state and returns its main thread.
Returns @id{NULL} if it cannot create the state
(due to lack of memory).
The argument @id{f} is the @x{allocator function};
Lua will do all memory allocation for this state
through this function @seeF{lua_Alloc}.
The second argument, @id{ud}, is an opaque pointer that Lua
passes to the allocator in every call.

}

@APIEntry{void lua_newtable (lua_State *L);|
@apii{0,1,m}

Creates
 a new empty table and pushes it onto the stack.
It is equivalent to @T{lua_createtable(L, 0, 0)}.

}

@APIEntry{lua_State *lua_newthread (lua_State *L);|
@apii{0,1,m}

Creates a new thread, pushes it on the stack,
and returns a pointer to a @Lid{lua_State} that represents this new thread.
The new thread returned by this function shares with the original thread
its global environment,
but has an independent execution stack.

Threads are subject to garbage collection,
like any Lua object.

}

@APIEntry{void *lua_newuserdatauv (lua_State *L, size_t size, int nuvalue);|
@apii{0,1,m}

This function creates and pushes on the stack a new full userdata,
with @id{nuvalue} associated Lua values, called @id{user values},
plus an associated block of raw memory with @id{size} bytes.
(The user values can be set and read with the functions
@Lid{lua_setiuservalue} and @Lid{lua_getiuservalue}.)

The function returns the address of the block of memory.
Lua ensures that this address is valid as long as
the
 corresponding userdata is alive @see{GC}.
Moreover, if the userdata is marked for finalization @see{finalizers},

its address is valid at least until the call to its finalizer.

}

@APIEntry{int lua_next (lua_State *L, int index);|
@apii{1,2|0,v}

Pops a key from the stack,
and pushes a key@En{}value pair from the table at the given index,
the @Q{next} pair after the given key.
If there are no more elements in the table,
then @Lid{lua_next} @N{returns 0} and pushes nothing.

A typical table traversal looks like this:
@verbatim{
/* table is in the stack at index 't' */
lua_pushnil(L); /* first key */
while (lua_next(L, t) != 0) {
 /* uses 'key' (at index -2) and 'value' (at index -1) */
 printf("%s - %s\n",
        lua_typename(L, lua_type(L, -2)),
        lua_typename(L, lua_type(L, -1)));
 /* removes 'value'; keeps 'key' for next iteration */
 lua_pop(L, 1);
}
}

While traversing a table,
avoid calling @Lid{lua_tolstring} directly on a key,
unless you know that the key is
 actually a string.
Recall that @Lid{lua_tolstring} may change
the value at the given index;
this confuses the next call to @Lid{lua_next}.

This function may raise an error if the given key
is neither @nil nor present in the table.
See function @Lid{next} for the caveats of modifying
the table during its traversal.

}

@APIEntry{typedef @ldots lua_Number;|

The type of floats in Lua.

By default this type is double,
but that can be changed to a single float or a long double.

(See @id{LUA_FLOAT_TYPE} in @id{luaconf.h}.)

}

@APIEntry{int lua_numbertointeger (lua_Number n, lua_Integer *p);|

Tries to convert a Lua float to a Lua integer;
the float @id{n} must have an integral value.
If that value is within the range of Lua integers,
it is converted to an integer and assigned to @T{*p}.
The macro results in a boolean indicating whether the
conversion was successful.
(Note that this range test can be tricky to do
correctly without this macro, due to rounding.)

This macro may evaluate its
arguments more than once.

}

@APIEntry{int lua_pcall (lua_State *L, int nargs, int nresults, int msgh);|
@apii{nargs + 1,nresults|1,-}

Calls a function (or a callable object) in protected mode.

Both @id{nargs} and @id{nresults} have the same meaning as
in @Lid{lua_call}.
If there are no errors during the call,
@Lid{lua_pcall} behaves exactly like @Lid{lua_call}.
However, if there is any error,
@Lid{lua_pcall} catches it,
pushes a single value on the stack (the error object),
and returns an error code.
Like @Lid{lua_call},
@Lid{lua_pcall} always removes the function
and its arguments from the stack.

If @id{msgh} is 0,
then the error object returned on the stack
is exactly the original error object.
Otherwise, @id{msgh} is the stack index of a
@emph{message handler}.
(This index cannot be a pseudo-index.)
In case of runtime errors,
this handler will be called with the error object
and its return value will be the object
returned on the stack by @Lid{lua_pcall}.

Typically, the message
handler is used to add more debug
information to the error object, such as a stack traceback.
Such information cannot be gathered after the return of @Lid{lua_pcall},
since by then the stack has unwound.

The @Lid{lua_pcall} function returns one of the following status codes:
@Lid{LUA_OK}, @Lid{LUA_ERRRUN}, @Lid{LUA_ERRMEM}, or @Lid{LUA_ERRERR}.

}

@APIEntry{
int lua_pcallk (lua_State *L,
int nargs,
int nresults,
int msgh,
lua_KContext ctx,
lua_KFunction k);|
@apii{nargs + 1,nresults|1,-}

This function behaves exactly like @Lid{lua_pcall},
except that it allows the called function to yield @see{continuations}.

}

@APIEntry{void lua_pop (lua_State *L, int n);|
@apii{n,0,e}

Pops @id{n} elements from the stack.
It is implemented as a macro over @Lid{lua_settop}.

}

@APIEntry{void lua_pushboolean (lua_State *L, int b);|
@apii{0,1,-}

Pushes a boolean value with value @id{b} onto the stack.

}

@APIEntry{void
lua_pushcclosure (lua_State *L, lua_CFunction fn, int n);|
@apii{n,1,m}

Pushes a new @N{C closure} onto the stack.
This function receives a pointer to a @N{C function}
and pushes onto the stack a Lua value of type @id{function} that,
when called, invokes the corresponding @N{C function}.

The parameter @id{n} tells how many upvalues this function will have
@see{c-closure}.

Any function to be callable by Lua must
follow the correct protocol to receive its parameters
and return its results @seeC{lua_CFunction}.

When a @N{C function} is created,
it is possible to associate some values with it,
the so called upvalues;
these upvalues are then accessible to the function whenever it is called.
This association is called a @x{@N{C closure}} @see{c-closure}.
To create a @N{C closure},
first the initial values for its upvalues must be pushed onto the stack.
(When there are multiple upvalues, the first value is pushed first.)
Then @Lid{lua_pushcclosure}
is called to create and push the @N{C
function} onto the stack,
with the argument @id{n} telling how many values will be
associated with the function.
@Lid{lua_pushcclosure} also pops these values from the stack.

The maximum value for @id{n} is 255.

When @id{n} is zero,
this function creates a @def{light @N{C function}},
which is just a pointer to the @N{C function}.
In that case, it never raises a memory error.

}

@APIEntry{void lua_pushcfunction (lua_State *L, lua_CFunction f);|
@apii{0,1,-}

Pushes a @N{C function} onto the stack.
This function is equivalent to @Lid{lua_pushcclosure} with no upvalues.

}

@APIEntry{const char *lua_pushfstring (lua_State *L, const char *fmt, ...);|
@apii{0,1,v}

Pushes onto the stack a formatted string
and returns a pointer to this string @see{constchar}.
It is similar to the @ANSI{sprintf},
but has two important differences.
First,
you do not have to allocate space for the result;

the result is a Lua string and Lua takes care of memory allocation
(and deallocation, through garbage
collection).
Second,
the conversion specifiers are quite restricted.
There are no flags, widths, or precisions.
The conversion specifiers can only be
@Char{%%} (inserts the character @Char{%}),
@Char{%s} (inserts a zero-terminated string, with no size restrictions),
@Char{%f} (inserts a @Lid{lua_Number}),
@Char{%I} (inserts a @Lid{lua_Integer}),
@Char{%p} (inserts a pointer),
@Char{%d} (inserts an @T{int}),
@Char{%c} (inserts an @T{int} as a one-byte character), and
@Char{%U} (inserts a @T{long int} as a @x{UTF-8} byte sequence).

This function may raise errors due to memory overflow
or an invalid conversion specifier.

}

@APIEntry{void lua_pushglobaltable (lua_State *L);|
@apii{0,1,-}

Pushes the @x{global environment} onto the stack.

}

@APIEntry{void lua_pushinteger (lua_State *L, lua_Integer n);|
@apii{0,1,-}

Pushes an integer with value @id{n} onto the stack.

}

@APIEntry{void lua_pushlightuserdata (lua_State *L, void *p);|
@apii{0,1,-}

Pushes a light userdata onto the stack.

Userdata
represent @N{C values} in Lua.
A @def{light userdata} represents a pointer, a @T{void*}.
It is a value (like a number):
you do not create it, it has no individual metatable,
and it is not collected (as it was never created).
A light userdata is equal to @Q{any}
light userdata with the same @N{C address}.

}

@APIEntry{const char *lua_pushliteral (lua_State *L, const char *s);|
@apii{0,1,m}

This macro is equivalent to @Lid{lua_pushstring},
but should be used only when @id{s} is a literal string.
(Lua may optimize this case.)

}

@APIEntry{const char *lua_pushlstring (lua_State *L, const char *s, size_t len);|
@apii{0,1,m}

Pushes the string pointed to by @id{s} with size @id{len}
onto the stack.
Lua will make or reuse an internal copy of the given string,
so the memory at @id{s} can be freed or reused immediately after
the function returns.
The string can contain any binary data,
including @x{embedded zeros}.

Returns a pointer to the internal copy of the string @see{constchar}.

}

@APIEntry{void
 lua_pushnil (lua_State *L);|
@apii{0,1,-}

Pushes a nil value onto the stack.

}

@APIEntry{void lua_pushnumber (lua_State *L, lua_Number n);|
@apii{0,1,-}

Pushes a float with value @id{n} onto the stack.

}

@APIEntry{const char *lua_pushstring (lua_State *L, const char *s);|
@apii{0,1,m}

Pushes the zero-terminated string pointed to by @id{s}
onto the stack.
Lua will make or reuse an internal copy of the given string,

so the memory at @id{s} can be freed or reused immediately after
the function returns.

Returns a pointer to the internal copy of the string @see{constchar}.

If @id{s} is @id{NULL}, pushes @nil and returns @id{NULL}.

}

@APIEntry{int lua_pushthread (lua_State *L);|
@apii{0,1,-}

Pushes the thread represented by @id{L} onto the stack.
Returns 1 if this thread is the @x{main thread} of its state.

}

@APIEntry{void lua_pushvalue (lua_State *L, int index);|
@apii{0,1,-}

Pushes a copy of the element at the given index
onto the stack.

}

@APIEntry{
const
 char *lua_pushvfstring (lua_State *L,
                         const char *fmt,
                         va_list argp);|
@apii{0,1,v}

Equivalent to @Lid{lua_pushfstring}, except that it receives a @id{va_list}
instead of a variable number of arguments.

}

@APIEntry{int lua_rawequal (lua_State *L, int index1, int index2);|
@apii{0,0,-}

Returns 1 if the two values in indices @id{index1} and
@id{index2} are primitively equal
(that is, equal without calling the @idx{__eq} metamethod).
Otherwise @N{returns 0}.
Also @N{returns 0} if any of the indices are not valid.

}

@APIEntry{int lua_rawget (lua_State *L, int index);|
@apii{1,1,-}

Similar to @Lid{lua_gettable}, but does a raw access
(i.e., without metamethods).
The value at @id{index} must be a table.

}

@APIEntry{int lua_rawgeti (lua_State *L, int index, lua_Integer n);|
@apii{0,1,-}

Pushes onto the stack the value @T{t[n]},
where @id{t} is the table at the given index.
The access is raw,
that is, it does not use
the @idx{__index} metavalue.

Returns the type of the pushed value.

}

@APIEntry{int lua_rawgetp (lua_State *L, int index, const void *p);|
@apii{0,1,-}

Pushes onto the stack the value @T{t[k]},
where @id{t} is the table at the given index and
@id{k} is the pointer @id{p} represented as a light userdata.
The access is raw;
that is, it does not use the @idx{__index} metavalue.

Returns the type of the pushed value.

}

@APIEntry{lua_Unsigned lua_rawlen (lua_State *L, int index);|
@apii{0,0,-}

Returns the raw @Q{length} of the value at the given index:
for strings, this is the string length;
for tables, this is the result of the length operator (@Char{#})
with no metamethods;
for userdata, this is the size of the block of memory allocated
for the userdata.
For other values, this call @N{returns 0}.

}

@APIEntry{void lua_rawset (lua_State *L, int index);|
@apii{2,0,m}

Similar to @Lid{lua_settable}, but does a raw assignment
(i.e., without metamethods).
The value at @id{index} must
be a table.

}

@APIEntry{void lua_rawseti (lua_State *L, int index, lua_Integer i);|
@apii{1,0,m}

Does the equivalent of @T{t[i] = v},
where @id{t} is the table at the given index
and @id{v} is the value on the top of the stack.

This function pops the value from the stack.
The assignment is raw,
that is, it does not use the @idx{__newindex} metavalue.

}

@APIEntry{void lua_rawsetp (lua_State *L, int index, const void *p);|
@apii{1,0,m}

Does the equivalent of @T{t[p] = v},
where @id{t} is the table at the given index,
@id{p} is encoded as a light userdata,
and @id{v} is the value on the top of the stack.

This function pops the value from the stack.
The assignment is raw,
that is, it does not use the @idx{__newindex} metavalue.

}

@APIEntry{
typedef const char * (*lua_Reader) (lua_State *L,
                                    void *data,
                                    size_t *size);|

The reader function used by @Lid{lua_load}.
Every time @Lid{lua_load} needs another piece of
the chunk,
it calls the reader,
passing along its @id{data} parameter.
The reader must return a pointer to a block of memory

with a new piece of the chunk
and set @id{size} to the block size.
The block must exist until the reader function is called again.
To signal the end of the chunk,
the reader must return @id{NULL} or set @id{size} to zero.
The reader function may return pieces of any size greater than zero.

}

@APIEntry{void lua_register (lua_State *L, const char *name, lua_CFunction f);|
@apii{0,0,e}

Sets the @N{C function} @id{f} as the new value of global @id{name}.
It is defined as a macro:
@verbatim{
#define lua_register(L,n,f) \
    (lua_pushcfunction(L, f), lua_setglobal(L, n))
}

}

@APIEntry{void lua_remove (lua_State *L, int index);|
@apii{1,0,-}

Removes the element at the given valid index,
shifting down the elements above this index to fill the gap.
This function cannot be called with a pseudo-index,
because a pseudo-index is not an actual stack position.

}

@APIEntry{void
 lua_replace (lua_State *L, int index);|
@apii{1,0,-}

Moves the top element into the given valid index
without shifting any element
(therefore replacing the value at that given index),
and then pops the top element.

}

@APIEntry{int lua_resetthread (lua_State *L);|
@apii{0,?,-}

This function is deprecated;
it is equivalent to @Lid{lua_closethread} with
@id{from} being @id{NULL}.

}

@APIEntry{int lua_resume (lua_State *L, lua_State *from, int nargs,
int *nresults);|
@apii{?,?,-}

Starts and resumes a coroutine in the given thread @id{L}.

To start a coroutine,
you push the main function plus any arguments
onto the empty stack of the thread.
then you call @Lid{lua_resume},
with @id{nargs} being the number of arguments.
This call returns when the coroutine suspends or finishes its execution.
When it returns,
@id{*nresults} is updated and
the top of the stack contains
the @id{*nresults} values passed to @Lid{lua_yield}
or returned by the body function.
@Lid{lua_resume}
returns
@Lid{LUA_YIELD} if the coroutine yields,
@Lid{LUA_OK} if the coroutine finishes its execution
without errors,
or an error code in case of errors @see{statuscodes}.
In case of errors,
the error object is on the top of the stack.

To resume a coroutine,
you remove the @id{*nresults} yielded values from its stack,
push the values to be passed as results from @id{yield},
and then call @Lid{lua_resume}.

The parameter @id{from} represents the coroutine that is resuming @id{L}.
If there is no such coroutine,
this parameter can be @id{NULL}.

}

@APIEntry{void lua_rotate (lua_State *L, int idx, int n);|
@apii{0,0,-}

Rotates the stack elements between the valid index @id{idx}
and the top of the stack.
The elements are rotated @id{n} positions in the direction of the top,
for a positive @id{n},
or @T{-n} positions in the direction of the bottom,

for a negative @id{n}.
The absolute value of @id{n} must not be greater than the size
of the slice being rotated.
This function
cannot be called with a pseudo-index,
because a pseudo-index is not an actual stack position.

}

@APIEntry{void lua_setallocf (lua_State *L, lua_Alloc f, void *ud);|
@apii{0,0,-}

Changes the @x{allocator function} of a given state to @id{f}
with user data @id{ud}.

}

@APIEntry{void lua_setfield (lua_State *L, int index, const char *k);|
@apii{1,0,e}

Does the equivalent to @T{t[k] = v},
where @id{t} is the value at the given index
and @id{v} is the value on the top of the stack.

This function pops the value from the stack.
As in Lua, this function may trigger a metamethod
for the @Q{newindex} event @see{metatable}.

}

@APIEntry{void lua_setglobal (lua_State *L, const char *name);|
@apii{1,0,e}

Pops a value from the stack and
sets it as the new value of global @id{name}.

}

@APIEntry{void lua_seti (lua_State *L, int index, lua_Integer n);|
@apii{1,0,e}

Does the equivalent to @T{t[n] = v},
where @id{t} is the value at the given index
and @id{v} is the value on the top of
the stack.

This function pops the value from the stack.
As in Lua, this function may trigger a metamethod

for the @Q{newindex} event @see{metatable}.

}

@APIEntry{int lua_setiuservalue (lua_State *L, int index, int n);|
@apii{1,0,-}

Pops a value from the stack and sets it as
the new @id{n}-th user value associated to the
full userdata at the given index.
Returns 0 if the userdata does not have that value.

}

@APIEntry{int lua_setmetatable (lua_State *L, int index);|
@apii{1,0,-}

Pops a table or @nil from the stack and
sets that value as the new metatable for the value at the given index.
(@nil means no metatable.)

(For historical reasons, this function returns an @id{int},
which now is always 1.)

}

@APIEntry{void lua_settable (lua_State *L, int index);|
@apii{2,0,e}

Does the equivalent to @T{t[k] = v},
where @id{t} is the value at the given index,
@id{v} is the value on the top of the stack,
and @id{k} is the value just below the top.

This function pops both the key and the value
from the stack.
As in Lua, this function may trigger a metamethod
for the @Q{newindex} event @see{metatable}.

}

@APIEntry{void lua_settop (lua_State *L, int index);|
@apii{?,?,e}

Accepts any index, @N{or 0},
and sets the stack top to this index.
If the new top is greater than the old one,
then the new elements are filled with @nil.

If @id{index} @N{is 0}, then all stack elements are removed.

This function can run arbitrary code when removing an index
marked as to-be-closed from the stack.

}

@APIEntry{void lua_setwarnf (lua_State *L, lua_WarnFunction f, void *ud);|
@apii{0,0,-}

Sets the @x{warning function} to be used by Lua to emit warnings
@see{lua_WarnFunction}.
The @id{ud} parameter sets the value @id{ud} passed to
the warning function.

}

@APIEntry{typedef struct lua_State lua_State;|

An opaque structure that points to a thread and indirectly
(through the thread) to the whole state of a Lua interpreter.
The Lua library is fully reentrant:
it has no global variables.
All
information about a state is accessible through this structure.

A pointer to this structure must be passed as the first argument to
every function in the library, except to @Lid{lua_newstate},
which creates a Lua state from scratch.

}

@APIEntry{int lua_status (lua_State *L);|
@apii{0,0,-}

Returns the status of the thread @id{L}.

The status can be @Lid{LUA_OK} for a normal thread,
an error code if the thread finished the execution
of a @Lid{lua_resume} with an error,
or @Lid{LUA_YIELD} if the thread is suspended.

You can call functions only in threads with status @Lid{LUA_OK}.
You can resume threads with status @Lid{LUA_OK}
(to start a new coroutine) or @Lid{LUA_YIELD}
(to resume a coroutine).

}

@APIEntry{size_t lua_stringtonumber (lua_State *L, const char *s);|
@apii{0,1,-}

Converts the zero-terminated string @id{s} to a number,
pushes that number into the stack,
and returns the total size of the string,
that is, its length plus one.
The conversion can result in an integer
 or a float,
according to the lexical conventions of Lua @see{lexical}.
The string may have leading and trailing whitespaces and a sign.
If the string is not a valid numeral,
returns 0 and pushes nothing.
(Note that the result can be used as a boolean,
true if the conversion succeeds.)

}

@APIEntry{int lua_toboolean (lua_State *L, int index);|
@apii{0,0,-}

Converts the Lua value at the given index to a @N{C boolean}
value (@N{0 or 1}).
Like all tests in Lua,
@Lid{lua_toboolean} returns true for any Lua value
different from @false and @nil;
otherwise it returns false.
(If you want to accept only actual boolean values,
use @Lid{lua_isboolean} to test the value's type.)

}

@APIEntry{lua_CFunction lua_tocfunction (lua_State *L, int index);|
@apii{0,0,-}

Converts a value at the given index to a @N{C function}.
That value must be a @N{C function};
otherwise, returns @id{NULL}.

}

@APIEntry{void lua_toclose (lua_State *L, int index);|
@apii{0,0,m}

Marks the given index in the stack as a
to-be-closed

slot @see{to-be-closed}.
Like a to-be-closed variable in Lua,
the value at that slot in the stack will be closed
when it goes out of scope.
Here, in the context of a C function,
to go out of scope means that the running function returns to Lua,
or there is an error,
or the slot is removed from the stack through
@Lid{lua_settop} or @Lid{lua_pop},
or there is a call to @Lid{lua_closeslot}.
A slot marked as to-be-closed should not be removed from the stack
by any other function in the API except @Lid{lua_settop} or @Lid{lua_pop},
unless previously deactivated by @Lid{lua_closeslot}.

This function should not be called for an index
that is equal to or below an active to-be-closed slot.

Note that, both in case of errors and of a regular return,
by the time the @idx{__close} metamethod runs,
the @N{C stack} was already unwound,
so that any automatic @N{C variable} declared in the calling function
(e.g., a buffer) will be out of scope.

}

@APIEntry{lua_Integer lua_tointeger (lua_State
*L, int index);|
@apii{0,0,-}

Equivalent to @Lid{lua_tointegerx} with @id{isnum} equal to @id{NULL}.

}

@APIEntry{lua_Integer lua_tointegerx (lua_State *L, int index, int *isnum);|
@apii{0,0,-}

Converts the Lua value at the given index
to the signed integral type @Lid{lua_Integer}.
The Lua value must be an integer,
or a number or string convertible to an integer @see{coercion};
otherwise, @id{lua_tointegerx} @N{returns 0}.

If @id{isnum} is not @id{NULL},
its referent is assigned a boolean value that
indicates whether the operation succeeded.

}

@APIEntry{const char *lua_tolstring (lua_State *L, int index, size_t *len);|
@apii{0,0,m}

Converts the Lua value at the given index to a @N{C string}.
If @id{len} is not @id{NULL},
it sets @T{*len} with the string length.
The Lua value must be a string or a number;
otherwise, the function returns @id{NULL}.
If the value is a number,
then @id{lua_tolstring} also
@emph{changes the actual value in the stack to a string}.
(This change
 confuses @Lid{lua_next}
when @id{lua_tolstring} is applied to keys during a table traversal.)

@id{lua_tolstring} returns a pointer
to a string inside the Lua state @see{constchar}.
This string always has a zero (@Char{\0})
after its last character (as @N{in C}),
but can contain other zeros in its body.

}

@APIEntry{lua_Number lua_tonumber (lua_State *L, int index);|
@apii{0,0,-}

Equivalent to @Lid{lua_tonumberx} with @id{isnum} equal to @id{NULL}.

}

@APIEntry{lua_Number lua_tonumberx (lua_State *L, int index, int *isnum);|
@apii{0,0,-}

Converts the Lua value at the given index
to the @N{C type} @Lid{lua_Number} @seeC{lua_Number}.
The Lua value must be a number or a string convertible to a number
@see{coercion};
otherwise, @Lid{lua_tonumberx} @N{returns 0}.

If @id{isnum} is not @id{NULL},
its referent is assigned a boolean value that
indicates whether the operation succeeded.

}

@APIEntry{const void *lua_topointer (lua_State *L, int index);|
@apii{0,0,-}

Converts the value at the
given index to a generic
@N{C pointer} (@T{void*}).
The value can be a userdata, a table, a thread, a string, or a function;
otherwise, @id{lua_topointer} returns @id{NULL}.
Different objects will give different pointers.
There is no way to convert the pointer back to its original value.

Typically this function is used only for hashing and debug information.

}

@APIEntry{const char *lua_tostring (lua_State *L, int index);|
@apii{0,0,m}

Equivalent to @Lid{lua_tolstring} with @id{len} equal to @id{NULL}.

}

@APIEntry{lua_State *lua_tothread (lua_State *L, int index);|
@apii{0,0,-}

Converts the value at the given index to a Lua thread
(represented as @T{lua_State*}).
This value must be a thread;
otherwise, the function returns @id{NULL}.

}

@APIEntry{void *lua_touserdata (lua_State *L, int index);|
@apii{0,0,-}

If the value at the given index is a full userdata,
returns its memory-block address.
If the value is a light userdata,
returns its value (a pointer).
Otherwise, returns
@id{NULL}.

}

@APIEntry{int lua_type (lua_State *L, int index);|
@apii{0,0,-}

Returns the type of the value in the given valid index,
or @id{LUA_TNONE} for a non-valid but acceptable index.
The types returned by @Lid{lua_type} are coded by the following constants
defined in @id{lua.h}:

@defid{LUA_TNIL},
@defid{LUA_TNUMBER},
@defid{LUA_TBOOLEAN},
@defid{LUA_TSTRING},
@defid{LUA_TTABLE},
@defid{LUA_TFUNCTION},
@defid{LUA_TUSERDATA},
@defid{LUA_TTHREAD},
and
@defid{LUA_TLIGHTUSERDATA}.

}

@APIEntry{const char *lua_typename (lua_State *L, int tp);|
@apii{0,0,-}

Returns the name of the type encoded by the value @id{tp},
which must be one the values returned by @Lid{lua_type}.

}

@APIEntry{typedef @ldots lua_Unsigned;|

The unsigned version of @Lid{lua_Integer}.

}

@APIEntry{int lua_upvalueindex (int i);|
@apii{0,0,-}

Returns the pseudo-index that represents the @id{i}-th upvalue of
the running function @see{c-closure}.
@id{i} must be in the range @M{[1,256]}.

}

@APIEntry{lua_Number
 lua_version (lua_State *L);|
@apii{0,0,-}

Returns the version number of this core.

}

@APIEntry{
typedef void (*lua_WarnFunction) (void *ud, const char *msg, int tocont);|

The type of @x{warning function}s, called by Lua to emit warnings.

The first parameter is an opaque pointer
set by @Lid{lua_setwarnf}.
The second parameter is the warning message.
The third parameter is a boolean that
indicates whether the message is
to be continued by the message in the next call.

See @Lid{warn} for more details about warnings.

}

@APIEntry{
void lua_warning (lua_State *L, const char *msg, int tocont);|
@apii{0,0,-}

Emits a warning with the given message.
A message in a call with @id{tocont} true should be
continued in another call to this function.

See @Lid{warn} for more details about warnings.

}

@APIEntry{
typedef int (*lua_Writer) (lua_State *L,
                    const void* p,
                    size_t sz,
                    void* ud);|

The type of the writer
 function used by @Lid{lua_dump}.
Every time @Lid{lua_dump} produces another piece of chunk,
it calls the writer,
passing along the buffer to be written (@id{p}),
its size (@id{sz}),
and the @id{ud} parameter supplied to @Lid{lua_dump}.

The writer returns an error code:
@N{0 means} no errors;
any other value means an error and stops @Lid{lua_dump} from
calling the writer again.

}

@APIEntry{void lua_xmove (lua_State *from, lua_State *to, int n);|
@apii{?,?,-}

Exchange values between different threads of the same state.

This function pops @id{n} values from the stack @id{from},
and pushes them onto the stack @id{to}.

}

@APIEntry{int lua_yield (lua_State *L, int nresults);|
@apii{?,?,v}

This function is equivalent to @Lid{lua_yieldk},
but it has no continuation @see{continuations}.
Therefore, when the thread resumes,
it continues the function that called
the function calling @id{lua_yield}.
To avoid surprises,
this function should be called only in a tail call.

}

@APIEntry{
int
 lua_yieldk (lua_State *L,
             int nresults,
             lua_KContext ctx,
             lua_KFunction k);|
@apii{?,?,v}

Yields a coroutine (thread).

When a @N{C function} calls @Lid{lua_yieldk},
the running coroutine suspends its execution,
and the call to @Lid{lua_resume} that started this coroutine returns.
The parameter @id{nresults} is the number of values from the stack
that will be passed as results to @Lid{lua_resume}.

When the coroutine is resumed again,
Lua calls the given @x{continuation function} @id{k} to continue
the execution of the @N{C function} that yielded @see{continuations}.
This continuation function receives the same stack
from the previous function,
with the @id{n} results removed and
replaced by the arguments passed to @Lid{lua_resume}.
Moreover,
the continuation function receives the value @id{ctx}
that was passed to @Lid{lua_yieldk}.

Usually, this function does not return;

when the coroutine eventually resumes,
it continues executing the
continuation function.
However, there is one special case,
which is when this function is called
from inside a line or a count hook @see{debugI}.
In that case, @id{lua_yieldk} should be called with no continuation
(probably in the form of @Lid{lua_yield}) and no results,
and the hook should return immediately after the call.
Lua will yield and,
when the coroutine resumes again,
it will continue the normal execution
of the (Lua) function that triggered the hook.

This function can raise an error if it is called from a thread
with a pending C call with no continuation function
(what is called a @emphx{C-call boundary}),
or it is called from a thread that is not running inside a resume
(typically the main thread).

}

}

@sect2{debugI| @title{The Debug Interface}

Lua has no built-in debugging facilities.
Instead, it offers a special interface
by means of functions and @emph{hooks}.
This interface allows the construction of different
kinds of debuggers, profilers, and other tools
that need
@Q{inside information} from the interpreter.

@APIEntry{
typedef struct lua_Debug {
int event;
const char *name; /* (n) */
const char *namewhat; /* (n) */
const char *what; /* (S) */
const char *source; /* (S) */
size_t srclen; /* (S) */
int currentline; /* (l) */
int linedefined; /* (S) */
int lastlinedefined; /* (S) */
unsigned char nups; /* (u) number of upvalues */
unsigned char nparams; /* (u) number of parameters */

```
 char isvararg;               /* (u) */
 char istailcall;             /* (t) */
 unsigned short ftransfer;   /* (r) index of first value transferred */
 unsigned short ntransfer;   /* (r) number of transferred values */
 char short_src[LUA_IDSIZE]; /* (S) */
 /* private part */
 @rep{other fields}
} lua_Debug;
|
```

A structure used to carry different pieces of
information about a function or an activation record.
@Lid{lua_getstack} fills only the private
part
of this structure, for later use.
To fill the other fields of @Lid{lua_Debug} with useful information,
you must call @Lid{lua_getinfo} with an appropriate parameter.
(Specifically, to get a field,
you must add the letter between parentheses in the field's comment
to the parameter @id{what} of @Lid{lua_getinfo}.)

The fields of @Lid{lua_Debug} have the following meaning:
@description{

@item{@id{source}|
the source of the chunk that created the function.
If @T{source} starts with a @Char{@At},
it means that the function was defined in a file where
the file name follows the @Char{@At}.
If @T{source} starts with a @Char{=},
the remainder of its contents describes the source in a user-dependent manner.
Otherwise,
the function was defined in a string where
@T{source} is that string.
}

@item{@id{srclen}|
The length of the string @id{source}.
}

@item{@id{short_src}|
a @Q{printable} version of @T{source}, to be used in error messages.
}

@item{@id{linedefined}|
the line number where
the definition of the function starts.
}

@item{@id{lastlinedefined}|
the line number where the definition of the function ends.
}

@item{@id{what}|
the string @T{"Lua"} if the function is a Lua function,
@T{"C"} if it is a @N{C function},
@T{"main"} if it is the main part of a chunk.
}

@item{@id{currentline}|
the current line where the given function is executing.
When no line information is available,
@T{currentline} is set to @num{-1}.
}

@item{@id{name}|
a reasonable name for the given function.
Because functions in Lua are first-class values,
they do not have a fixed name:
some functions can be the value of multiple global variables,
while others can be stored only in a table field.
The @T{lua_getinfo} function checks how the function was
called to find a suitable name.
If it cannot find a name,
then @id{name} is set to @id{NULL}.
}

@item{@id{namewhat}|
explains the @T{name} field.
The value of @T{namewhat} can be
@T{"global"}, @T{"local"}, @T{"method"},
@T{"field"}, @T{"upvalue"},
 or @T{""} (the empty string),
according to how the function was called.
(Lua uses the empty string when no other option seems to apply.)
}

@item{@id{istailcall}|
true if this function invocation was called by a tail call.
In this case, the caller of this level is not in the stack.
}

@item{@id{nups}|
the number of upvalues of the function.
}

@item{@id{nparams}|
the number of parameters of the function
(always @N{0 for} @N{C functions}).
}

@item{@id{isvararg}|
true if the function is a variadic function
(always true for @N{C functions}).
}

@item{@id{ftransfer}|
the index in the stack of the first value being @Q{transferred},
that is, parameters in a call or return values in a return.
(The other values are in consecutive indices.)
Using this index, you can access and modify these values
through @Lid{lua_getlocal} and @Lid{lua_setlocal}.
This field is only meaningful during a
call hook, denoting the first parameter,
or a return hook, denoting the first value being returned.
(For call
 hooks, this value is always 1.)
}

@item{@id{ntransfer}|
The number of values being transferred (see previous item).
(For calls of Lua functions,
this value is always equal to @id{nparams}.)
}

}

}

@APIEntry{lua_Hook lua_gethook (lua_State *L);|
@apii{0,0,-}

Returns the current hook function.

}

@APIEntry{int lua_gethookcount (lua_State *L);|
@apii{0,0,-}

Returns the current hook count.

}

@APIEntry{int lua_gethookmask (lua_State *L);|

@apii{0,0,-}

Returns the current hook mask.

}

@APIEntry{int lua_getinfo (lua_State *L, const char *what, lua_Debug *ar);|
@apii{0|1,0|1|2,m}

Gets information about a specific function or function invocation.

To get information about a function invocation,
the parameter @id{ar} must be a valid activation record that was
filled by a previous call to @Lid{lua_getstack} or
given as argument to a hook @seeC{lua_Hook}.

To get information about a function, you push it onto the stack
and start the @id{what} string with the character @Char{>}.
(In
 that case,
@id{lua_getinfo} pops the function from the top of the stack.)
For instance, to know in which line a function @id{f} was defined,
you can write the following code:
@verbatim{
lua_Debug ar;
lua_getglobal(L, "f"); /* get global 'f' */
lua_getinfo(L, ">S", &ar);
printf("%d\n", ar.linedefined);
}

Each character in the string @id{what}
selects some fields of the structure @id{ar} to be filled or
a value to be pushed on the stack.
(These characters are also documented in the declaration of
the structure @Lid{lua_Debug},
between parentheses in the comments following each field.)
@description{

@item{@Char{f}|
pushes onto the stack the function that is
running at the given level;
}

@item{@Char{l}| fills in the field @id{currentline};
}

@item{@Char{n}| fills in the fields @id{name} and @id{namewhat};
}

@item{@Char{r}| fills in the fields @id{ftransfer} and @id{ntransfer};
}

@item{@Char{S}|
fills in the fields @id{source}, @id{short_src},
@id{linedefined}, @id{lastlinedefined},
and @id{what};
}

@item{@Char{t}| fills in the field @id{istailcall};
}

@item{@Char{u}| fills in the fields
@id{nups}, @id{nparams}, and @id{isvararg};
}

@item{@Char{L}|
pushes onto the stack a table whose indices are
the lines on the function with some associated code,
that is, the lines where you can put a break point.
(Lines with no code include empty lines and comments.)
If this option is given together with option @Char{f},
its table is pushed after the function.
This is the only option that can raise a memory error.
}

}

This function returns 0 to signal an invalid option in @id{what};
even then the valid options are handled correctly.

}

@APIEntry{const char *lua_getlocal (lua_State *L, const lua_Debug *ar, int n);|
@apii{0,0|1,-}

Gets information about a local variable or a temporary value
of a given activation record or a given function.

In the first case,
the parameter @id{ar} must be a valid activation record that was
filled by a previous call to @Lid{lua_getstack} or
given
as argument to a hook @seeC{lua_Hook}.
The index @id{n} selects which local variable to inspect;
see @Lid{debug.getlocal} for details about variable indices
and names.

@Lid{lua_getlocal} pushes the variable's value onto the stack
and returns its name.

In the second case, @id{ar} must be @id{NULL} and the function
to be inspected must be on the top of the stack.
In this case, only parameters of Lua functions are visible
(as there is no information about what variables are active)
and no values are pushed onto the stack.

Returns @id{NULL} (and pushes nothing)
when the index is greater than
the number of active local variables.

}

@APIEntry{int lua_getstack (lua_State *L, int level, lua_Debug *ar);|
@apii{0,0,-}

Gets information about the interpreter runtime stack.

This function fills parts of a @Lid{lua_Debug} structure with
an identification of the @emph{activation record}
of the function executing at a given level.
@N{Level 0} is the current running function,
whereas level
 @M{n+1} is the function that has called level @M{n}
(except for tail calls, which do not count in the stack).
When called with a level greater than the stack depth,
@Lid{lua_getstack} returns 0;
otherwise it returns 1.

}

@APIEntry{const char *lua_getupvalue (lua_State *L, int funcindex, int n);|
@apii{0,0|1,-}

Gets information about the @id{n}-th upvalue
of the closure at index @id{funcindex}.
It pushes the upvalue's value onto the stack
and returns its name.
Returns @id{NULL} (and pushes nothing)
when the index @id{n} is greater than the number of upvalues.

See @Lid{debug.getupvalue} for more information about upvalues.

}

@APIEntry{typedef void (*lua_Hook) (lua_State *L, lua_Debug *ar);|

Type for debugging hook functions.

Whenever a hook is called, its @id{ar} argument has its field
@id{event} set to the specific event that triggered the hook.
Lua identifies these events with the following constants:
@defid{LUA_HOOKCALL}, @defid{LUA_HOOKRET},
@defid{LUA_HOOKTAILCALL}, @defid{LUA_HOOKLINE},
and
@defid{LUA_HOOKCOUNT}.
Moreover, for line events, the field @id{currentline} is also set.
To get the value of any other field in @id{ar},
the hook must call @Lid{lua_getinfo}.

For call events, @id{event} can be @id{LUA_HOOKCALL},
the normal value, or @id{LUA_HOOKTAILCALL}, for a tail call;
in this case, there will be no corresponding return event.

While Lua is running a hook, it disables other calls to hooks.
Therefore, if a hook calls back Lua to execute a function or a chunk,
this execution occurs without any calls to hooks.

Hook functions cannot have continuations,
that is, they cannot call @Lid{lua_yieldk},
@Lid{lua_pcallk}, or @Lid{lua_callk} with a non-null @id{k}.

Hook functions can yield under the following conditions:
Only count and line events can yield;
to yield, a hook function must finish its execution
calling @Lid{lua_yield} with @id{nresults} equal to zero
(that is, with no values).

}

@APIEntry{void lua_sethook (lua_State *L, lua_Hook f, int mask,
int count);|
@apii{0,0,-}

Sets the debugging hook function.

Argument @id{f} is the hook function.
@id{mask} specifies on which events the hook will be called:
it is formed by a bitwise OR of the constants
@defid{LUA_MASKCALL},
@defid{LUA_MASKRET},
@defid{LUA_MASKLINE},
and @defid{LUA_MASKCOUNT}.

The @id{count} argument is only meaningful when the mask
includes @id{LUA_MASKCOUNT}.
For each event, the hook is called as explained below:
@description{

@item{The call hook| is called when the interpreter calls a function.
The hook is called just after Lua enters the new function.
}

@item{The return hook| is called when the interpreter returns from a function.
The hook is called just before Lua leaves the function.
}

@item{The line hook| is called when the interpreter is about to
start the execution of a new line of code,
or when it jumps back in the code (even to the same line).
This event only happens while Lua is executing a Lua function.
}

@item{The count hook| is called after the
interpreter executes every
@T{count} instructions.
This event only happens while Lua is executing a Lua function.
}

}

Hooks are disabled by setting @id{mask} to zero.

}

@APIEntry{const char *lua_setlocal (lua_State *L, const lua_Debug *ar, int n);|
@apii{0|1,0,-}

Sets the value of a local variable of a given activation record.
It assigns the value on the top of the stack
to the variable and returns its name.
It also pops the value from the stack.

Returns @id{NULL} (and pops nothing)
when the index is greater than
the number of active local variables.

Parameters @id{ar} and @id{n} are as in the function @Lid{lua_getlocal}.

}

@APIEntry{const char *lua_setupvalue (lua_State *L, int funcindex, int n);|

@apii{0|1,0,-}

Sets the value of a closure's upvalue.
It assigns the value on the top of the stack
to the upvalue and returns its name.
It also pops the value from the stack.

Returns @id{NULL} (and pops nothing)
when the index @id{n} is greater than the number of upvalues.

Parameters
 @id{funcindex} and @id{n} are as in
the function @Lid{lua_getupvalue}.

}

@APIEntry{void *lua_upvalueid (lua_State *L, int funcindex, int n);|
@apii{0,0,-}

Returns a unique identifier for the upvalue numbered @id{n}
from the closure at index @id{funcindex}.

These unique identifiers allow a program to check whether different
closures share upvalues.
Lua closures that share an upvalue
(that is, that access a same external local variable)
will return identical ids for those upvalue indices.

Parameters @id{funcindex} and @id{n} are as in
the function @Lid{lua_getupvalue},
but @id{n} cannot be greater than the number of upvalues.

}

@APIEntry{
void lua_upvaluejoin (lua_State *L, int funcindex1, int n1,
                      int funcindex2, int n2);|
@apii{0,0,-}

Make the @id{n1}-th upvalue of the Lua closure at index @id{funcindex1}
refer to the @id{n2}-th upvalue of the Lua closure at index @id{funcindex2}.

}

}

}

@C{--}
@sect1{auxlib|@title{The
Auxiliary Library}

@simplesect{

@index{lauxlib.h}
The @def{auxiliary library} provides several convenient functions
to interface C with Lua.
While the basic API provides the primitive functions for all
interactions between C and Lua,
the auxiliary library provides higher-level functions for some
common tasks.

All functions and types from the auxiliary library
are defined in header file @id{lauxlib.h} and
have a prefix @id{luaL_}.

All functions in the auxiliary library are built on
top of the basic API,
and so they provide nothing that cannot be done with that API.
Nevertheless, the use of the auxiliary library ensures
more consistency to your code.

Several functions in the auxiliary library use internally some
extra stack slots.
When a function in the auxiliary library uses less than five slots,
it does not check the stack size;
it simply assumes that there are enough slots.

Several functions in the auxiliary library are used
to
check @N{C function} arguments.
Because the error message is formatted for arguments
(e.g., @St{bad argument #1}),
you should not use these functions for other stack values.

Functions called @id{luaL_check*}
always raise an error if the check is not satisfied.

}

@sect2{@title{Functions and Types}

Here we list all functions and types from the auxiliary library

in alphabetical order.

@APIEntry{void luaL_addchar (luaL_Buffer *B, char c);|
@apii{?,?,m}

Adds the byte @id{c} to the buffer @id{B}
@seeC{luaL_Buffer}.

}

@APIEntry{
const void luaL_addgsub (luaL_Buffer *B, const char *s,
                         const char *p, const char *r);|
@apii{?,?,m}

Adds a copy of the string @id{s} to the buffer @id{B} @seeC{luaL_Buffer},
replacing any occurrence of the string @id{p}
with the string @id{r}.

}

@APIEntry{void luaL_addlstring (luaL_Buffer *B, const char *s, size_t l);|
@apii{?,?,m}

Adds the string pointed to by @id{s} with length @id{l} to
the buffer @id{B}
@seeC{luaL_Buffer}.
The
 string can contain @x{embedded zeros}.

}

@APIEntry{void luaL_addsize (luaL_Buffer *B, size_t n);|
@apii{?,?,-}

Adds to the buffer @id{B}
a string of length @id{n} previously copied to the
buffer area @seeC{luaL_prepbuffer}.

}

@APIEntry{void luaL_addstring (luaL_Buffer *B, const char *s);|
@apii{?,?,m}

Adds the zero-terminated string pointed to by @id{s}
to the buffer @id{B}
@seeC{luaL_Buffer}.

}

@APIEntry{void luaL_addvalue (luaL_Buffer *B);|
@apii{?,?,m}

Adds the value on the top of the stack
to the buffer @id{B}
@seeC{luaL_Buffer}.
Pops the value.

This is the only function on string buffers that can (and must)
be called with an extra element on the stack,
which is the value to be added to the buffer.

}

@APIEntry{
void luaL_argcheck (lua_State *L,
                int cond,
                int arg,
                const char *extramsg);|
@apii{0,0,v}

Checks whether @id{cond} is true.
If it is not, raises an error with a standard message @seeF{luaL_argerror}.

}

@APIEntry{int
 luaL_argerror (lua_State *L, int arg, const char *extramsg);|
@apii{0,0,v}

Raises an error reporting a problem with argument @id{arg}
of the @N{C function} that called it,
using a standard message
that includes @id{extramsg} as a comment:
@verbatim{
bad argument #@rep{arg} to '@rep{funcname}' (@rep{extramsg})
}
This function never returns.

}

@APIEntry{
void luaL_argexpected (lua_State *L,
                  int cond,
                  int arg,

const char *tname);|
@apii{0,0,v}

Checks whether @id{cond} is true.
If it is not, raises an error about the type of the argument @id{arg}
with a standard message @seeF{luaL_typeerror}.

}

@APIEntry{typedef struct luaL_Buffer luaL_Buffer;|

Type for a @def{string buffer}.

A string buffer allows @N{C code} to build Lua strings piecemeal.
Its pattern of use is as follows:
@itemize{

@item{First declare a variable @id{b} of type @Lid{luaL_Buffer}.}

@item{Then initialize it with a call @T{luaL_buffinit(L,
&b)}.}

@item{
Then add string pieces to the buffer calling any of
the @id{luaL_add*} functions.
}

@item{
Finish by calling @T{luaL_pushresult(&b)}.
This call leaves the final string on the top of the stack.
}

}

If you know beforehand the maximum size of the resulting string,
you can use the buffer like this:
@itemize{

@item{First declare a variable @id{b} of type @Lid{luaL_Buffer}.}

@item{Then initialize it and preallocate a space of
size @id{sz} with a call @T{luaL_buffinitsize(L, &b, sz)}.}

@item{Then produce the string into that space.}

@item{
Finish by calling @T{luaL_pushresultsize(&b, sz)},
where @id{sz} is the total size of the resulting string

copied into that space (which may be less than or
equal to the preallocated size).
}

}

During its normal operation,
a string buffer uses a variable number of stack slots.
So, while using a buffer, you cannot assume that you know where
the top of the stack is.
You can use the stack between successive calls to buffer
operations
as long as that use is balanced;
that is,
when you call a buffer operation,
the stack is at the same level
it was immediately after the previous buffer operation.
(The only exception to this rule is @Lid{luaL_addvalue}.)
After calling @Lid{luaL_pushresult},
the stack is back to its level when the buffer was initialized,
plus the final string on its top.

}

@APIEntry{char *luaL_buffaddr (luaL_Buffer *B);|
@apii{0,0,-}

Returns the address of the current content of buffer @id{B}
@seeC{luaL_Buffer}.
Note that any addition to the buffer may invalidate this address.

}

@APIEntry{void luaL_buffinit (lua_State *L, luaL_Buffer *B);|
@apii{0,?,-}

Initializes a buffer @id{B}
@seeC{luaL_Buffer}.
This function does not allocate any space;
the buffer must be declared as a variable.

}

@APIEntry{size_t luaL_bufflen (luaL_Buffer *B);|
@apii{0,0,-}

Returns the length of the current content of buffer @id{B}
@seeC{luaL_Buffer}.

}

@APIEntry{char *luaL_buffinitsize (lua_State *L, luaL_Buffer
 *B, size_t sz);|
@apii{?,?,m}

Equivalent to the sequence
@Lid{luaL_buffinit}, @Lid{luaL_prepbuffsize}.

}

@APIEntry{void luaL_buffsub (luaL_Buffer *B, int n);|
@apii{?,?,-}

Removes @id{n} bytes from the buffer @id{B}
@seeC{luaL_Buffer}.
The buffer must have at least that many bytes.

}

@APIEntry{int luaL_callmeta (lua_State *L, int obj, const char *e);|
@apii{0,0|1,e}

Calls a metamethod.

If the object at index @id{obj} has a metatable and this
metatable has a field @id{e},
this function calls this field passing the object as its only argument.
In this case this function returns true and pushes onto the
stack the value returned by the call.
If there is no metatable or no metamethod,
this function returns false without pushing any value on the stack.

}

@APIEntry{void luaL_checkany (lua_State *L, int arg);|
@apii{0,0,v}

Checks whether the function has an argument
of any type (including @nil) at position @id{arg}.

}

@APIEntry{lua_Integer luaL_checkinteger (lua_State *L,
 int arg);|
@apii{0,0,v}

Checks whether the function argument @id{arg} is an integer
(or can be converted to an integer)
and returns this integer.

}

@APIEntry{const char *luaL_checklstring (lua_State *L, int arg, size_t *l);|
@apii{0,0,v}

Checks whether the function argument @id{arg} is a string
and returns this string;
if @id{l} is not @id{NULL} fills its referent
with the string's length.

This function uses @Lid{lua_tolstring} to get its result,
so all conversions and caveats of that function apply here.

}

@APIEntry{lua_Number luaL_checknumber (lua_State *L, int arg);|
@apii{0,0,v}

Checks whether the function argument @id{arg} is a number
and returns this number converted to a @id{lua_Number}.

}

@APIEntry{
int luaL_checkoption (lua_State *L,
                      int arg,
                      const char *def,
                      const char *const lst[]);|
@apii{0,0,v}

Checks whether the function argument @id{arg} is a string and
searches for this string in the array @id{lst}
(which
 must be NULL-terminated).
Returns the index in the array where the string was found.
Raises an error if the argument is not a string or
if the string cannot be found.

If @id{def} is not @id{NULL},
the function uses @id{def} as a default value when
there is no argument @id{arg} or when this argument is @nil.

This is a useful function for mapping strings to @N{C enums}.
(The usual convention in Lua libraries is

to use strings instead of numbers to select options.)

}

@APIEntry{void luaL_checkstack (lua_State *L, int sz, const char *msg);|
@apii{0,0,v}

Grows the stack size to @T{top + sz} elements,
raising an error if the stack cannot grow to that size.
@id{msg} is an additional text to go into the error message
(or @id{NULL} for no additional text).

}

@APIEntry{const char *luaL_checkstring (lua_State *L, int arg);|
@apii{0,0,v}

Checks whether the function argument @id{arg} is a string
and returns this string.

This function uses @Lid{lua_tolstring} to get its result,
so
 all conversions and caveats of that function apply here.

}

@APIEntry{void luaL_checktype (lua_State *L, int arg, int t);|
@apii{0,0,v}

Checks whether the function argument @id{arg} has type @id{t}.
See @Lid{lua_type} for the encoding of types for @id{t}.

}

@APIEntry{void *luaL_checkudata (lua_State *L, int arg, const char *tname);|
@apii{0,0,v}

Checks whether the function argument @id{arg} is a userdata
of the type @id{tname} @seeC{luaL_newmetatable} and
returns the userdata's memory-block address @seeC{lua_touserdata}.

}

@APIEntry{void luaL_checkversion (lua_State *L);|
@apii{0,0,v}

Checks whether the code making the call and the Lua library being called
are using the same version of Lua and the same numeric types.

}

@APIEntry{int luaL_dofile (lua_State *L, const char *filename);|
@apii{0,?,m}

Loads and runs the given file.
It is defined as the following macro:
@verbatim{
(luaL_loadfile(L, filename) || lua_pcall(L, 0, LUA_MULTRET, 0))
}
It @N{returns 0} (@Lid{LUA_OK})
 if there are no errors,
or 1 in case of errors.

}

@APIEntry{int luaL_dostring (lua_State *L, const char *str);|
@apii{0,?,-}

Loads and runs the given string.
It is defined as the following macro:
@verbatim{
(luaL_loadstring(L, str) || lua_pcall(L, 0, LUA_MULTRET, 0))
}
It @N{returns 0} (@Lid{LUA_OK}) if there are no errors,
or 1 in case of errors.

}

@APIEntry{int luaL_error (lua_State *L, const char *fmt, ...);|
@apii{0,0,v}

Raises an error.
The error message format is given by @id{fmt}
plus any extra arguments,
following the same rules of @Lid{lua_pushfstring}.
It also adds at the beginning of the message the file name and
the line number where the error occurred,
if this information is available.

This function never returns,
but it is an idiom to use it in @N{C functions}
as @T{return luaL_error(@rep{args})}.

}

@APIEntry{int luaL_execresult (lua_State *L, int stat);|

@apii{0,3,m}

This function produces the return values for
process-related functions in the standard library
(@Lid{os.execute}
 and @Lid{io.close}).

}

@APIEntry{
int luaL_fileresult (lua_State *L, int stat, const char *fname);|
@apii{0,1|3,m}

This function produces the return values for
file-related functions in the standard library
(@Lid{io.open}, @Lid{os.rename}, @Lid{file:seek}, etc.).

}

@APIEntry{int luaL_getmetafield (lua_State *L, int obj, const char *e);|
@apii{0,0|1,m}

Pushes onto the stack the field @id{e} from the metatable
of the object at index @id{obj} and returns the type of the pushed value.
If the object does not have a metatable,
or if the metatable does not have this field,
pushes nothing and returns @id{LUA_TNIL}.

}

@APIEntry{int luaL_getmetatable (lua_State *L, const char *tname);|
@apii{0,1,m}

Pushes onto the stack the metatable associated with the name @id{tname}
in the registry @seeC{luaL_newmetatable},
or @nil if there is no metatable associated with that name.
Returns the type of the pushed value.

}

@APIEntry{int luaL_getsubtable (lua_State *L, int idx, const
 char *fname);|
@apii{0,1,e}

Ensures that the value @T{t[fname]},
where @id{t} is the value at index @id{idx},
is a table,
and pushes that table onto the stack.

Returns true if it finds a previous table there
and false if it creates a new table.

}

@APIEntry{
const char *luaL_gsub (lua_State *L,
                       const char *s,
                       const char *p,
                       const char *r);|
@apii{0,1,m}

Creates a copy of string @id{s},
replacing any occurrence of the string @id{p}
with the string @id{r}.
Pushes the resulting string on the stack and returns it.

}

@APIEntry{lua_Integer luaL_len (lua_State *L, int index);|
@apii{0,0,e}

Returns the @Q{length} of the value at the given index
as a number;
it is equivalent to the @Char{#} operator in Lua @see{len-op}.
Raises an error if the result of the operation is not an integer.
(This case can only happen through metamethods.)

}

@APIEntry{
int luaL_loadbuffer (lua_State *L,
                     const char *buff,
                      size_t sz,
                     const char *name);|
@apii{0,1,-}

Equivalent to @Lid{luaL_loadbufferx} with @id{mode} equal to @id{NULL}.

}

@APIEntry{
int luaL_loadbufferx (lua_State *L,
                      const char *buff,
                      size_t sz,
                      const char *name,
                      const char *mode);|

@apii{0,1,-}

Loads a buffer as a Lua chunk.
This function uses @Lid{lua_load} to load the chunk in the
buffer pointed to by @id{buff} with size @id{sz}.

This function returns the same results as @Lid{lua_load}.
@id{name} is the chunk name,
used for debug information and error messages.
The string @id{mode} works as in the function @Lid{lua_load}.

}

@APIEntry{int luaL_loadfile (lua_State *L, const char *filename);|
@apii{0,1,m}

Equivalent to @Lid{luaL_loadfilex} with @id{mode} equal to @id{NULL}.

}

@APIEntry{int luaL_loadfilex (lua_State *L, const char *filename,
                              const char
 *mode);|
@apii{0,1,m}

Loads a file as a Lua chunk.
This function uses @Lid{lua_load} to load the chunk in the file
named @id{filename}.
If @id{filename} is @id{NULL},
then it loads from the standard input.
The first line in the file is ignored if it starts with a @T{#}.

The string @id{mode} works as in the function @Lid{lua_load}.

This function returns the same results as @Lid{lua_load}
or @Lid{LUA_ERRFILE} for file-related errors.

As @Lid{lua_load}, this function only loads the chunk;
it does not run it.

}

@APIEntry{int luaL_loadstring (lua_State *L, const char *s);|
@apii{0,1,-}

Loads a string as a Lua chunk.
This function uses @Lid{lua_load} to load the chunk in

the zero-terminated string @id{s}.

This function returns the same results as @Lid{lua_load}.

Also as @Lid{lua_load}, this function only loads the chunk;
it does not run it.

}

@APIEntry{void luaL_newlib (lua_State *L, const luaL_Reg l[]);|
@apii{0,1,m}

Creates a new table and registers there
the functions in the
list @id{l}.

It is implemented as the following macro:
@verbatim{
(luaL_newlibtable(L,l), luaL_setfuncs(L,l,0))
}
The array @id{l} must be the actual array,
not a pointer to it.

}

@APIEntry{void luaL_newlibtable (lua_State *L, const luaL_Reg l[]);|
@apii{0,1,m}

Creates a new table with a size optimized
to store all entries in the array @id{l}
(but does not actually store them).
It is intended to be used in conjunction with @Lid{luaL_setfuncs}
@seeF{luaL_newlib}.

It is implemented as a macro.
The array @id{l} must be the actual array,
not a pointer to it.

}

@APIEntry{int luaL_newmetatable (lua_State *L, const char *tname);|
@apii{0,1,m}

If the registry already has the key @id{tname},
returns 0.
Otherwise,
creates a new table to be used as a metatable for userdata,

adds to this new table the pair @T{__name = tname},
adds to the registry the pair @T{[tname] = new table},
and returns 1.

In both cases,
the function pushes onto the stack the final value associated
with @id{tname} in
the registry.

}

@APIEntry{lua_State *luaL_newstate (void);|
@apii{0,0,-}

Creates a new Lua state.
It calls @Lid{lua_newstate} with an
allocator based on the @N{ISO C} allocation functions
and then sets a warning function and a panic function @see{C-error}
that print messages to the standard error output.

Returns the new state,
or @id{NULL} if there is a @x{memory allocation error}.

}

@APIEntry{void luaL_openlibs (lua_State *L);|
@apii{0,0,e}

Opens all standard Lua libraries into the given state.

}

@APIEntry{
T luaL_opt (L, func, arg, dflt);|
@apii{0,0,-}

This macro is defined as follows:
@verbatim{
(lua_isnoneornil(L,(arg)) ? (dflt) : func(L,(arg)))
}
In words, if the argument @id{arg} is nil or absent,
the macro results in the default @id{dflt}.
Otherwise, it results in the result of calling @id{func}
with the state @id{L} and the argument index @id{arg} as
arguments.
Note that it evaluates the expression @id{dflt} only if needed.

}

@APIEntry{
lua_Integer luaL_optinteger
 (lua_State *L,
                  int arg,
                  lua_Integer d);|
@apii{0,0,v}

If the function argument @id{arg} is an integer
(or it is convertible to an integer),
returns this integer.
If this argument is absent or is @nil,
returns @id{d}.
Otherwise, raises an error.

}

@APIEntry{
const char *luaL_optlstring (lua_State *L,
                  int arg,
                  const char *d,
                  size_t *l);|
@apii{0,0,v}

If the function argument @id{arg} is a string,
returns this string.
If this argument is absent or is @nil,
returns @id{d}.
Otherwise, raises an error.

If @id{l} is not @id{NULL},
fills its referent with the result's length.
If the result is @id{NULL}
(only possible when returning @id{d} and @T{d == NULL}),
its length is considered zero.

This function uses @Lid{lua_tolstring} to get its result,
so all conversions and caveats of that function apply here.

}

@APIEntry{lua_Number luaL_optnumber
 (lua_State *L, int arg, lua_Number d);|
@apii{0,0,v}

If the function argument @id{arg} is a number,
returns this number as a @id{lua_Number}.
If this argument is absent or is @nil,

returns @id{d}.
Otherwise, raises an error.

}

@APIEntry{
const char *luaL_optstring (lua_State *L,
                int arg,
                const char *d);|
@apii{0,0,v}

If the function argument @id{arg} is a string,
returns this string.
If this argument is absent or is @nil,
returns @id{d}.
Otherwise, raises an error.

}

@APIEntry{char *luaL_prepbuffer (luaL_Buffer *B);|
@apii{?,?,m}

Equivalent to @Lid{luaL_prepbuffsize}
with the predefined size @defid{LUAL_BUFFERSIZE}.

}

@APIEntry{char *luaL_prepbuffsize (luaL_Buffer *B, size_t sz);|
@apii{?,?,m}

Returns an address to a space of size @id{sz}
where you can copy a string to be added to buffer @id{B}
@seeC{luaL_Buffer}.
After copying the string into this space you must call
@Lid{luaL_addsize} with the size of the string to actually
 add
it to the buffer.

}

@APIEntry{void luaL_pushfail (lua_State *L);|
@apii{0,1,-}

Pushes the @fail value onto the stack @see{libraries}.

}

@APIEntry{void luaL_pushresult (luaL_Buffer *B);|

@apii{?,1,m}

Finishes the use of buffer @id{B} leaving the final string on
the top of the stack.

}

@APIEntry{void luaL_pushresultsize (luaL_Buffer *B, size_t sz);|
@apii{?,1,m}

Equivalent to the sequence @Lid{luaL_addsize}, @Lid{luaL_pushresult}.

}

@APIEntry{int luaL_ref (lua_State *L, int t);|
@apii{1,0,m}

Creates and returns a @def{reference},
in the table at index @id{t},
for the object on the top of the stack (and pops the object).

A reference is a unique integer key.
As long as you do not manually add integer keys into the table @id{t},
@Lid{luaL_ref} ensures the uniqueness of the key it returns.
You can retrieve an object referred by the reference @id{r}
by calling @T{lua_rawgeti(L, t, r)}.
The function @Lid{luaL_unref} frees a reference.

If the object on the top of the stack
 is @nil,
@Lid{luaL_ref} returns the constant @defid{LUA_REFNIL}.
The constant @defid{LUA_NOREF} is guaranteed to be different
from any reference returned by @Lid{luaL_ref}.

}

@APIEntry{
typedef struct luaL_Reg {
 const char *name;
 lua_CFunction func;
} luaL_Reg;
|

Type for arrays of functions to be registered by
@Lid{luaL_setfuncs}.
@id{name} is the function name and @id{func} is a pointer to
the function.
Any array of @Lid{luaL_Reg} must end with a sentinel entry

in which both @id{name} and @id{func} are @id{NULL}.

}

@APIEntry{
void luaL_requiref (lua_State *L, const char *modname,
                    lua_CFunction openf, int glb);|
@apii{0,1,e}

If @T{package.loaded[modname]} is not true,
calls the function @id{openf} with the string @id{modname} as an argument
and sets the call result to @T{package.loaded[modname]},
as if that function has been called through @Lid{require}.

If @id{glb} is true,
also stores the module into the global @id{modname}.

Leaves a copy of the module
on the stack.

}

@APIEntry{void luaL_setfuncs (lua_State *L, const luaL_Reg *l, int nup);|
@apii{nup,0,m}

Registers all functions in the array @id{l}
@seeC{luaL_Reg} into the table on the top of the stack
(below optional upvalues, see next).

When @id{nup} is not zero,
all functions are created with @id{nup} upvalues,
initialized with copies of the @id{nup} values
previously pushed on the stack
on top of the library table.
These values are popped from the stack after the registration.

A function with a @id{NULL} value represents a placeholder,
which is filled with @false.

}

@APIEntry{void luaL_setmetatable (lua_State *L, const char *tname);|
@apii{0,0,-}

Sets the metatable of the object on the top of the stack
as the metatable associated with name @id{tname}
in the registry @seeC{luaL_newmetatable}.

}

@APIEntry{
typedef struct luaL_Stream {
 FILE *f;
 lua_CFunction closef;
} luaL_Stream;
|

The standard representation for @x{file handles}
used by the standard I/O library.

A
 file handle is implemented as a full userdata,
with a metatable called @id{LUA_FILEHANDLE}
(where @id{LUA_FILEHANDLE} is a macro with the actual metatable's name).
The metatable is created by the I/O library
@seeF{luaL_newmetatable}.

This userdata must start with the structure @id{luaL_Stream};
it can contain other data after this initial structure.
The field @id{f} points to the corresponding C stream
(or it can be @id{NULL} to indicate an incompletely created handle).
The field @id{closef} points to a Lua function
that will be called to close the stream
when the handle is closed or collected;
this function receives the file handle as its sole argument and
must return either a true value, in case of success,
or a false value plus an error message, in case of error.
Once Lua calls this field,
it changes the field value to @id{NULL}
to signal that the handle is closed.

}

@APIEntry{void *luaL_testudata (lua_State *L, int arg, const char *tname);|
@apii{0,0,m}

This function works
 like @Lid{luaL_checkudata},
except that, when the test fails,
it returns @id{NULL} instead of raising an error.

}

@APIEntry{const char *luaL_tolstring (lua_State *L, int idx, size_t *len);|
@apii{0,1,e}

Converts any Lua value at the given index to a @N{C string}
in a reasonable format.
The resulting string is pushed onto the stack and also
returned by the function @see{constchar}.
If @id{len} is not @id{NULL},
the function also sets @T{*len} with the string length.

If the value has a metatable with a @idx{__tostring} field,
then @id{luaL_tolstring} calls the corresponding metamethod
with the value as argument,
and uses the result of the call as its result.

}

@APIEntry{
void luaL_traceback (lua_State *L, lua_State *L1, const char *msg,
                     int level);|
@apii{0,1,m}

Creates and pushes a traceback of the stack @id{L1}.
If @id{msg} is not @id{NULL}, it is appended
at the beginning of the traceback.
The @id{level} parameter tells at which level
to start the traceback.

}

@APIEntry{int
 luaL_typeerror (lua_State *L, int arg, const char *tname);|
@apii{0,0,v}

Raises a type error for the argument @id{arg}
of the @N{C function} that called it,
using a standard message;
@id{tname} is a @Q{name} for the expected type.
This function never returns.

}

@APIEntry{const char *luaL_typename (lua_State *L, int index);|
@apii{0,0,-}

Returns the name of the type of the value at the given index.

}

@APIEntry{void luaL_unref (lua_State *L, int t, int ref);|
@apii{0,0,-}

Releases the reference @id{ref} from the table at index @id{t}
@seeC{luaL_ref}.
The entry is removed from the table,
so that the referred object can be collected.
The reference @id{ref} is also freed to be used again.

If @id{ref} is @Lid{LUA_NOREF} or @Lid{LUA_REFNIL},
@Lid{luaL_unref} does nothing.

}

@APIEntry{void luaL_where (lua_State *L, int lvl);|
@apii{0,1,m}

Pushes onto the stack a string identifying the current position
of the control at level @id{lvl} in the call stack.
Typically
 this string has the following format:
@verbatim{
@rep{chunkname}:@rep{currentline}:
}
@N{Level 0} is the running function,
@N{level 1} is the function that called the running function,
etc.

This function is used to build a prefix for error messages.

}

}

}

@C{--}
@sect1{libraries| @title{The Standard Libraries}

@simplesect{

The standard Lua libraries provide useful functions
that are implemented @N{in C} through the @N{C API}.
Some of these functions provide essential services to the language
(e.g., @Lid{type} and @Lid{getmetatable});
others provide access to outside services (e.g., I/O);
and others could be implemented in Lua itself,
but that for different reasons
deserve an implementation in C (e.g., @Lid{table.sort}).

All libraries are implemented through the official @N{C API}
and are provided as separate @N{C modules}.
Unless otherwise noted,
these library functions do not adjust its number of arguments
to
its expected parameters.
For instance, a function documented as @T{foo(arg)}
should not be called without an argument.

The notation @fail means a false value representing
some kind of failure.
(Currently, @fail is equal to @nil,
but that may change in future versions.
The recommendation is to always test the success of these functions
with @T{(not status)}, instead of @T{(status == nil)}.)

Currently, Lua has the following standard libraries:
@itemize{

@item{@link{predefined|basic library};}

@item{@link{corolib|coroutine library};}

@item{@link{packlib|package library};}

@item{@link{strlib|string manipulation};}

@item{@link{utf8|basic UTF-8 support};}

@item{@link{tablib|table manipulation};}

@item{@link{mathlib|mathematical functions} (sin, log, etc.);}

@item{@link{iolib|input and output};}

@item{@link{oslib|operating system facilities};}

@item{@link{debuglib|debug facilities}.}

}
Except for the basic and the package libraries,
each library provides all its functions as
fields of a global table
or as methods of its objects.

To have access to these libraries,

the @N{C host} program should call the @Lid{luaL_openlibs} function,
which opens all standard libraries.
Alternatively,
the host program can open them individually by using
@Lid{luaL_requiref} to call
@defid{luaopen_base} (for the basic library),
@defid{luaopen_package} (for the package library),
@defid{luaopen_coroutine} (for the coroutine library),
@defid{luaopen_string} (for the string library),
@defid{luaopen_utf8} (for the UTF-8 library),
@defid{luaopen_table} (for the table library),
@defid{luaopen_math} (for the mathematical library),
@defid{luaopen_io} (for the I/O library),
@defid{luaopen_os} (for the operating system library),
and @defid{luaopen_debug} (for the debug library).
These functions are declared in @defid{lualib.h}.

}

@sect2{predefined| @title{Basic Functions}

The basic library provides core functions to Lua.
If you do not include this library in your application,
you should
 check carefully whether you need to provide
implementations for some of its facilities.

@LibEntry{assert (v [, message])|

Raises an error if
the value of its argument @id{v} is false (i.e., @nil or @false);
otherwise, returns all its arguments.
In case of error,
@id{message} is the error object;
when absent, it defaults to @St{assertion failed!}

}

@LibEntry{collectgarbage ([opt [, arg]])|

This function is a generic interface to the garbage collector.
It performs different functions according to its first argument, @id{opt}:
@description{

@item{@St{collect}|
Performs a full garbage-collection cycle.

This is the default option.
}

@item{@St{stop}|
Stops automatic execution of the garbage collector.
The collector will run only when explicitly invoked,
until a call to restart it.
}

@item{@St{restart}|
Restarts automatic execution of the garbage collector.
}

@item{@St{count}|
Returns the total memory in use by Lua in Kbytes.
The value has a fractional part,
so that it multiplied
by 1024
gives the exact number of bytes in use by Lua.
}

@item{@St{step}|
Performs a garbage-collection step.
The step @Q{size} is controlled by @id{arg}.
With a zero value,
the collector will perform one basic (indivisible) step.
For non-zero values,
the collector will perform as if that amount of memory
(in Kbytes) had been allocated by Lua.
Returns @true if the step finished a collection cycle.
}

@item{@St{isrunning}|
Returns a boolean that tells whether the collector is running
(i.e., not stopped).
}

@item{@St{incremental}|
Change the collector mode to incremental.
This option can be followed by three numbers:
the garbage-collector pause,
the step multiplier,
and the step size @see{incmode}.
A zero means to not change that value.
}

@item{@St{generational}|
Change the collector mode to generational.

This option can be followed by two numbers:
the garbage-collector minor multiplier
and the major multiplier @see{genmode}.
A zero means to not change that value.
}

}
See @See{GC}
for more details about garbage collection
and some of these options.

This function should not be called by a finalizer.

}

@LibEntry{dofile ([filename])|
Opens the named file and executes its content as a Lua chunk.
When called without arguments,
@id{dofile} executes the content of the standard input (@id{stdin}).
Returns all values returned by the chunk.
In case of errors, @id{dofile} propagates the error
to its caller.
(That is, @id{dofile} does not run in protected mode.)

}

@LibEntry{error (message [, level])|
Raises an error @see{error} with @id{message} as the error object.
This function never returns.

Usually, @id{error} adds some information about the error position
at the beginning of the message, if the message is a string.
The @id{level} argument specifies how to get the error position.
With @N{level 1} (the default), the error position is where the
@id{error} function was called.
@N{Level 2} points the error to where the function
that called @id{error} was called; and
so on.
Passing a @N{level 0} avoids the addition of error position information
to the message.

}

@LibEntry{_G|
A global variable (not a function) that
holds the @x{global environment} @see{globalenv}.
Lua itself does not use this variable;
changing its value does not affect any environment,

nor vice versa.

}

@LibEntry{getmetatable (object)|

If @id{object} does not have a metatable, returns @nil.
Otherwise,
if the object's metatable has a @idx{__metatable} field,
returns the associated value.
Otherwise, returns the metatable of the given object.

}

@LibEntry{ipairs (t)|

Returns three values (an iterator function, the table @id{t}, and 0)
so that the construction
@verbatim{
for i,v in ipairs(t) do @rep{body} end
}
will iterate over the key@En{}value pairs
(@T{1,t[1]}), (@T{2,t[2]}), @ldots,
up to the first absent index.

}

@LibEntry{load (chunk [, chunkname [, mode [, env]]])|

Loads a chunk.

If @id{chunk} is a string, the chunk is this string.
If @id{chunk} is a function,
@id{load}
calls it repeatedly to get the chunk pieces.
Each call to @id{chunk} must return a string that concatenates
with previous results.
A return of an empty string, @nil, or no value signals the end of the chunk.

If there are no syntactic errors,
@id{load} returns the compiled chunk as a function;
otherwise, it returns @fail plus the error message.

When you load a main chunk,
the resulting function will always have exactly one upvalue,
the @id{_ENV} variable @see{globalenv}.
However,
when you load a binary chunk created from a function @seeF{string.dump},

the resulting function can have an arbitrary number of upvalues,
and there is no guarantee that its first upvalue will be
the @id{_ENV} variable.
(A non-main function may not even have an @id{_ENV} upvalue.)

Regardless, if the resulting function has any upvalues,
its first upvalue is set to the value of @id{env},
if that parameter is given,
or to the value of the @x{global environment}.
Other upvalues are initialized with @nil.
All
upvalues are fresh, that is,
they are not shared with any other function.

@id{chunkname} is used as the name of the chunk for error messages
and debug information @see{debugI}.
When absent,
it defaults to @id{chunk}, if @id{chunk} is a string,
or to @St{=(load)} otherwise.

The string @id{mode} controls whether the chunk can be text or binary
(that is, a precompiled chunk).
It may be the string @St{b} (only @x{binary chunk}s),
@St{t} (only text chunks),
or @St{bt} (both binary and text).
The default is @St{bt}.

It is safe to load malformed binary chunks;
@id{load} signals an appropriate error.
However,
Lua does not check the consistency of the code inside binary chunks;
running maliciously crafted bytecode can crash the interpreter.

}

@LibEntry{loadfile ([filename [, mode [, env]]])|

Similar to @Lid{load},
but gets the chunk from file @id{filename}
or from the standard input,
if no file name is given.

}

@LibEntry{next (table [, index])|

Allows a program to traverse all fields

of a table.
Its first argument is a table and its second argument
is an index in this table.
A call to @id{next} returns the next index of the table
and its associated value.
When called with @nil as its second argument,
@id{next} returns an initial index
and its associated value.
When called with the last index,
or with @nil in an empty table,
@id{next} returns @nil.
If the second argument is absent, then it is interpreted as @nil.
In particular,
you can use @T{next(t)} to check whether a table is empty.

The order in which the indices are enumerated is not specified,
@emph{even for numeric indices}.
(To traverse a table in numerical order,
use a numerical @Rw{for}.)

You should not assign any value to a non-existent field in a table
during its traversal.
You may however modify existing fields.
In particular, you may set existing fields to nil.

}

@LibEntry{pairs (t)|

If @id{t} has a metamethod @idx{__pairs},
calls it with @id{t} as argument and returns the first three
results from
the call.

Otherwise,
returns three values: the @Lid{next} function, the table @id{t}, and @nil,
so that the construction
@verbatim{
for k,v in pairs(t) do @rep{body} end
}
will iterate over all key@En{}value pairs of table @id{t}.

See function @Lid{next} for the caveats of modifying
the table during its traversal.

}

@LibEntry{pcall (f [, arg1, @Cdots])|

Calls the function @id{f} with
the given arguments in @emphx{protected mode}.
This means that any error @N{inside @T{f}} is not propagated;
instead, @id{pcall} catches the error
and returns a status code.
Its first result is the status code (a boolean),
which is @true if the call succeeds without errors.
In such case, @id{pcall} also returns all results from the call,
after this first result.
In case of any error, @id{pcall} returns @false plus the error object.
Note that errors caught by @id{pcall} do not call a message handler.

}

@LibEntry{print (@Cdots)|
Receives any number of arguments
and prints their values to @id{stdout},
converting
each argument to a string
following the same rules of @Lid{tostring}.

The function @id{print} is not intended for formatted output,
but only as a quick way to show a value,
for instance for debugging.
For complete control over the output,
use @Lid{string.format} and @Lid{io.write}.

}

@LibEntry{rawequal (v1, v2)|
Checks whether @id{v1} is equal to @id{v2},
without invoking the @idx{__eq} metamethod.
Returns a boolean.

}

@LibEntry{rawget (table, index)|
Gets the real value of @T{table[index]},
without using the @idx{__index} metavalue.
@id{table} must be a table;
@id{index} may be any value.

}

@LibEntry{rawlen (v)|
Returns the length of the object @id{v},
which must be a table or a string,

without invoking the @idx{__len} metamethod.
Returns an integer.

}

@LibEntry{rawset (table, index, value)|
Sets the real value of @T{table[index]} to @id{value},
without using the @idx{__newindex} metavalue.
@id{table} must be a table,
@id{index} any value different from @nil and @x{NaN},
and
@id{value} any Lua value.

This function returns @id{table}.

}

@LibEntry{select (index, @Cdots)|

If @id{index} is a number,
returns all arguments after argument number @id{index};
a negative number indexes from the end (@num{-1} is the last argument).
Otherwise, @id{index} must be the string @T{"#"},
and @id{select} returns the total number of extra arguments it received.

}

@LibEntry{setmetatable (table, metatable)|

Sets the metatable for the given table.
If @id{metatable} is @nil,
removes the metatable of the given table.
If the original metatable has a @idx{__metatable} field,
raises an error.

This function returns @id{table}.

To change the metatable of other types from Lua code,
you must use the @link{debuglib|debug library}.

}

@LibEntry{tonumber (e [, base])|

When called with no @id{base},
@id{tonumber} tries to convert its argument to a number.
If the argument is already a number or
a string convertible to a number,

then @id{tonumber} returns this number;
otherwise,
 it returns @fail.

The conversion of strings can result in integers or floats,
according to the lexical conventions of Lua @see{lexical}.
The string may have leading and trailing spaces and a sign.

When called with @id{base},
then @id{e} must be a string to be interpreted as
an integer numeral in that base.
The base may be any integer between 2 and 36, inclusive.
In bases @N{above 10}, the letter @Char{A} (in either upper or lower case)
@N{represents 10}, @Char{B} @N{represents 11}, and so forth,
with @Char{Z} representing 35.
If the string @id{e} is not a valid numeral in the given base,
the function returns @fail.

}

@LibEntry{tostring (v)|

Receives a value of any type and
converts it to a string in a human-readable format.

If the metatable of @id{v} has a @idx{__tostring} field,
then @id{tostring} calls the corresponding value
with @id{v} as argument,
and uses the result of the call as its result.
Otherwise, if the metatable of @id{v} has a @idx{__name} field
with a string
 value,
@id{tostring} may use that string in its final result.

For complete control of how numbers are converted,
use @Lid{string.format}.

}

@LibEntry{type (v)|

Returns the type of its only argument, coded as a string.
The possible results of this function are
@St{nil} (a string, not the value @nil),
@St{number},
@St{string},
@St{boolean},
@St{table},

@St{function},
@St{thread},
and @St{userdata}.

}

@LibEntry{_VERSION|

A global variable (not a function) that
holds a string containing the running Lua version.
The current value of this variable is @St{Lua 5.4}.

}

@LibEntry{warn (msg1, @Cdots)|

Emits a warning with a message composed by the concatenation
of all its arguments (which should be strings).

By convention,
a one-piece message starting with @Char{@At}
is intended to be a @emph{control message},
which is a message to the warning system itself.
In particular, the standard warning function in Lua
recognizes the control messages @St{@At{}off},
to stop the emission of warnings,
and
@St{@At{}on}, to (re)start the emission;
it ignores unknown control messages.

}

@LibEntry{xpcall (f, msgh [, arg1, @Cdots])|

This function is similar to @Lid{pcall},
except that it sets a new @x{message handler} @id{msgh}.

}

}

@sect2{corolib| @title{Coroutine Manipulation}

This library comprises the operations to manipulate coroutines,
which come inside the table @defid{coroutine}.
See @See{coroutine} for a general description of coroutines.

@LibEntry{coroutine.close (co)|

Closes coroutine @id{co},
that is,
closes all its pending to-be-closed variables
and puts the coroutine in a dead state.
The given coroutine must be dead or suspended.
In case of error
(either the original error that stopped the coroutine or
errors in closing methods),
returns @false plus the error object;
otherwise returns @true.

}

@LibEntry{coroutine.create (f)|

Creates a new coroutine, with body @id{f}.
@id{f} must be a function.
Returns this new coroutine,
an object with type @T{"thread"}.

}

@LibEntry{coroutine.isyieldable
([co])|

Returns @true when the coroutine @id{co} can yield.
The default for @id{co} is the running coroutine.

A coroutine is yieldable if it is not the main thread and
it is not inside a non-yieldable @N{C function}.

}

@LibEntry{coroutine.resume (co [, val1, @Cdots])|

Starts or continues the execution of coroutine @id{co}.
The first time you resume a coroutine,
it starts running its body.
The values @id{val1}, @ldots are passed
as the arguments to the body function.
If the coroutine has yielded,
@id{resume} restarts it;
the values @id{val1}, @ldots are passed
as the results from the yield.

If the coroutine runs without any errors,

@id{resume} returns @true plus any values passed to @id{yield}
(when the coroutine yields) or any values returned by the body function
(when the coroutine terminates).
If there is any error,
@id{resume} returns @false plus the error message.

}

@LibEntry{coroutine.running ()|

Returns the running coroutine plus a boolean,
@true
when the running coroutine is the main one.

}

@LibEntry{coroutine.status (co)|

Returns the status of the coroutine @id{co}, as a string:
@T{"running"},
if the coroutine is running
(that is, it is the one that called @id{status});
@T{"suspended"}, if the coroutine is suspended in a call to @id{yield},
or if it has not started running yet;
@T{"normal"} if the coroutine is active but not running
(that is, it has resumed another coroutine);
and @T{"dead"} if the coroutine has finished its body function,
or if it has stopped with an error.

}

@LibEntry{coroutine.wrap (f)|

Creates a new coroutine, with body @id{f};
@id{f} must be a function.
Returns a function that resumes the coroutine each time it is called.
Any arguments passed to this function behave as the
extra arguments to @id{resume}.
The function returns the same values returned by @id{resume},
except the first boolean.
In case of error,
the function closes the coroutine and propagates the error.

}

@LibEntry{coroutine.yield
(@Cdots)|

Suspends the execution of the calling coroutine.
Any arguments to @id{yield} are passed as extra results to @id{resume}.

}

}

@sect2{packlib| @title{Modules}

The package library provides basic
facilities for loading modules in Lua.
It exports one function directly in the global environment:
@Lid{require}.
Everything else is exported in the table @defid{package}.

@LibEntry{require (modname)|

Loads the given module.
The function starts by looking into the @Lid{package.loaded} table
to determine whether @id{modname} is already loaded.
If it is, then @id{require} returns the value stored
at @T{package.loaded[modname]}.
(The absence of a second result in this case
signals that this call did not have to load the module.)
Otherwise, it tries to find a @emph{loader} for the module.

To find a loader,
@id{require} is guided by the table @Lid{package.searchers}.
Each item in this table is a search function,
that searches for the module in a particular way.
By changing
this table,
we can change how @id{require} looks for a module.
The following explanation is based on the default configuration
for @Lid{package.searchers}.

First @id{require} queries @T{package.preload[modname]}.
If it has a value,
this value (which must be a function) is the loader.
Otherwise @id{require} searches for a Lua loader using the
path stored in @Lid{package.path}.
If that also fails, it searches for a @N{C loader} using the
path stored in @Lid{package.cpath}.
If that also fails,
it tries an @emph{all-in-one} loader @seeF{package.searchers}.

Once a loader is found,

@id{require} calls the loader with two arguments:
@id{modname} and an extra value,
a @emph{loader data},
also returned by the searcher.
The loader data can be any value useful to the module;
for the default searchers,
it indicates where the loader was found.
(For instance, if the loader came from a file,
this extra value is the file path.)
If the loader returns any non-nil value,
@id{require} assigns the returned
value to @T{package.loaded[modname]}.
If the loader does not return a non-nil value and
has not assigned any value to @T{package.loaded[modname]},
then @id{require} assigns @true to this entry.
In any case, @id{require} returns the
final value of @T{package.loaded[modname]}.
Besides that value, @id{require} also returns as a second result
the loader data returned by the searcher,
which indicates how @id{require} found the module.

If there is any error loading or running the module,
or if it cannot find any loader for the module,
then @id{require} raises an error.

}

@LibEntry{package.config|

A string describing some compile-time configurations for packages.
This string is a sequence of lines:
@itemize{

@item{The first line is the @x{directory separator} string.
Default is @Char{\} for @x{Windows} and @Char{/} for all other systems.}

@item{The second line is the character that separates templates in a path.
Default is @Char{;}.}

@item{The third line is the string that marks the
substitution
points in a template.
Default is @Char{?}.}

@item{The fourth line is a string that, in a path in @x{Windows},
is replaced by the executable's directory.
Default is @Char{!}.}

@item{The fifth line is a mark to ignore all text after it
when building the @id{luaopen_} function name.
Default is @Char{-}.}

}

}

@LibEntry{package.cpath|

A string with the path used by @Lid{require}
to search for a @N{C loader}.

Lua initializes the @N{C path} @Lid{package.cpath} in the same way
it initializes the Lua path @Lid{package.path},
using the environment variable @defid{LUA_CPATH_5_4},
or the environment variable @defid{LUA_CPATH},
or a default path defined in @id{luaconf.h}.

}

@LibEntry{package.loaded|

A table used by @Lid{require} to control which
modules are already loaded.
When you require a module @id{modname} and
@T{package.loaded[modname]} is not false,
@Lid{require} simply returns the value stored there.

This variable is only a reference to the real table;
assignments
 to this variable do not change the
table used by @Lid{require}.
The real table is stored in the C registry @see{registry},
indexed by the key @defid{LUA_LOADED_TABLE}, a string.

}

@LibEntry{package.loadlib (libname, funcname)|

Dynamically links the host program with the @N{C library} @id{libname}.

If @id{funcname} is @St{*},
then it only links with the library,
making the symbols exported by the library
available to other dynamically linked libraries.
Otherwise,
it looks for a function @id{funcname} inside the library

and returns this function as a @N{C function}.
So, @id{funcname} must follow the @Lid{lua_CFunction} prototype
@seeC{lua_CFunction}.

This is a low-level function.
It completely bypasses the package and module system.
Unlike @Lid{require},
it does not perform any path searching and
does not automatically adds extensions.
@id{libname} must be the complete file name of the @N{C library},
including if necessary a path and an extension.
@id{funcname} must be the exact name
exported by the @N{C library}
(which may depend on the @N{C compiler} and linker used).

This functionality is not supported by @N{ISO C}.
As such, it is only available on some platforms
(Windows, Linux, Mac OS X, Solaris, BSD,
plus other Unix systems that support the @id{dlfcn} standard).

This function is inherently insecure,
as it allows Lua to call any function in any readable dynamic
library in the system.
(Lua calls any function assuming the function
has a proper prototype and respects a proper protocol
@see{lua_CFunction}.
Therefore,
calling an arbitrary function in an arbitrary dynamic library
more often than not results in an access violation.)

}

@LibEntry{package.path|

A string with the path used by @Lid{require}
to search for a Lua loader.

At start-up, Lua initializes this variable with
the value of the environment variable @defid{LUA_PATH_5_4} or
the environment variable @defid{LUA_PATH} or
with a default path defined in @id{luaconf.h},
if those environment variables
are not defined.
A @St{;;} in the value of the environment variable
is replaced by the default path.

}

@LibEntry{package.preload|

A table to store loaders for specific modules
@seeF{require}.

This variable is only a reference to the real table;
assignments to this variable do not change the
table used by @Lid{require}.
The real table is stored in the C registry @see{registry},
indexed by the key @defid{LUA_PRELOAD_TABLE}, a string.

}

@LibEntry{package.searchers|

A table used by @Lid{require} to control how to find modules.

Each entry in this table is a @def{searcher function}.
When looking for a module,
@Lid{require} calls each of these searchers in ascending order,
with the module name (the argument given to @Lid{require}) as its
sole argument.
If the searcher finds the module,
it returns another function, the module @def{loader},
plus an extra value, a @emph{loader data},
that will be passed to that loader and
returned as a second result by @Lid{require}.
If it cannot find the
 module,
it returns a string explaining why
(or @nil if it has nothing to say).

Lua initializes this table with four searcher functions.

The first searcher simply looks for a loader in the
@Lid{package.preload} table.

The second searcher looks for a loader as a Lua library,
using the path stored at @Lid{package.path}.
The search is done as described in function @Lid{package.searchpath}.

The third searcher looks for a loader as a @N{C library},
using the path given by the variable @Lid{package.cpath}.
Again,
the search is done as described in function @Lid{package.searchpath}.
For instance,
if the @N{C path} is the string
@verbatim{

"./?.so;./?.dll;/usr/local/?/init.so"
}
the searcher for module @id{foo}
will try to open the files @T{./foo.so}, @T{./foo.dll},
and @T{/usr/local/foo/init.so}, in that order.
Once it finds a @N{C library},
this searcher first uses a dynamic link facility to link the
application with the library.
Then it tries to find a @N{C function} inside the library
to
be used as the loader.
The name of this @N{C function} is the string @St{luaopen_}
concatenated with a copy of the module name where each dot
is replaced by an underscore.
Moreover, if the module name has a hyphen,
its suffix after (and including) the first hyphen is removed.
For instance, if the module name is @id{a.b.c-v2.1},
the function name will be @id{luaopen_a_b_c}.

The fourth searcher tries an @def{all-in-one loader}.
It searches the @N{C path} for a library for
the root name of the given module.
For instance, when requiring @id{a.b.c},
it will search for a @N{C library} for @id{a}.
If found, it looks into it for an open function for
the submodule;
in our example, that would be @id{luaopen_a_b_c}.
With this facility, a package can pack several @N{C submodules}
into one single library,
with each submodule keeping its original open function.

All searchers except the first one (preload) return as the extra value
the file path where the module was found,
as returned by @Lid{package.searchpath}.
The
first searcher always returns the string @St{:preload:}.

Searchers should raise no errors and have no side effects in Lua.
(They may have side effects in C,
for instance by linking the application with a library.)

}

@LibEntry{package.searchpath (name, path [, sep [, rep]])|

Searches for the given @id{name} in the given @id{path}.

A path is a string containing a sequence of

@emph{templates} separated by semicolons.
For each template,
the function replaces each interrogation mark (if any)
in the template with a copy of @id{name}
wherein all occurrences of @id{sep}
(a dot, by default)
were replaced by @id{rep}
(the system's directory separator, by default),
and then tries to open the resulting file name.

For instance, if the path is the string
@verbatim{
"./?.lua;./?.lc;/usr/local/?/init.lua"
}
the search for the name @id{foo.a}
will try to open the files
@T{./foo/a.lua}, @T{./foo/a.lc}, and
@T{/usr/local/foo/a/init.lua}, in that order.

Returns the resulting
 name of the first file that it can
open in read mode (after closing the file),
or @fail plus an error message if none succeeds.
(This error message lists all file names it tried to open.)

}

}

@sect2{strlib| @title{String Manipulation}

@simplesect{

This library provides generic functions for string manipulation,
such as finding and extracting substrings, and pattern matching.
When indexing a string in Lua, the first character is at @N{position 1}
(not @N{at 0}, as in C).
Indices are allowed to be negative and are interpreted as indexing backwards,
from the end of the string.
Thus, the last character is at position @num{-1}, and so on.

The string library provides all its functions inside the table
@defid{string}.
It also sets a @x{metatable for strings}
where the @idx{__index} field points to the @id{string} table.
Therefore, you can use the string functions in object-oriented style.
For instance, @T{string.byte(s,i)}
can be written as @T{s:byte(i)}.

The string library assumes one-byte
character encodings.

@LibEntry{string.byte (s [, i [, j]])|
Returns the internal numeric codes of the characters @T{s[i]},
@T{s[i+1]}, @ldots, @T{s[j]}.
The default value for @id{i} @N{is 1};
the default value for @id{j} @N{is @id{i}}.
These indices are corrected
following the same rules of function @Lid{string.sub}.

Numeric codes are not necessarily portable across platforms.

}

@LibEntry{string.char (@Cdots)|
Receives zero or more integers.
Returns a string with length equal to the number of arguments,
in which each character has the internal numeric code equal
to its corresponding argument.

Numeric codes are not necessarily portable across platforms.

}

@LibEntry{string.dump (function [, strip])|

Returns a string containing a binary representation
(a @emph{binary chunk})
of the given function,
so that a later @Lid{load} on this string returns
a copy of the function (but with new upvalues).
If @id{strip} is a true value,
the binary representation may not include all debug
information
about the function,
to save space.

Functions with upvalues have only their number of upvalues saved.
When (re)loaded,
those upvalues receive fresh instances.
(See the @Lid{load} function for details about
how these upvalues are initialized.
You can use the debug library to serialize
and reload the upvalues of a function
in a way adequate to your needs.)

}

@LibEntry{string.find (s, pattern [, init [, plain]])|

Looks for the first match of
@id{pattern} @see{pm} in the string @id{s}.
If it finds a match, then @id{find} returns the indices @N{of @T{s}}
where this occurrence starts and ends;
otherwise, it returns @fail.
A third, optional numeric argument @id{init} specifies
where to start the search;
its default value @N{is 1} and can be negative.
A @true as a fourth, optional argument @id{plain}
turns off the pattern matching facilities,
so the function does a plain @Q{find substring} operation,
with no characters in @id{pattern} being considered magic.

If the pattern has
captures,
then in a successful match
the captured values are also returned,
after the two indices.

}

@LibEntry{string.format (formatstring, @Cdots)|

Returns a formatted version of its variable number of arguments
following the description given in its first argument,
which must be a string.
The format string follows the same rules as the @ANSI{sprintf}.
The only differences are that the conversion specifiers and modifiers
@id{F}, @id{n}, @T{*}, @id{h}, @id{L}, and @id{l} are not supported
and that there is an extra specifier, @id{q}.
Both width and precision, when present,
are limited to two digits.

The specifier @id{q} formats booleans, nil, numbers, and strings
in a way that the result is a valid constant in Lua source code.
Booleans and nil are written in the obvious way
(@id{true}, @id{false}, @id{nil}).
Floats are written in hexadecimal,
to preserve full precision.
A string is written between double quotes,
using escape sequences when necessary to ensure that
it can safely

be read back by the Lua interpreter.
For instance, the call
@verbatim{
string.format('%q', 'a string with "quotes" and \n new line')
}
may produce the string:
@verbatim{
"a string with \"quotes\" and \
new line"
}
This specifier does not support modifiers (flags, width, precision).

The conversion specifiers
@id{A}, @id{a}, @id{E}, @id{e}, @id{f},
@id{G}, and @id{g} all expect a number as argument.
The specifiers @id{c}, @id{d},
@id{i}, @id{o}, @id{u}, @id{X}, and @id{x}
expect an integer.
When Lua is compiled with a C89 compiler,
the specifiers @id{A} and @id{a} (hexadecimal floats)
do not support modifiers.

The specifier @id{s} expects a string;
if its argument is not a string,
it is converted to one following the same rules of @Lid{tostring}.
If the specifier has any modifier,
the corresponding string argument should not contain @x{embedded zeros}.

The specifier @id{p} formats the pointer
returned by @Lid{lua_topointer}.
That gives a unique string identifier for tables, userdata,
threads,
strings, and functions.
For other values (numbers, nil, booleans),
this specifier results in a string representing
the pointer @id{NULL}.

}

@LibEntry{string.gmatch (s, pattern [, init])|
Returns an iterator function that,
each time it is called,
returns the next captures from @id{pattern} @see{pm}
over the string @id{s}.
If @id{pattern} specifies no captures,
then the whole match is produced in each call.
A third, optional numeric argument @id{init} specifies
where to start the search;

its default value @N{is 1} and can be negative.

As an example, the following loop
will iterate over all the words from string @id{s},
printing one per line:
@verbatim{
s = "hello world from Lua"
for w in string.gmatch(s, "%a+") do
 print(w)
end
}
The next example collects all pairs @T{key=value} from the
given string into a table:
@verbatim{
t = {}
s = "from=world, to=Lua"
for k, v in string.gmatch(s, "(%w+)=(%w+)") do
 t[k] = v
end
}

For this function, a caret @Char{^} at the start of a
 pattern does not
work as an anchor, as this would prevent the iteration.

}

@LibEntry{string.gsub (s, pattern, repl [, n])|
Returns a copy of @id{s}
in which all (or the first @id{n}, if given)
occurrences of the @id{pattern} @see{pm} have been
replaced by a replacement string specified by @id{repl},
which can be a string, a table, or a function.
@id{gsub} also returns, as its second value,
the total number of matches that occurred.
The name @id{gsub} comes from @emph{Global SUBstitution}.

If @id{repl} is a string, then its value is used for replacement.
The @N{character @T{%}} works as an escape character:
any sequence in @id{repl} of the form @T{%@rep{d}},
with @rep{d} between 1 and 9,
stands for the value of the @rep{d}-th captured substring;
the sequence @T{%0} stands for the whole match;
the sequence @T{%%} stands for a @N{single @T{%}}.

If @id{repl} is a table, then the table is queried for every match,
using the first capture as the key.

If @id{repl} is a function, then this
function is called every time a
match occurs, with all captured substrings passed as arguments,
in order.

In any case,
if the pattern specifies no captures,
then it behaves as if the whole pattern was inside a capture.

If the value returned by the table query or by the function call
is a string or a number,
then it is used as the replacement string;
otherwise, if it is @Rw{false} or @nil,
then there is no replacement
(that is, the original match is kept in the string).

Here are some examples:
@verbatim{
x = string.gsub("hello world", "(%w+)", "%1 %1")
--> x="hello hello world world"

x = string.gsub("hello world", "%w+", "%0 %0", 1)
--> x="hello hello world"

x = string.gsub("hello world from Lua", "(%w+)%s*(%w+)", "%2 %1")
--> x="world hello Lua from"

x = string.gsub("home = $HOME, user = $USER", "%$(%w+)", os.getenv)
--> x="home = /home/roberto, user = roberto"

x = string.gsub("4+5 = $return 4+5$", "%$(.-)%$", function (s)
    return load(s)()
  end)
--> x="4+5 = 9"

local
 t = {name="lua", version="5.4"}
x = string.gsub("$name-$version.tar.gz", "%$(%w+)", t)
--> x="lua-5.4.tar.gz"
}

}

@LibEntry{string.len (s)|

Receives a string and returns its length.
The empty string @T{""} has length 0.
Embedded zeros are counted,

so @T{"a\000bc\000"} has length 5.

}

@LibEntry{string.lower (s)|

Receives a string and returns a copy of this string with all
uppercase letters changed to lowercase.
All other characters are left unchanged.
The definition of what an uppercase letter is depends on the current locale.

}

@LibEntry{string.match (s, pattern [, init])|

Looks for the first @emph{match} of
the @id{pattern} @see{pm} in the string @id{s}.
If it finds one, then @id{match} returns
the captures from the pattern;
otherwise it returns @fail.
If @id{pattern} specifies no captures,
then the whole match is returned.
A third, optional numeric argument @id{init} specifies
where to start the search;
its default value @N{is 1} and can be negative.

}

@LibEntry{string.pack
 (fmt, v1, v2, @Cdots)|

Returns a binary string containing the values @id{v1}, @id{v2}, etc.
serialized in binary form (packed)
according to the format string @id{fmt} @see{pack}.

}

@LibEntry{string.packsize (fmt)|

Returns the length of a string resulting from @Lid{string.pack}
with the given format.
The format string cannot have the variable-length options
@Char{s} or @Char{z} @see{pack}.

}

@LibEntry{string.rep (s, n [, sep])|

Returns a string that is the concatenation of @id{n} copies of
the string @id{s} separated by the string @id{sep}.
The default value for @id{sep} is the empty string
(that is, no separator).
Returns the empty string if @id{n} is not positive.

(Note that it is very easy to exhaust the memory of your machine
with a single call to this function.)

}

@LibEntry{string.reverse (s)|

Returns a string that is the string @id{s} reversed.

}

@LibEntry{string.sub (s, i [, j])|

Returns the substring of @id{s} that
starts at @id{i} and continues until @id{j};
@id{i}
 and @id{j} can be negative.
If @id{j} is absent, then it is assumed to be equal to @num{-1}
(which is the same as the string length).
In particular,
the call @T{string.sub(s,1,j)} returns a prefix of @id{s}
with length @id{j},
and @T{string.sub(s, -i)} (for a positive @id{i})
returns a suffix of @id{s}
with length @id{i}.

If, after the translation of negative indices,
@id{i} is less than 1,
it is corrected to 1.
If @id{j} is greater than the string length,
it is corrected to that length.
If, after these corrections,
@id{i} is greater than @id{j},
the function returns the empty string.

}

@LibEntry{string.unpack (fmt, s [, pos])|

Returns the values packed in string @id{s} @seeF{string.pack}
according to the format string @id{fmt} @see{pack}.
An optional @id{pos} marks where

to start reading in @id{s} (default is 1).
After the read values,
this function also returns the index of the first unread byte in @id{s}.

}

@LibEntry{string.upper (s)|

Receives a string and returns a copy
of this string with all
lowercase letters changed to uppercase.
All other characters are left unchanged.
The definition of what a lowercase letter is depends on the current locale.

}

}

@sect3{pm| @title{Patterns}

@simplesect{

Patterns in Lua are described by regular strings,
which are interpreted as patterns by the pattern-matching functions
@Lid{string.find},
@Lid{string.gmatch},
@Lid{string.gsub},
and @Lid{string.match}.
This section describes the syntax and the meaning
(that is, what they match) of these strings.

}

@sect4{@title{Character Class:}
A @def{character class} is used to represent a set of characters.
The following combinations are allowed in describing a character class:
@description{

@item{@rep{x}|
(where @rep{x} is not one of the @emphx{magic characters}
@T{^$()%.[]*+-?})
represents the character @emph{x} itself.
}

@item{@T{.}| (a dot) represents all characters.}

@item{@T{%a}| represents all letters.}

@item{@T{%c}| represents all control characters.}

@item{@T{%d}|
represents all digits.}

@item{@T{%g}| represents all printable characters except space.}

@item{@T{%l}| represents all lowercase letters.}

@item{@T{%p}| represents all punctuation characters.}

@item{@T{%s}| represents all space characters.}

@item{@T{%u}| represents all uppercase letters.}

@item{@T{%w}| represents all alphanumeric characters.}

@item{@T{%x}| represents all hexadecimal digits.}

@item{@T{%@rep{x}}| (where @rep{x} is any non-alphanumeric character)
represents the character @rep{x}.
This is the standard way to escape the magic characters.
Any non-alphanumeric character
(including all punctuation characters, even the non-magical)
can be preceded by a @Char{%} to represent itself in a pattern.
}

@item{@T{[@rep{set}]}|
represents the class which is the union of all
characters in @rep{set}.
A range of characters can be specified by
separating the end characters of the range,
in ascending order, with a @Char{-}.
All classes @T{%}@emph{x} described above can also
be used as
components in @rep{set}.
All other characters in @rep{set} represent themselves.
For example, @T{[%w_]} (or @T{[_%w]})
represents all alphanumeric characters plus the underscore,
@T{[0-7]} represents the octal digits,
and @T{[0-7%l%-]} represents the octal digits plus
the lowercase letters plus the @Char{-} character.

You can put a closing square bracket in a set
by positioning it as the first character in the set.
You can put a hyphen in a set
by positioning it as the first or the last character in the set.

(You can also use an escape for both cases.)

The interaction between ranges and classes is not defined.
Therefore, patterns like @T{[%a-z]} or @T{[a-%%]}
have no meaning.
}

@item{@T{[^@rep{set}]}|
represents the complement of @rep{set},
where @rep{set} is interpreted as above.
}

}
For all classes represented by single letters (@T{%a}, @T{%c}, etc.),
the corresponding uppercase letter represents the complement of the class.
For instance, @T{%S} represents all non-space
characters.

The definitions of letter, space, and other character groups
depend on the current locale.
In particular, the class @T{[a-z]} may not be equivalent to @T{%l}.

}

@sect4{@title{Pattern Item:}
A @def{pattern item} can be
@itemize{

@item{
a single character class,
which matches any single character in the class;
}

@item{
a single character class followed by @Char{*},
which matches sequences of zero or more characters in the class.
These repetition items will always match the longest possible sequence;
}

@item{
a single character class followed by @Char{+},
which matches sequences of one or more characters in the class.
These repetition items will always match the longest possible sequence;
}

@item{
a single character class followed by @Char{-},
which also matches sequences of zero or more characters in the class.

Unlike @Char{*},
these repetition items will always match the shortest possible sequence;
}

@item{
a single character class followed by @Char{?},
which matches
zero or one occurrence of a character in the class.
It always matches one occurrence if possible;
}

@item{
@T{%@rep{n}}, for @rep{n} between 1 and 9;
such item matches a substring equal to the @rep{n}-th captured string
(see below);
}

@item{
@T{%b@rep{xy}}, where @rep{x} and @rep{y} are two distinct characters;
such item matches strings that start @N{with @rep{x}}, end @N{with @rep{y}},
and where the @rep{x} and @rep{y} are @emph{balanced}.
This means that, if one reads the string from left to right,
counting @M{+1} for an @rep{x} and @M{-1} for a @rep{y},
the ending @rep{y} is the first @rep{y} where the count reaches 0.
For instance, the item @T{%b()} matches expressions with
balanced parentheses.
}

@item{
@T{%f[@rep{set}]}, a @def{frontier pattern};
such item matches an empty string at any position such that
the next character belongs to @rep{set}
and the previous character does not belong to @rep{set}.
The set @rep{set} is interpreted as previously described.
The beginning and
the end of the subject are handled as if
they were the character @Char{\0}.
}

}

}

@sect4{@title{Pattern:}
A @def{pattern} is a sequence of pattern items.
A caret @Char{^} at the beginning of a pattern anchors the match at the
beginning of the subject string.
A @Char{$} at the end of a pattern anchors the match at the

end of the subject string.
At other positions,
@Char{^} and @Char{$} have no special meaning and represent themselves.

}

@sect4{@title{Captures:}
A pattern can contain sub-patterns enclosed in parentheses;
they describe @def{captures}.
When a match succeeds, the substrings of the subject string
that match captures are stored (@emph{captured}) for future use.
Captures are numbered according to their left parentheses.
For instance, in the pattern @T{"(a*(.)%w(%s*))"},
the part of the string matching @T{"a*(.)%w(%s*)"} is
stored as the first capture, and therefore has @N{number 1};
the character matching @St{.} is captured with @N{number 2},
and the part matching @St{%s*}
has @N{number 3}.

As a special case, the capture @T{()} captures
the current string position (a number).
For instance, if we apply the pattern @T{"()aa()"} on the
string @T{"flaaap"}, there will be two captures: @N{3 and 5}.

}

@sect4{@title{Multiple matches:}
The function @Lid{string.gsub} and the iterator @Lid{string.gmatch}
match multiple occurrences of the given pattern in the subject.
For these functions,
a new match is considered valid only
if it ends at least one byte after the end of the previous match.
In other words, the pattern machine never accepts the
empty string as a match immediately after another match.
As an example,
consider the results of the following code:
@verbatim{
> string.gsub("abc", "()a*()", print);
--> 1   2
--> 3   3
--> 4   4
}
The second and third results come from Lua matching an empty
string after @Char{b} and another one after @Char{c}.
Lua does not match an empty string after @Char{a},
because it would end at the same position of the previous match.

}

}

@sect3{pack|
 @title{Format Strings for Pack and Unpack}

The first argument to @Lid{string.pack},
@Lid{string.packsize}, and @Lid{string.unpack}
is a format string,
which describes the layout of the structure being created or read.

A format string is a sequence of conversion options.
The conversion options are as follows:
@description{
@item{@T{<}|sets little endian}
@item{@T{>}|sets big endian}
@item{@T{=}|sets native endian}
@item{@T{![@rep{n}]}|sets maximum alignment to @id{n}
(default is native alignment)}
@item{@T{b}|a signed byte (@id{char})}
@item{@T{B}|an unsigned byte (@id{char})}
@item{@T{h}|a signed @id{short} (native size)}
@item{@T{H}|an unsigned @id{short} (native size)}
@item{@T{l}|a signed @id{long} (native size)}
@item{@T{L}|an unsigned @id{long} (native size)}
@item{@T{j}|a @id{lua_Integer}}
@item{@T{J}|a @id{lua_Unsigned}}
@item{@T{T}|a @id{size_t} (native size)}
@item{@T{i[@rep{n}]}|a signed @id{int} with @id{n} bytes
(default is native size)}
@item{@T{I[@rep{n}]}|an
 unsigned @id{int} with @id{n} bytes
(default is native size)}
@item{@T{f}|a @id{float} (native size)}
@item{@T{d}|a @id{double} (native size)}
@item{@T{n}|a @id{lua_Number}}
@item{@T{c@rep{n}}|a fixed-sized string with @id{n} bytes}
@item{@T{z}|a zero-terminated string}
@item{@T{s[@emph{n}]}|a string preceded by its length
coded as an unsigned integer with @id{n} bytes
(default is a @id{size_t})}
@item{@T{x}|one byte of padding}
@item{@T{X@rep{op}}|an empty item that aligns
according to option @id{op}
(which is otherwise ignored)}
@item{@Char{ }|(space) ignored}
}
(A @St{[@rep{n}]} means an optional integral numeral.)

Except for padding, spaces, and configurations
(options @St{xX <=>!}),
each option corresponds to an argument in @Lid{string.pack}
or a result in @Lid{string.unpack}.

For options @St{!@rep{n}}, @St{s@rep{n}}, @St{i@rep{n}}, and @St{I@rep{n}},
@id{n} can be any integer between 1 and 16.
All integral options check overflows;
@Lid{string.pack} checks whether
the given value fits in the given size;
@Lid{string.unpack} checks whether the read value fits in a Lua integer.
For the unsigned options,
Lua integers are treated as unsigned values too.

Any format string starts as if prefixed by @St{!1=},
that is,
with maximum alignment of 1 (no alignment)
and native endianness.

Native endianness assumes that the whole system is
either big or little endian.
The packing functions will not emulate correctly the behavior
of mixed-endian formats.

Alignment works as follows:
For each option,
the format gets extra padding until the data starts
at an offset that is a multiple of the minimum between the
option size and the maximum alignment;
this minimum must be a power of 2.
Options @St{c} and @St{z} are not aligned;
option @St{s} follows the alignment of its starting integer.

All padding is filled with zeros by @Lid{string.pack}
and ignored by @Lid{string.unpack}.

}

}

@sect2{utf8| @title{UTF-8 Support}

This library provides basic support for @x{UTF-8}
encoding.
It provides all its functions inside the table @defid{utf8}.
This library does not provide any support for @x{Unicode} other
than the handling of the encoding.

Any operation that needs the meaning of a character,
such as character classification, is outside its scope.

Unless stated otherwise,
all functions that expect a byte position as a parameter
assume that the given position is either the start of a byte sequence
or one plus the length of the subject string.
As in the string library,
negative indices count from the end of the string.

Functions that create byte sequences
accept all values up to @T{0x7FFFFFFF},
as defined in the original UTF-8 specification;
that implies byte sequences of up to six bytes.

Functions that interpret byte sequences only accept
valid sequences (well formed and not overlong).
By default, they only accept byte sequences
that result in valid Unicode code points,
rejecting values greater than @T{10FFFF} and surrogates.
A boolean argument @id{lax},
when available,
lifts these checks,
so that all values up to @T{0x7FFFFFFF} are accepted.
(Not well formed and overlong sequences are still rejected.)

@LibEntry{utf8.char (@Cdots)|

Receives zero or more integers,
converts each one to its corresponding UTF-8 byte sequence
and returns a string with the concatenation of all these sequences.

}

@LibEntry{utf8.charpattern|

The pattern (a string, not a function) @St{[\0-\x7F\xC2-\xFD][\x80-\xBF]*}
@see{pm},
which matches exactly one UTF-8 byte sequence,
assuming that the subject is a valid UTF-8 string.

}

@LibEntry{utf8.codes (s [, lax])|

Returns values so that the construction
@verbatim{

for p, c in utf8.codes(s) do @rep{body} end
}
will iterate over all UTF-8 characters in string @id{s},
with @id{p} being the position (in bytes) and @id{c} the code point
of each character.
It raises an error if it meets any invalid byte sequence.

}

@LibEntry{utf8.codepoint (s [, i [, j [, lax]]])|

Returns the code points (as integers) from
all characters in @id{s}
that start between byte position @id{i} and @id{j} (both included).
The default for @id{i} is 1 and for @id{j} is @id{i}.
It raises an error if it meets any invalid byte sequence.

}

@LibEntry{utf8.len (s [, i [, j [, lax]]])|

Returns the number of UTF-8 characters in string @id{s}
that start between positions @id{i} and @id{j} (both inclusive).
The default for @id{i} is @num{1} and for @id{j} is @num{-1}.
If it finds any invalid byte sequence,
returns @fail plus the position of the first invalid byte.

}

@LibEntry{utf8.offset (s, n [, i])|

Returns the position (in bytes) where the encoding of the
@id{n}-th character of @id{s}
(counting from position @id{i}) starts.
A negative @id{n} gets characters before position @id{i}.
The default for @id{i} is 1 when @id{n} is non-negative
and @T{#s + 1} otherwise,
so that @T{utf8.offset(s, -n)} gets the offset of the
@id{n}-th character from the end of the string.
If the specified character is neither in the subject
nor
right after its end,
the function returns @fail.

As a special case,
when @id{n} is 0 the function returns the start of the encoding
of the character that contains the @id{i}-th byte of @id{s}.

This function assumes that @id{s} is a valid UTF-8 string.

}

}

@sect2{tablib| @title{Table Manipulation}

This library provides generic functions for table manipulation.
It provides all its functions inside the table @defid{table}.

Remember that, whenever an operation needs the length of a table,
all caveats about the length operator apply @see{len-op}.
All functions ignore non-numeric keys
in the tables given as arguments.

@LibEntry{table.concat (list [, sep [, i [, j]]])|

Given a list where all elements are strings or numbers,
returns the string @T{list[i]..sep..list[i+1] @Cdots sep..list[j]}.
The default value for @id{sep} is the empty string,
the default for @id{i} is 1,
and the default for @id{j} is @T{#list}.
If @id{i} is greater than @id{j}, returns the empty string.

}

@LibEntry{table.insert
 (list, [pos,] value)|

Inserts element @id{value} at position @id{pos} in @id{list},
shifting up the elements
@T{list[pos], list[pos+1], @Cdots, list[#list]}.
The default value for @id{pos} is @T{#list+1},
so that a call @T{table.insert(t,x)} inserts @id{x} at the end
of the list @id{t}.

}

@LibEntry{table.move (a1, f, e, t [,a2])|

Moves elements from the table @id{a1} to the table @id{a2},
performing the equivalent to the following
multiple assignment:
@T{a2[t],@Cdots = a1[f],@Cdots,a1[e]}.
The default for @id{a2} is @id{a1}.
The destination range can overlap with the source range.

The number of elements to be moved must fit in a Lua integer.

Returns the destination table @id{a2}.

}

@LibEntry{table.pack (@Cdots)|

Returns a new table with all arguments stored into keys 1, 2, etc.
and with a field @St{n} with the total number of arguments.
Note that the resulting table may not be a sequence,
if some arguments are @nil.

}

@LibEntry{table.remove (list [, pos])|

Removes
from @id{list} the element at position @id{pos},
returning the value of the removed element.
When @id{pos} is an integer between 1 and @T{#list},
it shifts down the elements
@T{list[pos+1], list[pos+2], @Cdots, list[#list]}
and erases element @T{list[#list]};
The index @id{pos} can also be 0 when @T{#list} is 0,
or @T{#list + 1}.

The default value for @id{pos} is @T{#list},
so that a call @T{table.remove(l)} removes the last element
of the list @id{l}.

}

@LibEntry{table.sort (list [, comp])|

Sorts the list elements in a given order, @emph{in-place},
from @T{list[1]} to @T{list[#list]}.
If @id{comp} is given,
then it must be a function that receives two list elements
and returns true when the first element must come
before the second in the final order,
so that, after the sort,
@T{i <= j} implies @T{not comp(list[j],list[i])}.
If @id{comp} is not given,
then the standard Lua operator @T{<} is used instead.

The @id{comp} function must define a consistent order;
more formally,

the function must define a strict weak order.
(A weak order is similar to a total order,
but it can equate different elements for comparison purposes.)

The sort algorithm is not stable:
Different elements considered equal by the given order
may have their relative positions changed by the sort.

}

@LibEntry{table.unpack (list [, i [, j]])|

Returns the elements from the given list.
This function is equivalent to
@verbatim{
return list[i], list[i+1], @Cdots, list[j]
}
By default, @id{i} @N{is 1} and @id{j} is @T{#list}.

}

}

@sect2{mathlib| @title{Mathematical Functions}

This library provides basic mathematical functions.
It provides all its functions and constants inside the table @defid{math}.
Functions with the annotation @St{integer/float} give
integer results for integer arguments
and float results for non-integer arguments.
The rounding functions
@Lid{math.ceil}, @Lid{math.floor}, and @Lid{math.modf}
return an integer when the result fits in the range of an integer,
or a
float otherwise.

@LibEntry{math.abs (x)|

Returns the maximum value between @id{x} and @id{-x}. (integer/float)

}

@LibEntry{math.acos (x)|

Returns the arc cosine of @id{x} (in radians).

}

@LibEntry{math.asin (x)|

Returns the arc sine of @id{x} (in radians).

}

@LibEntry{math.atan (y [, x])|

@index{atan} @index{atan2}
Returns the arc tangent of @T{y/x} (in radians),
using the signs of both arguments to find the
quadrant of the result.
It also handles correctly the case of @id{x} being zero.

The default value for @id{x} is 1,
so that the call @T{math.atan(y)}
returns the arc tangent of @id{y}.

}

@LibEntry{math.ceil (x)|

Returns the smallest integral value greater than or equal to @id{x}.

}

@LibEntry{math.cos (x)|

Returns the cosine of @id{x} (assumed to be in radians).

}

@LibEntry{math.deg (x)|

Converts the angle @id{x} from radians to degrees.

}

@LibEntry{math.exp (x)|

Returns the value @M{e@sp{x}}
(where @id{e} is the base of natural logarithms).

}

@LibEntry{math.floor
(x)|

Returns the largest integral value less than or equal to @id{x}.

}

@LibEntry{math.fmod (x, y)|

Returns the remainder of the division of @id{x} by @id{y}
that rounds the quotient towards zero. (integer/float)

}

@LibEntry{math.huge|

The float value @idx{HUGE_VAL},
a value greater than any other numeric value.

}

@LibEntry{math.log (x [, base])|

Returns the logarithm of @id{x} in the given base.
The default for @id{base} is @M{e}
(so that the function returns the natural logarithm of @id{x}).

}

@LibEntry{math.max (x, @Cdots)|

Returns the argument with the maximum value,
according to the Lua operator @T{<}.

}

@LibEntry{math.maxinteger|
An integer with the maximum value for an integer.

}

@LibEntry{math.min (x, @Cdots)|

Returns the argument with the minimum value,
according to the Lua operator @T{<}.

}

@LibEntry{math.mininteger|
An integer with the minimum value for an integer.

}

@LibEntry{math.modf (x)|

Returns the integral part of @id{x} and the fractional
part of @id{x}.
Its second result is always a float.

}

@LibEntry{math.pi|

The value of @M{@pi}.

}

@LibEntry{math.rad (x)|

Converts the angle @id{x} from degrees to radians.

}

@LibEntry{math.random ([m [, n]])|

When called without arguments,
returns a pseudo-random float with uniform distribution
in the range @C{(} @M{[0,1)}. @C{]}
When called with two integers @id{m} and @id{n},
@id{math.random} returns a pseudo-random integer
with uniform distribution in the range @M{[m, n]}.
The call @T{math.random(n)}, for a positive @id{n},
is equivalent to @T{math.random(1,n)}.
The call @T{math.random(0)} produces an integer with
all bits (pseudo)random.

This function uses the @idx{xoshiro256**} algorithm to produce
pseudo-random 64-bit integers,
which are the results of calls with @N{argument 0}.
Other results (ranges and floats)
are unbiased extracted from these integers.

Lua initializes its pseudo-random generator with the equivalent of
a call to @Lid{math.randomseed} with no arguments,
so
that @id{math.random} should generate
different sequences of results each time the program runs.

}

@LibEntry{math.randomseed ([x [, y]])|

When called with at least one argument,
the integer parameters @id{x} and @id{y} are
joined into a 128-bit @emphx{seed} that
is used to reinitialize the pseudo-random generator;
equal seeds produce equal sequences of numbers.
The default for @id{y} is zero.

When called with no arguments,
Lua generates a seed with
a weak attempt for randomness.

This function returns the two seed components
that were effectively used,
so that setting them again repeats the sequence.

To ensure a required level of randomness to the initial state
(or contrarily, to have a deterministic sequence,
for instance when debugging a program),
you should call @Lid{math.randomseed} with explicit arguments.

}

@LibEntry{math.sin (x)|

Returns the sine of @id{x} (assumed to be in radians).

}

@LibEntry{math.sqrt (x)|

Returns the square root of @id{x}.
(You can also
 use the expression @T{x^0.5} to compute this value.)

}

@LibEntry{math.tan (x)|

Returns the tangent of @id{x} (assumed to be in radians).

}

@LibEntry{math.tointeger (x)|

If the value @id{x} is convertible to an integer,

returns that integer.
Otherwise, returns @fail.

}

@LibEntry{math.type (x)|

Returns @St{integer} if @id{x} is an integer,
@St{float} if it is a float,
or @fail if @id{x} is not a number.

}

@LibEntry{math.ult (m, n)|

Returns a boolean,
@true if and only if integer @id{m} is below integer @id{n} when
they are compared as @x{unsigned integers}.

}

}

@sect2{iolib| @title{Input and Output Facilities}

The I/O library provides two different styles for file manipulation.
The first one uses implicit file handles;
that is, there are operations to set a default input file and a
default output file,
and all input/output operations are done over these default files.
The second style uses explicit file handles.

When using implicit file handles,
all operations are supplied
by table @defid{io}.
When using explicit file handles,
the operation @Lid{io.open} returns a file handle
and then all operations are supplied as methods of the file handle.

The metatable for file handles provides metamethods
for @idx{__gc} and @idx{__close} that try
to close the file when called.

The table @id{io} also provides
three predefined file handles with their usual meanings from C:
@defid{io.stdin}, @defid{io.stdout}, and @defid{io.stderr}.
The I/O library never closes these files.

Unless otherwise stated,
all I/O functions return @fail on failure,
plus an error message as a second result and
a system-dependent error code as a third result,
and some non-false value on success.
On non-POSIX systems,
the computation of the error message and error code
in case of errors
may be not @x{thread safe},
because they rely on the global C variable @id{errno}.

@LibEntry{io.close ([file])|

Equivalent to @T{file:close()}.
Without a @id{file}, closes the default output file.

}

@LibEntry{io.flush
()|

Equivalent to @T{io.output():flush()}.

}

@LibEntry{io.input ([file])|

When called with a file name, it opens the named file (in text mode),
and sets its handle as the default input file.
When called with a file handle,
it simply sets this file handle as the default input file.
When called without arguments,
it returns the current default input file.

In case of errors this function raises the error,
instead of returning an error code.

}

@LibEntry{io.lines ([filename, @Cdots])|

Opens the given file name in read mode
and returns an iterator function that
works like @T{file:lines(@Cdots)} over the opened file.
When the iterator function fails to read any value,
it automatically closes the file.
Besides the iterator function,
@id{io.lines} returns three other values:

two @nil values as placeholders,
plus the created file handle.
Therefore, when used in a generic @Rw{for} loop,
the file is closed also if the loop is interrupted by an
error or a @Rw{break}.

The call
@T{io.lines()} (with no file name) is equivalent
to @T{io.input():lines("l")};
that is, it iterates over the lines of the default input file.
In this case, the iterator does not close the file when the loop ends.

In case of errors opening the file,
this function raises the error,
instead of returning an error code.

}

@LibEntry{io.open (filename [, mode])|

This function opens a file,
in the mode specified in the string @id{mode}.
In case of success,
it returns a new file handle.

The @id{mode} string can be any of the following:
@description{
@item{@St{r}| read mode (the default);}
@item{@St{w}| write mode;}
@item{@St{a}| append mode;}
@item{@St{r+}| update mode, all previous data is preserved;}
@item{@St{w+}| update mode, all previous data is erased;}
@item{@St{a+}| append update mode, previous data is preserved,
writing is only allowed at the end of file.}
}
The @id{mode} string can also have a @Char{b} at the end,
which is needed in some systems to open the file in binary mode.

}

@LibEntry{io.output
([file])|

Similar to @Lid{io.input}, but operates over the default output file.

}

@LibEntry{io.popen (prog [, mode])|

This function is system dependent and is not available
on all platforms.

Starts the program @id{prog} in a separated process and returns
a file handle that you can use to read data from this program
(if @id{mode} is @T{"r"}, the default)
or to write data to this program
(if @id{mode} is @T{"w"}).

}

@LibEntry{io.read (@Cdots)|

Equivalent to @T{io.input():read(@Cdots)}.

}

@LibEntry{io.tmpfile ()|

In case of success,
returns a handle for a temporary file.
This file is opened in update mode
and it is automatically removed when the program ends.

}

@LibEntry{io.type (obj)|

Checks whether @id{obj} is a valid file handle.
Returns the string @T{"file"} if @id{obj} is an open file handle,
@T{"closed file"} if @id{obj} is a closed file handle,
or @fail if @id{obj} is not a file handle.

}

@LibEntry{io.write (@Cdots)|

Equivalent to @T{io.output():write(@Cdots)}.

}

@LibEntry{file:close
()|

Closes @id{file}.
Note that files are automatically closed when

their handles are garbage collected,
but that takes an unpredictable amount of time to happen.

When closing a file handle created with @Lid{io.popen},
@Lid{file:close} returns the same values
returned by @Lid{os.execute}.

}

@LibEntry{file:flush ()|

Saves any written data to @id{file}.

}

@LibEntry{file:lines (@Cdots)|

Returns an iterator function that,
each time it is called,
reads the file according to the given formats.
When no format is given,
uses @St{l} as a default.
As an example, the construction
@verbatim{
for c in file:lines(1) do @rep{body} end
}
will iterate over all characters of the file,
starting at the current position.
Unlike @Lid{io.lines}, this function does not close the file
when the loop ends.

}

@LibEntry{file:read (@Cdots)|

Reads the file @id{file},
according to the given formats, which specify what to read.
For each format,
the function
 returns a string or a number with the characters read,
or @fail if it cannot read data with the specified format.
(In this latter case,
the function does not read subsequent formats.)
When called without arguments,
it uses a default format that reads the next line
(see below).

The available formats are

@description{

@item{@St{n}|
reads a numeral and returns it as a float or an integer,
following the lexical conventions of Lua.
(The numeral may have leading whitespaces and a sign.)
This format always reads the longest input sequence that
is a valid prefix for a numeral;
if that prefix does not form a valid numeral
(e.g., an empty string, @St{0x}, or @St{3.4e-})
or it is too long (more than 200 characters),
it is discarded and the format returns @fail.
}

@item{@St{a}|
reads the whole file, starting at the current position.
On end of file, it returns the empty string;
this format never fails.
}

@item{@St{l}|
reads the next line skipping the end of line,
returning @fail on end of file.
This
 is the default format.
}

@item{@St{L}|
reads the next line keeping the end-of-line character (if present),
returning @fail on end of file.
}

@item{@emph{number}|
reads a string with up to this number of bytes,
returning @fail on end of file.
If @id{number} is zero,
it reads nothing and returns an empty string,
or @fail on end of file.
}

}
The formats @St{l} and @St{L} should be used only for text files.

}

@LibEntry{file:seek ([whence [, offset]])|

Sets and gets the file position,

measured from the beginning of the file,
to the position given by @id{offset} plus a base
specified by the string @id{whence}, as follows:
@description{
@item{@St{set}| base is position 0 (beginning of the file);}
@item{@St{cur}| base is current position;}
@item{@St{end}| base is end of file;}
}
In case of success, @id{seek} returns the final file position,
measured in bytes from the beginning of the file.
If @id{seek} fails, it returns @fail,
plus a string describing the error.

The default value
 for @id{whence} is @T{"cur"},
and for @id{offset} is 0.
Therefore, the call @T{file:seek()} returns the current
file position, without changing it;
the call @T{file:seek("set")} sets the position to the
beginning of the file (and returns 0);
and the call @T{file:seek("end")} sets the position to the
end of the file, and returns its size.

}

@LibEntry{file:setvbuf (mode [, size])|

Sets the buffering mode for a file.
There are three available modes:
@description{
@item{@St{no}| no buffering.}
@item{@St{full}| full buffering.}
@item{@St{line}| line buffering.}
}

For the last two cases,
@id{size} is a hint for the size of the buffer, in bytes.
The default is an appropriate size.

The specific behavior of each mode is non portable;
check the underlying @ANSI{setvbuf} in your platform for
more details.

}

@LibEntry{file:write (@Cdots)|

Writes the value of each of its arguments to @id{file}.

The arguments must be strings or numbers.

In case of success, this function returns @id{file}.

}

}

@sect2{oslib|
 @title{Operating System Facilities}

This library is implemented through table @defid{os}.

@LibEntry{os.clock ()|

Returns an approximation of the amount in seconds of CPU time
used by the program,
as returned by the underlying @ANSI{clock}.

}

@LibEntry{os.date ([format [, time]])|

Returns a string or a table containing date and time,
formatted according to the given string @id{format}.

If the @id{time} argument is present,
this is the time to be formatted
(see the @Lid{os.time} function for a description of this value).
Otherwise, @id{date} formats the current time.

If @id{format} starts with @Char{!},
then the date is formatted in Coordinated Universal Time.
After this optional character,
if @id{format} is the string @St{*t},
then @id{date} returns a table with the following fields:
@id{year}, @id{month} (1@En{}12), @id{day} (1@En{}31),
@id{hour} (0@En{}23), @id{min} (0@En{}59),
@id{sec} (0@En{}61, due to leap seconds),
@id{wday} (weekday, 1@En{}7, Sunday
 @N{is 1}),
@id{yday} (day of the year, 1@En{}366),
and @id{isdst} (daylight saving flag, a boolean).
This last field may be absent
if the information is not available.

If @id{format} is not @St{*t},

then @id{date} returns the date as a string,
formatted according to the same rules as the @ANSI{strftime}.

If @id{format} is absent, it defaults to @St{%c},
which gives a human-readable date and time representation
using the current locale.

On non-POSIX systems,
this function may be not @x{thread safe}
because of its reliance on @CId{gmtime} and @CId{localtime}.

}

@LibEntry{os.difftime (t2, t1)|

Returns the difference, in seconds,
from time @id{t1} to time @id{t2}
(where the times are values returned by @Lid{os.time}).
In @x{POSIX}, @x{Windows}, and some other systems,
this value is exactly @id{t2}@M{-}@id{t1}.

}

@LibEntry{os.execute ([command])|

This function is equivalent to the @ANSI{system}.
It passes @id{command} to be executed by an operating system shell.
Its first result is
 @true
if the command terminated successfully,
or @fail otherwise.
After this first result
the function returns a string plus a number,
as follows:
@description{

@item{@St{exit}|
the command terminated normally;
the following number is the exit status of the command.
}

@item{@St{signal}|
the command was terminated by a signal;
the following number is the signal that terminated the command.
}

}

When called without a @id{command},
@id{os.execute} returns a boolean that is true if a shell is available.

}

@LibEntry{os.exit ([code [, close]])|

Calls the @ANSI{exit} to terminate the host program.
If @id{code} is @true,
the returned status is @idx{EXIT_SUCCESS};
if @id{code} is @false,
the returned status is @idx{EXIT_FAILURE};
if @id{code} is a number,
the returned status is this number.
The default value for @id{code} is @true.

If the optional second argument @id{close} is true,
the function closes the Lua state before exiting @seeF{lua_close}.

}

@LibEntry{os.getenv (varname)|

Returns
the value of the process environment variable @id{varname}
or @fail if the variable is not defined.

}

@LibEntry{os.remove (filename)|

Deletes the file (or empty directory, on @x{POSIX} systems)
with the given name.
If this function fails, it returns @fail
plus a string describing the error and the error code.
Otherwise, it returns true.

}

@LibEntry{os.rename (oldname, newname)|

Renames the file or directory named @id{oldname} to @id{newname}.
If this function fails, it returns @fail,
plus a string describing the error and the error code.
Otherwise, it returns true.

}

@LibEntry{os.setlocale (locale [, category])|

Sets the current locale of the program.
@id{locale} is a system-dependent string specifying a locale;
@id{category} is an optional string describing which category to change:
@T{"all"}, @T{"collate"}, @T{"ctype"},
@T{"monetary"}, @T{"numeric"}, or @T{"time"};
the default category is @T{"all"}.
The function returns the name of the new locale,
or @fail if the request
 cannot be honored.

If @id{locale} is the empty string,
the current locale is set to an implementation-defined native locale.
If @id{locale} is the string @St{C},
the current locale is set to the standard C locale.

When called with @nil as the first argument,
this function only returns the name of the current locale
for the given category.

This function may be not @x{thread safe}
because of its reliance on @CId{setlocale}.

}

@LibEntry{os.time ([table])|

Returns the current time when called without arguments,
or a time representing the local date and time specified by the given table.
This table must have fields @id{year}, @id{month}, and @id{day},
and may have fields
@id{hour} (default is 12),
@id{min} (default is 0),
@id{sec} (default is 0),
and @id{isdst} (default is @nil).
Other fields are ignored.
For a description of these fields, see the @Lid{os.date} function.

When the function is called,
the values in these fields do not need to be inside their valid ranges.
For instance,
 if @id{sec} is -10,
it means 10 seconds before the time specified by the other fields;
if @id{hour} is 1000,
it means 1000 hours after the time specified by the other fields.

The returned value is a number, whose meaning depends on your system.

In @x{POSIX}, @x{Windows}, and some other systems,
this number counts the number
of seconds since some given start time (the @Q{epoch}).
In other systems, the meaning is not specified,
and the number returned by @id{time} can be used only as an argument to
@Lid{os.date} and @Lid{os.difftime}.

When called with a table,
@id{os.time} also normalizes all the fields
documented in the @Lid{os.date} function,
so that they represent the same time as before the call
but with values inside their valid ranges.

}

@LibEntry{os.tmpname ()|

Returns a string with a file name that can
be used for a temporary file.
The file must be explicitly opened before its use
and explicitly removed when no longer needed.

In @x{POSIX} systems,
this function also creates
a file with that name,
to avoid security risks.
(Someone else might create the file with wrong permissions
in the time between getting the name and creating the file.)
You still have to open the file to use it
and to remove it (even if you do not use it).

When possible,
you may prefer to use @Lid{io.tmpfile},
which automatically removes the file when the program ends.

}

}

@sect2{debuglib| @title{The Debug Library}

This library provides
the functionality of the @link{debugI|debug interface} to Lua programs.
You should exert care when using this library.
Several of its functions
violate basic assumptions about Lua code
(e.g., that variables local to a function
cannot be accessed from outside;

that userdata metatables cannot be changed by Lua code;
that Lua programs do not crash)
and therefore can compromise otherwise secure code.
Moreover, some functions in this library may be slow.

All functions in this library are provided
inside the @defid{debug} table.
All functions that operate
over a thread
have an optional first argument which is the
thread to operate over.
The default is always the current thread.

@LibEntry{debug.debug ()|

Enters an interactive mode with the user,
running each string that the user enters.
Using simple commands and other debug facilities,
the user can inspect global and local variables,
change their values, evaluate expressions, and so on.
A line containing only the word @id{cont} finishes this function,
so that the caller continues its execution.

Note that commands for @id{debug.debug} are not lexically nested
within any function and so have no direct access to local variables.

}

@LibEntry{debug.gethook ([thread])|

Returns the current hook settings of the thread, as three values:
the current hook function, the current hook mask,
and the current hook count,
as set by the @Lid{debug.sethook} function.

Returns @fail if there is no active hook.

}

@LibEntry{debug.getinfo ([thread,] f [, what])|

Returns a table with information
about a function.
You can give the function directly
or you can give a number as the value of @id{f},
which means the function running at level @id{f} of the call stack
of the given thread:

@N{level 0} is the current function (@id{getinfo} itself);
@N{level 1} is the function that called @id{getinfo}
(except for tail calls, which do not count in the stack);
and so on.
If @id{f} is a number greater than the number of active functions,
then @id{getinfo} returns @fail.

The returned table can contain all the fields returned by @Lid{lua_getinfo},
with the string @id{what} describing which fields to fill in.
The default for @id{what} is to get all information available,
except the table of valid lines.
If present,
the option @Char{f}
adds a field named @id{func} with the function itself.
If present,
the option @Char{L}
adds a field named @id{activelines} with the table of
valid lines.

For instance, the expression @T{debug.getinfo(1,"n").name} returns
a name for the current function,
if a
reasonable name can be found,
and the expression @T{debug.getinfo(print)}
returns a table with all available information
about the @Lid{print} function.

}

@LibEntry{debug.getlocal ([thread,] f, local)|

This function returns the name and the value of the local variable
with index @id{local} of the function at level @id{f} of the stack.
This function accesses not only explicit local variables,
but also parameters and temporary values.

The first parameter or local variable has @N{index 1}, and so on,
following the order that they are declared in the code,
counting only the variables that are active
in the current scope of the function.
Compile-time constants may not appear in this listing,
if they were optimized away by the compiler.
Negative indices refer to vararg arguments;
@num{-1} is the first vararg argument.
The function returns @fail
if there is no variable with the given index,
and raises an error when called with a level out of range.
(You can call @Lid{debug.getinfo} to check

whether the level is valid.)

Variable names starting with @Char{(} (open parenthesis) @C{)}
represent variables with no known names
(internal variables such as loop control variables,
and variables from chunks saved without debug information).

The parameter @id{f} may also be a function.
In that case, @id{getlocal} returns only the name of function parameters.

}

@LibEntry{debug.getmetatable (value)|

Returns the metatable of the given @id{value}
or @nil if it does not have a metatable.

}

@LibEntry{debug.getregistry ()|

Returns the registry table @see{registry}.

}

@LibEntry{debug.getupvalue (f, up)|

This function returns the name and the value of the upvalue
with index @id{up} of the function @id{f}.
The function returns @fail
if there is no upvalue with the given index.

(For Lua functions,
upvalues are the external local variables that the function uses,
and that are consequently included in its closure.)

For @N{C functions}, this function uses the empty string @T{""}
as
a name for all upvalues.

Variable name @Char{?} (interrogation mark)
represents variables with no known names
(variables from chunks saved without debug information).

}

@LibEntry{debug.getuservalue (u, n)|

Returns the @id{n}-th user value associated
to the userdata @id{u} plus a boolean,
@false if the userdata does not have that value.

}

@LibEntry{debug.sethook ([thread,] hook, mask [, count])|

Sets the given function as the debug hook.
The string @id{mask} and the number @id{count} describe
when the hook will be called.
The string mask may have any combination of the following characters,
with the given meaning:
@description{
@item{@Char{c}| the hook is called every time Lua calls a function;}
@item{@Char{r}| the hook is called every time Lua returns from a function;}
@item{@Char{l}| the hook is called every time Lua enters a new line of code.}
}
Moreover,
with a @id{count} different from zero,
the hook is called also after every @id{count} instructions.

When called without arguments,
@Lid{debug.sethook}
turns off the hook.

When the hook is called, its first parameter is a string
describing the event that has triggered its call:
@T{"call"}, @T{"tail call"}, @T{"return"},
@T{"line"}, and @T{"count"}.
For line events,
the hook also gets the new line number as its second parameter.
Inside a hook,
you can call @id{getinfo} with @N{level 2} to get more information about
the running function.
(@N{Level 0} is the @id{getinfo} function,
and @N{level 1} is the hook function.)

}

@LibEntry{debug.setlocal ([thread,] level, local, value)|

This function assigns the value @id{value} to the local variable
with index @id{local} of the function at level @id{level} of the stack.
The function returns @fail if there is no local
variable with the given index,
and raises an error when called with a @id{level} out of range.
(You can call @id{getinfo} to check whether the level is valid.)

Otherwise, it returns the name of the local variable.

See @Lid{debug.getlocal} for more
information about
variable indices and names.

}

@LibEntry{debug.setmetatable (value, table)|

Sets the metatable for the given @id{value} to the given @id{table}
(which can be @nil).
Returns @id{value}.

}

@LibEntry{debug.setupvalue (f, up, value)|

This function assigns the value @id{value} to the upvalue
with index @id{up} of the function @id{f}.
The function returns @fail if there is no upvalue
with the given index.
Otherwise, it returns the name of the upvalue.

See @Lid{debug.getupvalue} for more information about upvalues.

}

@LibEntry{debug.setuservalue (udata, value, n)|

Sets the given @id{value} as
the @id{n}-th user value associated to the given @id{udata}.
@id{udata} must be a full userdata.

Returns @id{udata},
or @fail if the userdata does not have that value.

}

@LibEntry{debug.traceback ([thread,] [message [, level]])|

If @id{message} is present but is neither a string nor @nil,
this function returns @id{message} without further processing.
Otherwise,
it returns a
string with a traceback of the call stack.
The optional @id{message} string is appended
at the beginning of the traceback.

An optional @id{level} number tells at which level
to start the traceback
(default is 1, the function calling @id{traceback}).

}

@LibEntry{debug.upvalueid (f, n)|

Returns a unique identifier (as a light userdata)
for the upvalue numbered @id{n}
from the given function.

These unique identifiers allow a program to check whether different
closures share upvalues.
Lua closures that share an upvalue
(that is, that access a same external local variable)
will return identical ids for those upvalue indices.

}

@LibEntry{debug.upvaluejoin (f1, n1, f2, n2)|

Make the @id{n1}-th upvalue of the Lua closure @id{f1}
refer to the @id{n2}-th upvalue of the Lua closure @id{f2}.

}

}

}

@C{---}
@sect1{lua-sa| @title{Lua Standalone}

Although Lua has been designed as an extension language,
to be embedded in
 a host @N{C program},
it is also frequently used as a standalone language.
An interpreter for Lua as a standalone language,
called simply @id{lua},
is provided with the standard distribution.
The @x{standalone interpreter} includes
all standard libraries.
Its usage is:
@verbatim{
lua [options] [script [args]]
}

The options are:
@description{
@item{@T{-e @rep{stat}}| execute string @rep{stat};}
@item{@T{-i}| enter interactive mode after running @rep{script};}
@item{@T{-l @rep{mod}}| @Q{require} @rep{mod} and assign the
result to global @rep{mod};}
@item{@T{-l @rep{g=mod}}| @Q{require} @rep{mod} and assign the
result to global @rep{g};}
@item{@T{-v}| print version information;}
@item{@T{-E}| ignore environment variables;}
@item{@T{-W}| turn warnings on;}
@item{@T{--}| stop handling options;}
@item{@T{-}| execute @id{stdin} as a file and stop handling options.}
}
(The form @T{-l @rep{g=mod}} was introduced in @N{release 5.4.4}.)

After handling its options, @id{lua} runs the given @emph{script}.
When
called without arguments,
@id{lua} behaves as @T{lua -v -i}
when the standard input (@id{stdin}) is a terminal,
and as @T{lua -} otherwise.

When called without the option @T{-E},
the interpreter checks for an environment variable @defid{LUA_INIT_5_4}
(or @defid{LUA_INIT} if the versioned name is not defined)
before running any argument.
If the variable content has the format @T{@At@rep{filename}},
then @id{lua} executes the file.
Otherwise, @id{lua} executes the string itself.

When called with the option @T{-E},
Lua does not consult any environment variables.
In particular,
the values of @Lid{package.path} and @Lid{package.cpath}
are set with the default paths defined in @id{luaconf.h}.

The options @T{-e}, @T{-l}, and @T{-W} are handled in
the order they appear.
For instance, an invocation like
@verbatim{
$ lua -e 'a=1' -llib1 script.lua
}
will first set @id{a} to 1, then require the library @id{lib1},
and finally run the file @id{script.lua} with no arguments.
(Here
@T{$} is the shell prompt. Your prompt may be different.)

Before running any code,
@id{lua} collects all command-line arguments
in a global table called @id{arg}.
The script name goes to index 0,
the first argument after the script name goes to index 1,
and so on.
Any arguments before the script name
(that is, the interpreter name plus its options)
go to negative indices.
For instance, in the call
@verbatim{
$ lua -la b.lua t1 t2
}
the table is like this:
@verbatim{
arg = { [-2] = "lua", [-1] = "-la",
      [0] = "b.lua",
      [1] = "t1", [2] = "t2" }
}
If there is no script in the call,
the interpreter name goes to index 0,
followed by the other arguments.
For instance, the call
@verbatim{
$ lua -e "print(arg[1])"
}
will print @St{-e}.
If there is a script,
the script is called with arguments
@T{arg[1]}, @Cdots, @T{arg[#arg]}.
Like all chunks in Lua,
the script is compiled as a variadic function.

In interactive mode,
Lua repeatedly prompts and waits for a line.
After reading
 a line,
Lua first try to interpret the line as an expression.
If it succeeds, it prints its value.
Otherwise, it interprets the line as a statement.
If you write an incomplete statement,
the interpreter waits for its completion
by issuing a different prompt.

If the global variable @defid{_PROMPT} contains a string,
then its value is used as the prompt.
Similarly, if the global variable @defid{_PROMPT2} contains a string,
its value is used as the secondary prompt

(issued during incomplete statements).

In case of unprotected errors in the script,
the interpreter reports the error to the standard error stream.
If the error object is not a string but
has a metamethod @idx{__tostring},
the interpreter calls this metamethod to produce the final message.
Otherwise, the interpreter converts the error object to a string
and adds a stack traceback to it.
When warnings are on,
they are simply printed in the standard error output.

When finishing normally,
the interpreter closes its main Lua state
@seeF{lua_close}.
The
script can avoid this step by
calling @Lid{os.exit} to terminate.

To allow the use of Lua as a
script interpreter in Unix systems,
Lua skips the first line of a file chunk if it starts with @T{#}.
Therefore, Lua scripts can be made into executable programs
by using @T{chmod +x} and @N{the @T{#!}} form,
as in
@verbatim{
#!/usr/local/bin/lua
}
Of course,
the location of the Lua interpreter may be different in your machine.
If @id{lua} is in your @id{PATH},
then
@verbatim{
#!/usr/bin/env lua
}
is a more portable solution.

}

@sect1{incompat| @title{Incompatibilities with the Previous Version}

@simplesect{

Here we list the incompatibilities that you may find when moving a program
from @N{Lua 5.3} to @N{Lua 5.4}.

You can avoid some incompatibilities by compiling Lua with

appropriate options (see file @id{luaconf.h}).
However,
all these compatibility options will be removed in the future.
More often than not,
compatibility issues arise when these compatibility
options
are removed.
So, whenever you have the chance,
you should try to test your code with a version of Lua compiled
with all compatibility options turned off.
That will ease transitions to newer versions of Lua.

Lua versions can always change the C API in ways that
do not imply source-code changes in a program,
such as the numeric values for constants
or the implementation of functions as macros.
Therefore,
you should never assume that binaries are compatible between
different Lua versions.
Always recompile clients of the Lua API when
using a new version.

Similarly, Lua versions can always change the internal representation
of precompiled chunks;
precompiled chunks are not compatible between different Lua versions.

The standard paths in the official distribution may
change between versions.

}

@sect2{@title{Incompatibilities in the Language}
@itemize{

@item{
The coercion of strings to numbers in
arithmetic and bitwise operations
has been removed from the core language.
The string
library does a similar job
for arithmetic (but not for bitwise) operations
using the string metamethods.
However, unlike in previous versions,
the new implementation preserves the implicit type of the numeral
in the string.
For instance, the result of @T{"1" + "2"} now is an integer,
not a float.
}

@item{
Literal decimal integer constants that overflow are read as floats,
instead of wrapping around.
You can use hexadecimal notation for such constants if you
want the old behavior
(reading them as integers with wrap around).
}

@item{
The use of the @idx{__lt} metamethod to emulate @idx{__le}
has been removed.
When needed, this metamethod must be explicitly defined.
}

@item{
The semantics of the numerical @Rw{for} loop
over integers changed in some details.
In particular, the control variable never wraps around.
}

@item{
A label for a @Rw{goto} cannot be declared where a label with the same
name is visible, even if this other label is declared in an enclosing
block.
}

@item{
When
 finalizing an object,
Lua does not ignore @idx{__gc} metamethods that are not functions.
Any value will be called, if present.
(Non-callable values will generate a warning,
like any other error when calling a finalizer.)
}

}

}

@sect2{@title{Incompatibilities in the Libraries}
@itemize{

@item{
The function @Lid{print} does not call @Lid{tostring}
to format its arguments;
instead, it has this functionality hardwired.
You should use @idx{__tostring} to modify how values are printed.

}

@item{
The pseudo-random number generator used by the function @Lid{math.random}
now starts with a somewhat random seed.
Moreover, it uses a different algorithm.
}

@item{
By default, the decoding functions in the @Lid{utf8} library
do not accept surrogates as valid code points.
An extra parameter in these functions makes them more permissive.
}

@item{
The options @St{setpause} and @St{setstepmul}
of the function @Lid{collectgarbage} are deprecated.
You should use the new option @St{incremental} to set
them.
}

@item{
The function @Lid{io.lines} now returns four values,
instead of just one.
That can be a problem when it is used as the sole
argument to another function that has optional parameters,
such as in @T{load(io.lines(filename, "L"))}.
To fix that issue,
you can wrap the call into parentheses,
to adjust its number of results to one.
}

}

}

@sect2{@title{Incompatibilities in the API}

@itemize{

@item{
Full userdata now has an arbitrary number of associated user values.
Therefore, the functions @id{lua_newuserdata},
@id{lua_setuservalue}, and @id{lua_getuservalue} were
replaced by @Lid{lua_newuserdatauv},
@Lid{lua_setiuservalue}, and @Lid{lua_getiuservalue},
which have an extra argument.

For compatibility, the old names still work as macros assuming
one single user value.
Note, however, that userdata with zero user values
are more efficient memory-wise.
}

@item{
The function @Lid{lua_resume} has an extra parameter.
This out parameter returns the number of values on
the top
 of the stack that were yielded or returned by the coroutine.
(In previous versions,
those values were the entire stack.)
}

@item{
The function @Lid{lua_version} returns the version number,
instead of an address of the version number.
The Lua core should work correctly with libraries using their
own static copies of the same core,
so there is no need to check whether they are using the same
address space.
}

@item{
The constant @id{LUA_ERRGCMM} was removed.
Errors in finalizers are never propagated;
instead, they generate a warning.
}

@item{
The options @idx{LUA_GCSETPAUSE} and @idx{LUA_GCSETSTEPMUL}
of the function @Lid{lua_gc} are deprecated.
You should use the new option @id{LUA_GCINC} to set them.
}

}

}

}

@C{[==}

@sect1{BNF| @title{The Complete Syntax of Lua}

Here is the complete syntax of Lua in extended BNF.

As usual in extended BNF,
@bnfNter{{A}} means 0 or more @bnfNter{A}s,
and @bnfNter{[A]} means an optional
@bnfNter{A}.
(For operator precedences, see @See{prec};
for a description of the terminals
@bnfNter{Name}, @bnfNter{Numeral},
and @bnfNter{LiteralString}, see @See{lexical}.)
@index{grammar}

@Produc{

@producname{chunk}@producbody{block}

@producname{block}@producbody{@bnfrep{stat} @bnfopt{retstat}}

@producname{stat}@producbody{
@bnfter{;}
@OrNL varlist @bnfter{=} explist
@OrNL functioncall
@OrNL label
@OrNL @Rw{break}
@OrNL @Rw{goto} Name
@OrNL @Rw{do} block @Rw{end}
@OrNL @Rw{while} exp @Rw{do} block @Rw{end}
@OrNL @Rw{repeat} block @Rw{until} exp
@OrNL @Rw{if} exp @Rw{then} block
@bnfrep{@Rw{elseif} exp @Rw{then} block}
@bnfopt{@Rw{else} block} @Rw{end}
@OrNL @Rw{for} @bnfNter{Name} @bnfter{=} exp @bnfter{,} exp @bnfopt{@bnfter{,} exp}
@Rw{do} block @Rw{end}
@OrNL @Rw{for} namelist @Rw{in} explist @Rw{do} block @Rw{end}
@OrNL @Rw{function} funcname funcbody
@OrNL @Rw{local} @Rw{function} @bnfNter{Name} funcbody
@OrNL @Rw{local} attnamelist @bnfopt{@bnfter{=} explist}
}

@producname{attnamelist}@producbody{
@bnfNter{Name} attrib @bnfrep{@bnfter{,} @bnfNter{Name} attrib}}

@producname{attrib}@producbody{@bnfopt{@bnfter{<} @bnfNter{Name} @bnfter{>}}}

@producname{retstat}@producbody{@Rw{return}
@bnfopt{explist} @bnfopt{@bnfter{;}}}

@producname{label}@producbody{@bnfter{::} Name @bnfter{::}}

@producname{funcname}@producbody{@bnfNter{Name} @bnfrep{@bnfter{.} @bnfNter{Name}}

```
                    @bnfopt{@bnfter{:} @bnfNter{Name}}}

@producname{varlist}@producbody{var @bnfrep{@bnfter{,} var}}

@producname{var}@producbody{
 @bnfNter{Name}
@Or prefixexp @bnfter{[} exp @bnfter{]}
@Or prefixexp @bnfter{.} @bnfNter{Name}
}

@producname{namelist}@producbody{@bnfNter{Name} @bnfrep{@bnfter{,} @bnfNter{Name}}}


@producname{explist}@producbody{exp @bnfrep{@bnfter{,} exp}}

@producname{exp}@producbody{
 @Rw{nil}
@Or @Rw{false}
@Or @Rw{true}
@Or @bnfNter{Numeral}
@Or @bnfNter{LiteralString}
@Or @bnfter{...}
@Or functiondef
@OrNL prefixexp
@Or tableconstructor
@Or exp
 binop exp
@Or unop exp
}

@producname{prefixexp}@producbody{var @Or functioncall @Or @bnfter{(} exp @bnfter{)}}

@producname{functioncall}@producbody{
 prefixexp args
@Or prefixexp @bnfter{:} @bnfNter{Name} args
}

@producname{args}@producbody{
 @bnfter{(} @bnfopt{explist} @bnfter{)}
@Or tableconstructor
@Or @bnfNter{LiteralString}
}

@producname{functiondef}@producbody{@Rw{function} funcbody}

@producname{funcbody}@producbody{@bnfter{(} @bnfopt{parlist} @bnfter{)} block @Rw{end}}

@producname{parlist}@producbody{namelist @bnfopt{@bnfter{,} @bnfter{...}}
```

```
 @Or @bnfter{...}}

@producname{tableconstructor}@producbody{@bnfter{@Open} @bnfopt{fieldlist} @bnfter{@Close}}

@producname{fieldlist}@producbody{field @bnfrep{fieldsep field} @bnfopt{fieldsep}}

@producname{field}@producbody{@bnfter{[} exp @bnfter{]} @bnfter{=} exp @Or @bnfNter{Name}
@bnfter{=} exp @Or exp}

@producname{fieldsep}@producbody{@bnfter{,} @Or @bnfter{;}}

@producname{binop}@producbody{
  @bnfter{+} @Or @bnfter{-} @Or @bnfter{*} @Or @bnfter{/} @Or @bnfter{//}
  @Or @bnfter{^} @Or @bnfter{%}
     @OrNL
 @bnfter{&} @Or @bnfter{~} @Or @bnfter{|} @Or @bnfter{>>} @Or @bnfter{<<}
  @Or @bnfter{..}
     @OrNL
 @bnfter{<} @Or @bnfter{<=} @Or @bnfter{>} @Or @bnfter{>=}
  @Or @bnfter{==} @Or @bnfter{~=}
     @OrNL
 @Rw{and} @Or @Rw{or}}

@producname{unop}@producbody{@bnfter{-} @Or @Rw{not} @Or @bnfter{#} @Or
 @bnfter{~}}

}

}

@C{]==================================================================}

}
@C{)]----------------------------------------------------------------------}
```

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* /lua-lua-v5-4-6-0-g6443185-tar-gz/lua-lua-6443185/manual/manual.of
No license file was found, but licenses were detected in source scan.

```
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1.176 open-vm-tools 10.3.5

1.176.1 Available under license :

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2009.09.18 Marcelo Vanzin <mvanzin@vmware.com>
 This release tag contains commits up to the following id:
 8bb94fbfbdf65b53b87279cf81529756dba7a2ca

 Other changes not captured in the git logs:

 * Resync with internal dev branch
(2009.08.24)

 * hgfsmounter/hgfsmounter.c: allow hgfs users to set ttl to 0 at mount time.

 * lib/guestApp/guestApp.c, lib/include/conf.h, lib/include/netutil.h,
   lib/include/procMgr.h, lib/include/system.h, lib/vixTools/vixTools.c,
   lib/vmCheck/vmcheck.c: remove (now unused) Netware checks.

 * lib/message/*, modules/freebsd/vmhgfs/Makefile,
   modules/linux/vmhgfs/Makefile.*, modules/solaris/vmhgfs/Makefile: remove
   unused message transport abstraction. The rpcChannel library is now used to
   do RPC abstraction.

 * modules/*/vmmemctl/*: refactor of the vmmemctl module as part of adding
   support for Mac OS guests.

 * modules/linux/pvscsi/pvscsi.c: don't clobber RESERVATION_CONFLICT sdstat
   up from linux pvscsi driver.

 * modules/linux/shared/*: VMCI changes unrelated to the guest driver.

* modules/linux/vmhgfs/fsutil.c, modules/linux/vmhgfs/inode.c: fix the case
  where two directories refer to the same inode.

* scripts/linux/*: support older versions of NetworkManager.

2009-08-24 Marcelo
Vanzin <mvanzin@vmware.com>
* Resync with internal trunk (2009.08.19)

* configure.ac: remove support for Linux kernels < 2.6.9.

* lib/include/vmtools.h, libvmtools/vmtoolsLog.c, doc/api/services/util.txt:
  add new log handled that allows appending to existing log files, and fix
  an issue where old log files would be "rotated" whenever the config file
  was reloaded.

* lib/appUtil/appUtilX11.c, lib/ghIntegration/ghIntegrationX11.c,
  lib/include/appUtil.h: fix compilation issues on FreeBSD when unity
  was enabled.

* lib/dnd/dndLinux.c, lib/include/vmblock_user.h, tests/testVmblock/*: add
  vmblock tests and, as part of the change, do some refactoring of vmblock
  related functions.

* lib/guestInfo/guestInfo.c, lib/include/wiper.h, lib/wiper/*,
  toolbox/toolboxcmd-shrink.c, toolbox/toolboxShrink.c: refactor the wiper
  structures so that they behave the same on Win32 and other platforms, and
  also reuse data structures already in use
by other parts of the code. This
  fixes an "use after free" issue that toolbox-cmd had on Win32.

* lib/guestInfo/guestInfo.c, lib/guestInfo/guestInfoInt.h,
  lib/guestInfo/guestInfoPosix.c, lib/guestRpc/nicinfo.x,
  lib/include/guestInfo.h, lib/include/netutil.h, lib/include/slashProc.h,
  lib/netutil/netUtilLinux.c, lib/slashProc/*,
  services/plugins/guestInfo/guestInfoServer.c: add support for sending more
  network-related information to the host, such as routing tables and name
  servers.

* lib/hgfsBd/hgfsBd.c: don't log RPC errors when HGFS is disabled.

* lib/hgfsHelper/*, lib/include/hgfsHelper.h, lib/vixTools/vixTools.c: new
  library with functions to query information about HGFS; expose some HGFS
  properties through VIX.

* lib/hgfsServer/*, lib/hgfsServerPolicyGuest/hgfsServerPolicyGuest.c,
  lib/include/hgfsServerPolicy.h: fix checking of whether an object belongs

to a particular share; this was causing issues with invalid information being returned
in certain cases.

* lib/hgfsServer/*, lib/include/hgfsProto.h: changes to support new VIX API calls (mostly affecting Win32 only).

* lib/include/guestCaps.h, lib/include/unityCommon.h: add boilerplate for new RPCs for setting windows as sticky / non-sticky (not yet implemented).

* lib/include/hgfsProto.h: new definitions for the next version of the HGFS protocol.

* lib/include/xdrutil.h: make XDRUTIL_ARRAYAPPEND() more type-safe when using GCC.

* lib/misc/codesetOld.c: fix some issues with UTF16 -> UTF8 conversion.

* lib/rpcChannel/rpcChannel.c, libvmtools/signalSource.c, libvmtools/vmtools.c, libvmtools/vmtoolsConfig.c: g_assert -> ASSERT.

* lib/unityWindowTracker/unityWindowTracker.c: fix issue with z-ordering of modal dialogs.

* libvmtools/vmtoolsConfig.c: fix some old config translation issues.

* modules/freebsd/shared/*, modules/freebsd/vmblock/*: make vmblock work on FreeBSD 8.

* modules/freebsd/vmmemctl/*, modules/linux/vmmemctl/*,

modules/solaris/vmmemctl/*, : refactoring and code changes to support the driver on Mac OS X.

* modules/linux/vmblock/*, modules/linux/vmci/*, modules/linux/vsock/linux/*: remove compatibility code for older kernels.

* modules/linux/vmhgfs/*: fix memory leak in HgfsAccessInt().

* modules/linux/vmxnet3/*: fix kunmap usage in vmxnet3_shm, and reset the shared pages when the char device is closed.

* modules/linux/vsock/linux/af_vsock.{c,h}, modules/linux/vsock/linux/util.c: add vsock protocol negotiation for notifyOn ops. This allows the driver to negotiate with the remove end which version of the notification protocol to use.

* modules/linux/vsock/linux/notify.c, modules/linux/vsock/linux/notify.h,

modules/linux/vsock/linux/notifyQState.c,
modules/linux/vsock/linux/vsockPacket.h: add pktOn protocol. This new
protocol improves performance by detecting changes in the queue state
instead of sending WAITING_READ and WAITING_WRITE packets.

* services/plugins/hgfsServer/hgfsPlugin.c,

services/plugins/resolutionSet/resolutionSet.c,
services/vmtoolsd/mainLoop.c, services/vmtoolsd/pluginMgr.c,
services/vmtoolsd/toolsRpc.c: load plugins even when an RPC channel cannot
be instantiated (i.e., when running outside of a virtual machine); this
allows plugins to perform actions (at load time) also when running outside
virtual machines (e.g., to undo some configuration done when the OS was run
in a VM).

* services/vmtoolsd/mainLoop.c, services/vmtoolsd/mainPosix.c,
services/vmtoolsd/toolsCoreInt.h: handle SIGHUP differently; instead of
stopping the service, just re-load the config data. This should make it
easier to integrate the tools service with other tools such as logrotate.

* toolbox/toolbox-cmd.c, toolbox/toolboxcmd-stat.c: remove memory info query,
which didn't really return useful information.

* vmware-user/copyPasteUI.cpp: if the clipboard/primary with most recent
timestamp has no data on it,
try the other before giving up during
copy/paste.

2009-07-22 Marcelo Vanzin <mvanzin@vmware.com>
* Resync with internal trunk (2009.07.17)

* configure.ac: fix detection of "dot" and its usage in the doxygen config
file.

* configure.ac, libguestlib/Makefile.am, libguestlib/vmguestlib.pc.in:
install vmguestlib headers and add new pkgconfig script.

* lib/dndGuest/dnd.{cc,hh}, lib/include/dndBase.h, vmware-user/dndUI.{cpp,h}:
fix an issue where the DnD code would prevent drops to other windows in
Unity mode, instead of just intercepting drops to the desktop.

* lib/dndGuest/dnd.{cc,hh}, lib/dndGuest/dndRpc.hh, lib/dndGuest/dndRpcV3.cc,
lib/include/dndBase.h, vmware-user/dndUI.{cpp,h}: fix an issue where the
host Unity code would cause an undesired drop event.

* lib/dndGuest/dnd.{cc,hh}, lib/dndGuest/dndRpc.hh, lib/dndGuest/dndRpcV3.cc,
lib/include/dndBase.h: cleanup mouse simulation code, and fix an issue
where a drag would be canceled if the contents

were dragged out of a guest
  and then back in.

* lib/dndGuest/dndRpcV3.cc, vmware-user/copyPasteDnDWrapper.cpp,
  vmware-user/dndUI.cpp, vmware-user/dndUI.h, vmware-user/dragDetWnd.cpp,
  vmware-user/dragDetWnd.h: several DnD fixes; make the DnD code behave
  more like other GTK applications (based on analysing the flow of signals
  on a test widget), and get rid of one of the detection windows, merging
  both the Unity and non-Unity windows. Also, some code refactoring.

* lib/ghIntegration/*, lib/guestRpc/*, lib/include/guestCaps.h,
  lib/include/unityCommon.h: add stubs for a few new GHI functions (setting
  window focus, tray icon updates and enhanced app info) - currently only
  implemented on Win32.

* lib/ghIntegration/ghIntegrationX11.c: examine WM_CLASS when determining
  which DE Tools are running in. The previous code was failing to show a
  few entries set as "OnlyShowIn=xxx" because checking WM_NAME wasn't enough
  to properly detect the desktop environment
in certain cases.

* lib/guestApp/guestAppPosixX11.c: use gconftool-2 to detect the user's
  browser, since gnome-open fails to open "file://" URLs which contain query
  strings. Also, use "kde-open" when running under KDE.

* lib/guestInfo/guestInfo.c, lib/include/wiper.h, lib/wiper/wiperPosix.c:
  allow shrinking LVM partitions.

* lib/include/appUtil.h: partial refactoring of icon retrieval code.

* lib/include/dbllnklst.h, lib/misc/dbllnklst.c: inline linked list
  functions.

* lib/include/guest_os.h, lib/misc/hostinfoPosix.c: add a couple of
  distros to the known distro list.

* lib/include/netutil.h, lib/netUtil/netUtilLinux.c: add Linux interface
  name, index lookup routines.

* lib/include/system.h, lib/system/systemLinux.c,
  services/plugins/timeSync/timeSync.c: fixes a few bugs in the backwards
  time sync code, mostly due to unit mismatches.

* lib/include/unityWindowTracker.h, lib/unity/unity.c,
  lib/unity/unityPlatform.h, lib/unity/unityPlatformX11Window.c,

 lib/unityWindowTracker/unityWindowTracker.c: expose two new properties in
  the window tracker to save an RPC to retrieve those properties.

* lib/include/vmtoolsApp.h, services/vmtoolsd/mainLoop.c,
  services/vmtoolsd/pluginMgr.c, services/vmtoolsd/toolsCoreInt.h: add
  support for "application providers", which allow plugins to add support to
  new kinds of application frameworks through vmtoolsd.

* lib/unity/unityPlatformX11.c: only enable GIO channels when Unity is
  actually active.

* lib/unity/*: cleanup old GTK1 code.

* libvmtools/vmtoolsConfig.c: don't complain if config file is empty.

* modules/linux/dkms.conf, modules/linux/dkms.sh: fix dkms.conf, and provide
  a script to create a dkms tree from open-vm-tools.

* modules/linux/shared/vmci_queue_pair.h, modules/linux/vmci/vmciKernelIf.c:
  remove two (now) unneeded functions.

* modules/linux/vmhgfs/*: code cleanups, properly initialize the list head,
  and allow receives to timeout so that hibernation
works.

* modules/linux/vmxnet/vmxnet.c, modules/linux/vmxnet3/vmxnet3_drv.c: fix
  drivers for kernels 2.6.29+.

* modules/linux/vmxnet3/*: add shared memory support for faster communication
  between user space and the device backend; this doesn't affect the regular
  driver functionality, but is used by some VMware code not part of Tools.

* modules/linux/vsock/*: fix an issue where it was possible for users to send
  VMCI datagrams directly to the hypervisor.

* scripts/common/vmware-user.desktop: work around a bug in KDE where desktop
  files with "NoDisplay" fail to autostart.

* scripts/freebsd/suspend-vm-default: use netif to bring down interfaces,
  since dhclient doesn't understand "-r" in the default install.

* services/plugins/vmbackup/*: add some new code used by enhancements being
  done in the Win32 version of the plugin.

* services/vmtoolsd/mainPosix.c: fix running in background when executing
  vmtoolsd while relying on PATH.

* services/vmtoolsd/Makefile.am:
point to the correct plugin install
  directory.

* toolbox/*: better command line handling in the CLI utility, plus some code cleanup.

* vmware-user/copyPaste.c, vmware-user/copyPasteDnDWrapper.cpp, vmware-user/copyPasteDnDWrapper.h, vmware-user/dnd.c: properly unregister RPCs to avoid multiple registrations (and the ensuing ASSERT) in certain cases.

* vmware-user/copyPasteUI.{cpp,h}: change way data is retrieved from the clipboard, using the gtk+ clipboard wait APIs (which turn out to be more reliable than the previous approach).

2009-06-18 Marcelo Vanzin <mvanzin@vmware.com>
* Resync with internal trunk (2009.06.15)

* docs/api/Makefile.am: replace all variables in the doxygen conf file with the correct values.

* lib/appUtil/appUtilX11.c: try alternate file extensions during icon search. Sometimes a package lists its icon as icon-foo.png, but the package didn't include icon-foo.png. Instead, it included icon-foo.xpm. Ex: Ubuntu

8.04's hwtest.

* lib/guestApp/guestAppPosixX11.c: change detection of the default browser so that the new help system works; the help files are not yet available in open-vm-tools.

* lib/hgfs/*, lib/include/cpName.h, lib/include/cpNameLite.h, lib/include/hgfsUtil.h: avoid compiling certain parts of the source in kernel modules.

* lib/hgfsServer/*: return correct error when files / directories don't exist.

* lib/include/hgfsChannel.h, modules/linux/vmhgfs/*: added support for vsock channel for HGFS.

* lib/include/util.h, lib/misc/utilMem.c: un-inline a bunch of functions to reduce the size of binaries.

* lib/include/vm_tools_version.h: bumped Tools version.

* lib/resolution/resolutionX11.c: fix for issue where the host would send a "topology set" command with a top-left corner that was not (0, 0) and cause the screen to be reconfigured in the wrong way.

* lib/unity/unityPlatformX11Window.c: check for errors in calls to
  XQueryTree.

*
lib/wiper/wiperPosix.c: check return of fgets() to avoid compiler warnings.

* libvmtools/vmtools.c: fix initialization of wiper library on Win32.

* modules/Makefile.am: install vsock header file on Linux.

* modules/freebsd/vmhgfs/*, modules/linux/vmci/*, modules/linux/vsock/*:
  changes related to 64-bit Mac drivers, don't affect either the FreeBSD
  or Linux drivers.

* modules/linux/vmhgfs/hgfs.h: removed duplicate file.

* modules/linux/vmhgfs/fsutil.c, modules/linux/vmhgfs/inode.c,
  modules/linux/vmhgfs/module.h: fix issue where two files would get the
  same inode number in some situations.

* modules/linux/vmxnet/vmxnet.c: re-probe vmxnet2 device features on resume
  from hibernate, to cover the case where a VM is resumed on a platform with
  a different version of the device backend (bug #2209565).

* scripts/resume-vm-default, scripts/suspend-vm-default: use NetworkManager
  to handle networking where it is available.

* services/plugins/hgfsServer/Makefile.am,
services/plugins/vix/Makefile.am:
  fix installation of vmusr plugins that are shared with vmsvc.

* services/plugins/timeSync/timeSync.c: fix backwards time sync.

* services/vmtoolsd/cmdLine.c, toolbox/toolbox-cmd.c: print build number as
  part of "-v" output.

* toolbox/toolboxcmd-shrink.c: correctly ignore unsupported partitions when
  shrinking.

* toolbox/toolbox-gtk.c: changes for the new help system, not yet available
  for open-vm-tools.

* toolbox/toolboxInt.{c,h}, toolbox/toolboxScripts.c: some code refactoring.

* vmware-user/Makefile.am: fix linking when compiling without gtkmm.

2009-05-22 Marcelo Vanzin <mvanzin@vmware.com>
* Resync with internal trunk (2009.05.18)

* configure.ac, m4/vmtools.m4: check for PAM and enable PAM support when
  available.

* configure.ac, services/plugins/*/Makefile.am, tests/*/Makefile.am: avoid
  the "-rpath" hack to create plugins, using plugin_LTLIBRARIES instead (and
  manually fixing things when necessary). Thanks
to Dominique Leuenberger for
  the suggestion (and sample patch).

* docs/api/Makefile.am: fix doc target directories.

* configure.ac, lib/Makefile.am, lib/deployPkg/*, lib/include/deployPkg.h:
  remove the deployPkg code, which depends on some VMware code that is not
  yet open source.

* lib/backdoor/*, lib/hgfs/*, lib/hgfsBd/*, lib/include/*,
  lib/include/compat/*, lib/message/*, lib/misc/dbllnklst.c,
  lib/rpcOut/rpcout.c: as part of sharing code between user-level code and
  kernel modules, some files have been tagged with more than one license.

* lib/dndGuest/*, lib/include/dndBase.h, lib/include/dndMsg.h,
  lib/include/unity*, lib/unity/unityPlatformX11.c: implement mouse movement
  from within the guest; this avoids a dependency on "unofficial" mouse APIs
  in the VMware host code, making DnD more reliable, and makes a few things
  (such as cancelling an ongoing DnD operation) easier.

* lib/file/filePosix.c: make File_FullPath()'s behavior consistent when the

 input path starts with a '/'.

* lib/ghIntegration/ghIntegration.c: send more info about the "start menu"
  contents to the host (only usable for Windows guests).

* lib/ghIntegration/ghIntegrationX11.c: prettify the category names of menu
  items. This is a temporary solution before actually reading this
  information from .desktop files.

* lib/guestApp/guestApp.c, libguestlib/vmGuestLib.c, lib/include/guestApp.h,
  toolbox/toolbox-gtk.c, vmware-user/foreignVM*, vmware-user/vmware-user.cpp,
  configure.ac, lib/Makefile.am, lib/include/socketMgr.h, lib/socketMgr.*:
  remove code related to "foreign VM" support, which was never really used.

* lib/guestInfo/guestInfo.c, lib/include/wiper.h, lib/wiper/wiperPosix.c:
  properly report disk info for LVM volumes.

* lib/hgfsServer/hgfsDirNotify*, lib/hgfsServer/hgfsServer.c: add support
  for directory / file monitoring. It's currently only implemented on

Mac OS X.

* lib/hgfsServer/hgfsServer*: fix issue where it was possible
to
create a file on a read-only share on Windows hosts.

* lib/hgfsServer/hgfsServer*, lib/hgfsServerManagerGuest/*,
lib/include/hgfs*.h, services/plugins/hgfsServer/hgfsPlugin.c,
services/plugins/vix/foundryToolsDaemon.c: some refactoring caused by the
work to make HGFS support pluggable transports.

* lib/include/procMgr.h, lib/procMgr/procMgrPosix.c:
remove ProcMgr_GetAsyncStatus().

* lib/include/vmsupport.h, scripts/vm-support, xferlogs/xferlogs.c,
services/plugins/guestInfo/guestInfoServer.c: new feature to automatically
collect support data from the guest from the VMware UI.

* lib/panicDefault/*, lib/user/*: change file names to avoid clash with
another file (Mac OS linker doesn't really like that).

* lib/rpcChannel/rpcChannel.c: try to reinitialize the outbound channel on
failure.

* lib/vixTools/vixTools.c, lib/include/vixCommands.h,
lib/include/vixOpenSource.h: add backend for new VIX API call to list the
guest's filesystems.

*
libvmtools/vmtoolsLog.c: lazily open the log file, instead of opening it
during configuration of the log system. This way two processes can use the
same conf file and not overwrite each other's log files (assuming the conf
data is sane).

* modules/Makefile.am, modules/linux/vmci/Makefile.kernel,
modules/linux/vsock/Makefile.kernel: don't store VMCI module symbols in
/tmp during build; this avoids a possible symlink attack that could cause
data to be overwritten when building open-vm-tools.

* modules/*/*, vmblock-fuse/*: remove a lot of duplicated files by either
moving them to a shared location or reusing files that were already
available elsewhere.

* modules/freebsd/vmblock/subr.c, modules/freebsd/vmblock/vmblock_k.h,
modules/freebsd/vmblock/vnoops.c: fix a possible kernel crash caused by
trying to read / write to the mount point (something vmware-user does to
detect whether it's using fuse or non-fuse vmblock).

* modules/linux/pvscsi/*: adds
support for a generic msg framework that is
  currently used to deliver hot-plug/unplug notifications; get rid of a few
  divisions; fix a bug where pvscsi_probe could return 0 (aka success) if
  a call to kmalloc() failed; remove a few unused fields.

* modules/linux/shared/vmci*: mostly changes related to the host VMCI drivers
  (removed user-level queue-pair daemon, added support for trusted VMCI
  endpoints) to keep binary compatibility between the host and guest VMCI
  drivers.

* modules/linux/hgfs/inode.c: check host's access rights when checking file
  permissions, so that permissions are correctly checked when the guest's
  user id is different from the host's user id.

* modules/linux/bdhandler.*, modules/linux/filesystem.c; modules/linux/tcp.*,
  modules/linux/transport.*,: postpone opening the channels so that module
  can load successfully even if shared folders are disabled on the host;
  fix a synchronization problem between recv and close/open; allow

hibernation to work by timing out the recv thread; correctly handle
  failures in recv, including injecting a dummy error to the pending
  requests when the recv thread exits; move the recv code to the channel's
  implementation so that it can be simpler.

* modules/linux/vmxnet3/vmxnet3.c, modules/linux/shared/compat_pci.h: fix
  Wake-On-LAN for 2.6.27 and newer Linux guests.

* modules/linux/vsock/linux/*: changes to support trusted VMCI host apps;
  pull out notification and stats logging code into their own files.

* modules/solaris/vmhgfs/vnode.c: do not substitute errors returned by
  uiomove() calls with EIO, propagate returned error code (which is EFAULT)
  up the stack.

* services/vmtoolsd/Makefile.am, scripts/common/linux/pam.d/vmtoolsd-x64,
  scripts/common/linux/pam.d/64/vmtoolsd: install the 64-bit PAM config
  file with the correct name.

* services/plugins/powerOps/powerOps.c: fix running default scripts by
  making sure the path to the script is absolute.

*
services/vmtoolsd/Makefile.am, services/vmtoolsd/pluginMgr.c: use info
  from the configure step to define the plugin path; this avoids requiring
  a symlink to be placed in /etc/vmware-tools for vmtoolsd to be able to
  find the plugins.

* services/vmtoolsd/toolsRpc.c: send the build information to the host so
  it's logged in the VM's logs.

* toolbox/toolbox-cmd.c, toolbox/toolboxcmd-*, toolbox/toolboxCmdInt.h:
  make string comparison case-insensitive on Win32.

* toolbox/toolboxcmd-shrink.c: properly finish the shrinking process by
  sending the "disk.shrink" RPC to the host.

* toolbox/toolboxScripts.c: fix showing default settings for power ops
  scripts (should show default script enabled, not script disabled).

* vmblock-fuse/Makefile.am: fix compilation on FreeBSD.

* vmware-user/copyPasteUI.cpp: disallow copy-paste text of size greater than
  4MB, instead of truncating the data.

* vmware-user/dndUI.*, lib/dndGuest/dnd.cc, lib/include/dndBase.h: remove

  drag timeout callback (which was not needed), and add new signal to
  indicate that a GH DnD was cancelled.

* vmware-user/Makefile.am: remove C++ link hack (not needed now since
  vmware-user has C++ code already).

2009-04-23 Marcelo Vanzin <mvanzin@vmware.com>
* Resync with internal trunk (2009.04.17)

* configure.ac, Makefile.am, docs/*: build API docs for vmtools; the
  documentation files are provided under a BSD-style license.

* configure.ac, Makefile.am, guestd/*, lib/Makefile.am, lib/guestInfo/*,
  lib/include/vmbackup_def.h, lib/include/vmBackup.h, lib/vmBackupLib/*,
  libvmtools/Makefile.am, services/plugins/vmbackup/vmbackup_def.h: remove
  guestd from open-vm-tools, and clean up code in other places that was only
  there because of guestd.

* configure.ac, modules/solaris/vmblock/*, modules/solaris/vmmemctl/*: add
  Solaris vmblock and vmmemctl driver sources. The vmmemctl module also
  includes a user-level daemon (vmmemctld.c).

* lib/conf/conf.c, lib/include/conf.h,
libvmtools/vmtoolsConfig.c: remove
  unused config options.

* lib/deployPkg/toolsDeployPkg.h: code refactoring.

* lib/dnd/dndClipboard.c: if size of clipboard exceeds the maximum backdoor

packet size, only keep text data (dropping the RTF data).

* lib/dnd/dndLinux.c, lib/include/dnd.h, lib/include/vmblock.h,
vmware-user/copyPaste.c, vmware-user/dnd.c, vmware-user/vmware-user.cpp,
vmware-user/vmwareuserint.h, vmware-user-suid-wrapper/main.c: detect
whether plain vmblock or vmblock-fuse is being used, allowing the same
executable to be used with either.

* lib/dndGuest/*, vmware-user/copyPaseDnDWrapper.{cpp,h},
vmware-user/dndUI.{cpp,h}, vmware-user/dragDetWnd.{cpp,h}:
vmware-user/vmware-user.cpp: more DnD V3 protocol work.

* lib/ghIntegration/*, lib/include/guestCaps.h, lib/include/unityCommon.h:
work related to mapping Outlook folders over HGFS and exposing the Windows
Recycle Bin to the host (doesn't really affect open-vm-tools).

*
lib/ghIntegration/ghIntegrationX11.c: restore the native environment when
launching external applications. This doesn't really affect open-vm-tools.

* lib/guestRpc/*, vmware-user/copyPasteUI.{cpp,h}: implement RTF and file
contents copy & paste.

* lib/include/circList.h, lib/include/vm_basic_math.h,
lib/include/vm_device_version.h, modules/linux/*, modules/Makefile.am:
changes to share files between the user space code and the kernel code,
instead of duplicating the same source files in different places.

* lib/include/rpcChannel.h, lib/rpcChannel/*, tests/testDebug/testDebug.c,
test/vmrpcdbg/debugChannel.c: some code cleanup, and fix crash when dealing
with multiple reset messages.

* lib/include/system.h, lib/system/systemLinux.c,
services/vmtoolsd/mainPosix.c: remove System_Daemon() (replaced with
Hostinfo_Daemonize()).

* lib/include/unityCommon.h, lib/unity/*: ressurrect UNITY_RPC_WINDOW_SHOW
and UNITY_RPC_WINDOW_HIDE RPCs.

* lib/procMgr/procMgrPosix.c:
fix ProcMgr_IsProcessRunning().

* lib/system/systemLinux.c: fix shutdown / reboot commands on Solaris; fix
rebuilding of native environment from variables set by VMware scripts (this
last one doesn't really affect open-vm-tools).

* lib/unicode/unicodeSimpleTypes.c: speed up UnicodeIANALookup, and fix case
where C++ constructors could call UnicodeIANALookup before Unicode_Init()

was called by lazily creating the internal cache.

* libguestlib/*: link libguestlib against libvmtools. This avoids having
two definitions of certain symbols (like Debug()) when an application
links to both libraries.

* modules/linux/vmblock/linux/control.c: only set directory entry owner when
needed.

* modules/linux/vmhgfs/bdhandler.{c,h}, modules/linux/vmhgfs/dir.c,
modules/linux/vmhgfs/file.c, modules/linux/vmhgfs/filesystem.c,
modules/linux/vmhgfs/fsutil.c, modules/linux/vmhgfs/inode.c,
modules/linux/vmhgfs/module.{c,h}, modules/linux/vmhgfs/page.c,
modules/linux/vmhgfs/request.{c,h},
modules/linux/vmhgfs/super.c,
modules/linux/vmhgfs/tcp.{c,h}, modules/linux/vmhgfs/transport.{c,h}:
cleanup use of atomic variables in HGFS; add a transport abstraction layer,
and add an initial version of a socket-based transport (not yet stable and
not yet supported by any released VMware product).

* modules/linux/vmxnet3/vmxnet3.c: fix build on kernel 2.6.29.

* modules/linux/vsock/af_vsock.c: export more functions to other kernel
modules; some changes to statistics gathering code.

* modules/solaris/vmhgfs/filesystem.c: make module loadable on Solaris 9.

* modules/solaris/vmhgfs/vnode.c: unify mapping of HGFS to Solaris error
codes.

* scripts/*: restart network before running user scripts in resume scripts.

* services/plugin/powerOps/powerOps.c: fix running default power scripts.

* services/vmtoolsd/pluginMgr.c: better error logging.

* toolbox/toolbox-cmd.c: fix help string.

* vmblock-fuse/block.c: fix vmblock-fuse
compilation on FreeBSD.

2009-03-18 Marcelo Vanzin <mvanzin@vmware.com>
* Resync with internal trunk (2009.03.13)

* configure.ac: check for FreeBSD kernel tree when building modules; warn
about which version of make to use when building kernel modules on FreeBSD
and Solaris; add compiler defines for identifying Solaris 9 and 11.

* configure.ac, modules/Makefile.am: handle SYSDIR on FreeBSD.

* guestd/main.c, modules/solaris/vmhgfs/Makefile: remove HGFS-related that
  is now obsolete with the recent changes to the HGFS module on Solaris.

* guestd/toolsDaemon.c: default to the configuration dir when the power
  script path is not absolute.

* guestd/toolsDaemon.c, lib/include/guestInfo.h, lib/netUtil/netUtilLinux.c:
  handle case when all network interfaces have been disabled and send an
  "unknown" IP address to the host.

* guestd/toolsDaemon.c, services/vmtoolsd/toolsRpc.c: always send
  TOOLS_VERSION_UNMANAGED from an open-vm-tools build, so there's no need for

 a config file option anymore.

* hgfsclient/*: make it link to libvmtools to avoid code duplication.

* lib/appUtil/appUtil.c: update list of "skippable" apps when figuring out
  an application's path.

* lib/auth/authPosix.c, scripts/linux/pam.d/*, guestd/Makefile.am,
  services/vmtoolsd/Makefile.am : change the name of the PAM application to
  "vmtoolsd" to reflect the new service name.

* lib/dnd/dndFileContentsUtil.h, lib/dnd/dndInt.h, lib/dndGuest/*.hh, and
  corresponding files in lib/include: relocate private headers.

* lib/ghIntegration/ghIntegration.c, lib/ghIntegration/ghIntegrationInt.h,
  lib/ghIntegration/ghIntegrationX11.c, lib/include/unityCommon.h: glue code
  for Outlook mirrored folder, which does not affect open-vm-tools.

* lib/guestRpc/guestlibV3.x, lib/include/vmGuestLib.h,
  libguestlib/vmGuestLib.c: add new guestlib counters.

* lib/include/conf.h, toolbox/toolbox-gtk.c: remove the need for the
  "helpdir" config option; this doesn't really
affect open-vm-tools since the
  help files are not yet included.

* lib/include/guest_os.h, lib/misc/hostinfoPosix.c: more guest OS names; fix
  name used to identify Solaris to match what VMware's host code expects.

* lib/include/guestStats.h: documentation changes.

* lib/include/hostinfo.h, lib/user/hostinfoPosix.c: add a new function that
  behaves like daemon(3), but is more Mac OS-friendly.

* lib/include/toolsLogger.h, lib/Makefile.am, lib/toolsLogger/*: removed
  library, which is not used anymore.

* lib/include/vm_basic_types.h, lib/misc/timeutil.c: fixes to compile under
  (Open) Solaris 11.

* lib/include/vmtoolsApp.h, services/plugins/vmbackup/stateMachine.c,
  services/vmtoolsd/mainLoop.c, services/vmtoolsd/mainPosix.c,
  services/vmtoolsd/serviceObj.c, services/vmtoolsd/toolsCoreInt.h: add new
  signal handler to gather debugging information from a running vmtoolsd
  instance.

* lib/misc/posixPosix.c: fix off-by-one error.

* lib/unity/unity.c, lib/unity/unityPlatform.h,
lib/unity/unityPlatformX11.c,
  lib/unity/unityPlatformX11Settings.c: always send Unity updates using RPCI;
  this avoids a possible race between replying to an incoming RPC and sending
  an Unity update from a different thread; also, API documentation updates.

* lib/unity/unityPlatformX11.c: verify the DnD detection window was
  initialized before actually using it.

* lib/unity/unityPlatformX11Settings.c, lib/unity/unityPlatformX11Window.c:
  reset _NET_WM_DESKTOP as necessary before exiting Unity; this could cause
  guest taskbars to disappear when in Unity mode.

* lib/unity/unityPlatformX11.c, lib/unity/unityPlatformX11Window.c,
  lib/unity/unityX11.h: examine WM_CLIENT_LEADER when gathering application
  information; certain applications use this property to define the window
  where the WM_COMMAND property should be.

* lib/vixTools/vixTools.c: do not follow symlinks when deleting files in the
  guest using the VIX API.

* libvmtools/vmtools.c,
libvmtools/vmtoolsLog.c: allow the logging subsystem
  to be re-configured, and clean up the logging data when unloading the
  library; allow ${USER} and ${PID} to be used in log file paths.

* modules/freebsd/vmblock/subr.c, modules/freebsd/vmblock/vnops.c: fix kernel
  panic on FreeBSD 7.

* modules/linux/*/Makefile: remove GCC version check.

* modules/linux/*/compat_wait.h: fix COMPAT_DEFINE_WAIT for "vanilla" 2.4
  kernels.

* modules/linux/vmhgfs/Makefile.normal: fix build of HGFS module on 2.4
  kernels.

* modules/linux/vmxnet/*, modules/linux/vmxnet3/*: avoid using compat
  functions when they're not needed; add compatibility functions for
  newer Linux kernels.

* modules/linux/vsock/linux/af_vsock.c: fix two races; one when the socket
  state changed between calls to VSockVmciRecvStreamCB and
  VSockVmciRecvPktWork, and another when trying to read from the socket after
  a RST arrived after the socket got a detach notification.

* modules/solaris/vmxnet3/*:
add Solaris vmxnet3 driver.

* rpctool/*: add "rpctool", a simple, stand-alone tool to send RPC commands
  to the host software.

* services/plugins/guestInfo/guestInfoServer.c: don't cache configuration
  data.

* services/plugins/guestInfo/perfMonLinux.c: fix problem with overwriting
  flags after GuestInfoMonitorReadMeminfo() was called. (Same as fix to
  lib/guestInfo on previous release.)

* services/plugins/powerOps/powerOps.c: handle power ops-related options
  sent from the host.

* services/vmtoolsd/mainLoop.c: handle re-loading the configuration file.

* services/vmtoolsd/mainPosix.c: exec after forking on Mac OS, since
  CoreFoundation classes don't work after a fork.

* services/vmtoolsd/pluginMgr.c: allow both 32 and 64 bit plugins to be
  installed on Solaris by loading them from the appropriate directory;
  add library loading code that is not really needed (nor used) in
  open-vm-tools.

* services/vmtoolsd/toolsRpc.c: send another "capability" the host
expects
  from Tools.

* toolbox/toolbox-gtk.c: add F1 shortcut to invoke help.

* toolbox/toolboxScripts.c: fix issue with freeing data that should not be
  freed.

* vmware-user/*: implement the new DnD protocol (V3).

2009-02-18 Marcelo Vanzin <mvanzin@vmware.com>
* Resync with internal trunk (2009.02.13)

* configure.ac, m4/vmtools.m4: clean up a lot of the library detection code.

* configure.ac: remove support for gtk+ 1.2 (code already depended on it in
any case); enforce need for glib 2.6.0 or later due to new code being
added; add detection for gtkmm; check for C++ compiler when it's needed;
reorder the include path to avoid clashing with system headers in some
situations.

* guestd/foundryToolsDaemon.*, vmware-user/foundryToolsDaemon.*,
guestd/Makefile.am, vmware-user/Makefile.am: moved shared source files to
a new place to avoid duplication.

* hgfsmounter/hgfsmounter.c: add support for Solaris.

* lib/appUtil/appUtilX11.c: fix loading of icons
when the name has a period.

* lib/dnd/dndClipboard.c, lib/dnd/dndInt.h, lib/dnd/dndMsg.c,
lib/dnd/Makefile.am, lib/dndGuest/*, lib/include/copyPasteBase.h,
lib/include/copyPaste.hh, lib/include/copyPasteRpc.hh,
lib/include/copyPasteRpcV3.hh, lib/include/dndBase.h,
lib/include/dndClipboard.h, lib/include/dndFileContentsUtil.h,
lib/include/dndFileList.hh, lib/include/dnd.h, lib/include/dnd.hh,
lib/include/dndInt.h, lib/include/dndMsg.h, lib/include/dndRpc.hh,
lib/include/dndRpcV3.hh, lib/include/dndTransportGuestRpc.hh,
lib/include/dndTransport.hh, lib/include/libExport.hh,
vmware-user/copyPaste.cpp, vmware-user/copyPasteUI.{cpp,h},
vmware-user/copyPasteV3.h, vmware-user/copyPasteWrapper.{cpp,h},
vmware-user/dnd.cpp, vmware-user/Makefile.am,
vmware-user/vmware-user.{c,cpp}, vmware-user/vmwareuserInt.h,
vmware-user/stringxx/string.{cc,hh}, vmware-user/stringxx/ubstr_t.hh: add
support for new version of the DnD protocol.

* lib/guestInfo/guestInfoPerfMonLinux.c:
fix problem with overwriting flags
after GuestInfoMonitorReadMeminfo() was called.

* lib/guestRpc/guestlibV3.x, lib/include/vmGuestLib.h,
libguestlib/vmGuestLib.c: add new host stats.

* lib/guestRpc/Makefile.am: fix a few compatibility issues with non-GNU
versions of make.

* lib/hgfsServer/hgfsServer.c, lib/hgfsServer/hgfsServerInt.h,
  lib/hgfsServer/hgfsServerLinux.c, */hgfsProto.h,
  modules/freebsd/vmhgfs/vnops.c, modules/freebsd/vmhgfs/vnopscommon.{c,h}:
  don't trust the local VFS layer, check the HGFS server to see if an
  operation would succeed.

* lib/include/rpcChannel.h, lib/rpcChannel/*: add new Guest RPC channel
  abstraction library used by the new "core services" code.

* lib/include/vmrpcdbg.h, tests/*: add test code from the "core services"
  project.

* lib/include/vmtoolsApp.h, lib/include/vmtoolsd_version.h,
  services/vmtoolsd/*: add "vmtoolsd", the new service "shell" used in the
  "core services" project.

* lib/unity/unityPlatformX11Window.c:
don't send initial "region" updates for
  shaped windows. This works around an issue where resizing a shaped window
  would not work as expected in Unity mode.

* lib/wiper/wiperPosix.c: fix major number detection for disks on newer Linux
  kernels.

* libvmtools/Makefile.am: link more libraries needed by vmtoolsd and the new
  plugins.

* modules/linux/pvscsi/pvscsi.c, modules/linux/pvscsi/pvscsi_version.h: use
  PCI-specific memory allocation functions and update driver version.

* modules/linux/vmci/vmciKernelIf.c: disable queue pair support in the host
  version of the driver on older Linux kernels. This doesn't affect the
  guest driver.

* modules/linux/vmci/vmci_queue_pair.h: implement MSG_PEEK support on
  Linux driver.

* modules/linux/vmhgfs/bdhandler.c, modules/linux/vmhgfs/compat_sched.h,
  modules/linux/vmmemctl/os.c: fix issue with HGFS module interfering with
  suspend / hibernation on newer Linux kernels (bug #2523263).

*
modules/linux/vmhgfs/compat_cred.h, modules/linux/vmhgfs/file.c,
  modules/linux/vmhgfs/filesystem.c, modules/linux/vmhgfs/inode.c: changes
  for compatibility with newer Linux kernels, where it's not possible to
  change fsuid/capabilities directly anymore.

* modules/linux/vmhgfs/compat_pagemap.h, modules/linux/vmhgfs/page.c:
  fix warning, and compatibility changes for newer Linux kernels
  (2.6.28.1 and newer; bug #2530616).

* modules/linux/vmhgfs/inode.c: fix creation of symlinks (bug #2531303).

* modules/linux/vmxnet/vmxnet.c: use PCI-specific memory allocation
  functions.

* modules/linux/vmxnet/vmxnet.c, modules/linux/vmxnet3/vmxnet3.c: add option
  to disable LRO.

* modules/linux/vsock/af_inet.{c,h}, modules/linux/vsock/util.{c,h}: add
  MSG_PEEK support; remove ifdefs that were disabling support for queue
  pairs on the host kernel module; fix compilation with certain versions
  of gcc (bug #2531283).

* modules/solaris/vmhgfs/*: move backdoor handling code
to the HGFS driver;
  this makes the user-level code to handle the driver (currently in
  vmware-guestd) obsolete.

* modules/solaris/vmxnet/*: add vmxnet driver for Solaris, under the CDDL.

* services/plugins/*: add all currently available "core services" plugins.
  The current set of plugins provide the functionality available in
  vmware-guestd; there are a few plugins that replace functionality from
  vmware-user, but not all features are ported yet (and vmtoolsd - with
  vmware-user plugins - and vmware-user cannot run at the same time).

* toolbox/toolboxAbout.c: fix the copyright character.

* toolbox/toolbox-cmd.c: reword a few messages, fix typos.

* toolbox/toolboxCmdInt.h, toolbox/toolboxcmd-record.c,
  toolbox/toolbox-gtk.c, toolbox/toolboxRecord.c: remove the "record"
  functionality from tools (due to internal request).

* toolbox/toolboxInt.c, toolbox/toolboxScripts.c, toolbox/toolbox-scripts.c:
  changes to use the new config file format used by the
"core services" code.

* */Makefile.am: make sure 'rm' and 'mv' are being used instead of $(RM) and
  $(MV) (which are not defined by automake; bug #2492040).

2009-01-21 Marcelo Vanzin <mvanzin@vmware.com>
* Resync with internal trunk (2009.01.19)

* configure.ac: detect the presence of FUSE libraries.

* configure.ac, Makefile.am: compile kernel modules for Solaris, and
  vmblock-fuse module if FUSE is available.

* lib/ghIntegration/ghIntegrationX11.c: retrieved localized application
  names.

* lib/guestInfo/guestInfo.c, lib/guestInfo/guestInfoPosix.c,
  lib/include/hostinfo.h, lib/misc/hostinfo_misc.c, lib/misc/hostinfoPosic.c,
  lib/vixTools/vixTools.c: refactoring to move code shared with other VMware
  products to a common library.

* lib/guestRpc/guestlibV3.x, lib/guestRpc/Makefile.am,
  lib/include/vmGuestLib.h, libguestlib/*: add new iteration of the
  "guestlib" protocol. This is a more extensible solution than the current
  protocol, and should make it easier
to add new information when needed.

* lib/include/dynarray.h, lib/include/dynbuf.h, lib/misc/dynarray.c,
  lib/misc/dynbuf.c: make some DynArray/DynBuf functions inline for speed.

* lib/include/unityCommon.h: more documentation about the Unity protocol.

* lib/unity/unityPlatformX11.c: fix Unity<->guest desktop ID mappings.

* libvmtools/vmtoolsLog.c: change the way log domains are configured; now
  sub-domains inherit the default handler for the app if no handler is
  specified.

* modules/freebsd/vmhgfs/state.c, modules/freebsd/vmhgfs/state.h,
  modules/freebsd/vmhgfs/vnopscommon.{c,h}: implement support for mmap on
  the Mac OS driver, which allows running executables from an HGFS
  share. The FreeBSD module still does not support this functionality.

* modules/freebsd/vmhgfs/transport.{c,h}: refactoring for sharing structure
  definitions.

* modules/linux/pvscsi/pvscsi.c, modules/linux/vmblock/linux/module.c,
  modules/linux/vmci/vmci_drv.c, modules/linux/hgfs/module.c,

 modules/linux/vmmemctl/os.c, modules/linux/vmsync/sync.c,
  modules/linux/vmxnet/vmxnet.c, modules/linux/vmxnet3/vmxnet3.c: add support
  for Novell's proprietary module info tag ("supported").

* modules/linux/vmci/vmciKernelIf.c: add support for VMCI queue pairs on
  the host. This does not affect the driver when it runs inside virtual
  machines.

* modules/linux/vmci/*.h, modules/linux/vsock/*.h: some changes in the common
  code to support Mac OS X, and also queue pairs on the Solaris VMCI module.

* modules/linux/vsock/af_vsock.{c,h}: add functions for registering with
  the vsock driver from within the kernel.

* modules/linux/*/Makefile: add $(LINUXINCLUDE) to the compiler flags; this
  allows compiling the modules against recent kernels which removed that
  from $(KBUILD_CPPFLAGS).

* modules/Makefile.am: add support for compiling Solaris kernel modules.

* modules/solaris/vmhgfs/*: initial release of the Solaris HGFS driver in
  open-vm-tools. Driver
is licensed under the CDDL 1.0.

* vmblock-fuse/*: add the user-level implementation of the vmblock driver,
  which is build on top of FUSE, to open-vm-tools. vmware-user hasn't yet
  been modified to use this version of vmblock.

* vmware-user/copyPaseV3.h: new header introduced during development of the
  next version of copy paste / DnD for X11 platforms.

2008-11-23 Marcelo Vanzin <mvanzin@vmware.com>
* Resync with internal trunk (2008.12.19)

* configure.ac, */Makefile.am: standardize on using libtool archives for
  the libraries. This also means several makefiles were removed, since
  there's no need to build two archives of the same library anymore.

* configure.ac: add logic to detect glib 2.6; this is the minimum version
  required by the "Core Services" project. Currently it's an optional
  dependency.

* configure.ac: disable Unity when user specifies --disable-multimon.

* configure.ac: actually build the pvscsi modules if the detected kernel
  version
supports it.

* configure.ac, Makefile.am, lib/guestInfo/Makefile.am,
  lib/stubs/Makefile.am, libvmtools/*, lib/include/vmtools.h: add the
  "vmtools" shared library used in the "Core Services" project. The library
  is a collection of a lot of other libraries used by most VMware Tools
  programs, and adds some functionality on top of glib that is used in the
  "Core Services" project. Currently no other components from that project

are available as part of open-vm-tools.

* lib/deployPkg/deployPkgLog.h, lib/deployPkg/toolsDeployPkg.h: moved private
headers out of the public header directory.

* lib/guestRpc/Makefile.am, modules/Makefile.am: fix the makefiles so that
it's possible to build open-vm-tools from a directory different from the
source dir.

* lib/hgfsServer/hgfsServer.c: changes to support aliases on Mac OS hosts.

* lib/hgfsServer/hgfsServerLinux.c: changes to map Windows attributes to
Mac OS FileInfo.

* lib/include/circList.h: removed unused file.

*
lib/include/unityCommon.h, lib/unity/unity.c: changes to add documentation
to various application RPCs used in Tools.

* lib/misc/posixPosix.c, toolbox/toolboxScripts.c: fix include path for
syslimits.h on FreeBSD.

* lib/unity/unityPlatformX11.c: better detection of the guest's work area
boundaries; fixes a problem when dragging a Window in Unity mode with
the host's task bar on the left/right of screen would result in weird
behavior.

* lib/unity/unityPlatformX11Settings.c, lib/unity/unityPlatformX11Window.c,
lib/unity/unityX11.h: preserve the _NET_WM_DESKTOP setting when hiding
windows; this fixes a problem where hiding a panel and later restoring it
would result in the wrong _NET_WM_DESKTOP property being set for the panel,
causing it to only display on the first virtual desktop.

* modules/linux/vmci/*: minor changes related to internal development of the
Mac OS drivers.

* modules/linux/vmhgfs/page.c: fix HGFS driver for kernel 2.6.28.

*
modules/linux/vsock/linux/af_vsock.c: added code to gather some performance
statistics for the driver.

* toolbox/toolbox-gtk.c: a few fixes to the help functionality.

* vmware-user/vmware-user.c, vmware-user-suid-wrapper/main.c: change the
"blockFd" argument to have an extra dash so it follows the convention of
common command line parsing libraries.

* Other bug fixes and changes in shared code that don't affect open-vm-tools.

2008-11-18 Marcelo Vanzin <mvanzin@vmware.com>
* Resync with internal trunk (2008.11.14)

* lib/include/vm_version.h: Bumped TOOLS_VERSION.

* guestd/toolsDaemon.c, lib/include/vm_app.h: changes related to host-side
  configuration of power operations.

* hgfsclient/hgfsclient.c, lib/dnd/dndCommon.c, lib/dnd/dndLinux.c,
  lib/hgfs/*, lib/hgfsServer/*, lib/include/cpName.h, lib/include/dnd.h,
  lib/include/hgfsEscape.h, lib/include/staticEscape.h, modules/*/vmhgfs/*,
  vmware-user/dnd.c: refactor the HGFS character escaping code; escape

 invalid characters when the sender allows characters in the file name that
  the receiver does not allow.

 * lib/hgfsServer/hgfsServerLinux.c: return proper error code when the
   remote path points to a non-existent directory.

* lib/deployPkg/deployPkg.c, lib/deployPkg/deployPkgLog.c,
  lib/include/deployPkg.h, lib/include/rpcin.h, lib/rpcin/rpcin.c:
   refactoring for the Tools Core Services project.

* lib/dnd/dndCommon.c: don't ASSERT if the staging directory is not
  actually a directory.

* lib/dynxdr/xdrutil.c, lib/include/xdrutil.h: more XDR-related utility
  functions.

* lib/file/file.c, lib/file/fileLockPrimitive.c, lib/include/vm_basic_defs.h:
  replace use of strtok with strtok_r.

* lib/guestApp/guestApp.c, lib/include/guestApp.h: more utility functions.

* lib/guestApp/guestApp.c, lib/include/backdoor_def.h, vmware-user/pointer.c:
  add the ability to detect whether the mouse hardware can be used in
   absolute mode, which allows for auto grab /
auto ungrab to work.

* lib/guestInfo/guestInfo.c, lib/guestInfo/guestInfoPosix.c,
   lib/guestRpc/nicinfo.x: provide the prefix length of an IPv6 address in a
   separate field of the NicInfo struct.

* lib/guestInfo/guestInfoPerfMonLinux.c: reduce log spew.

* lib/guestInfo/guestInfoServer.c, lib/include/guestInfo.h: changes related
  to how the VMware code in the host handles Tools version information.

* lib/include/unityCommon.h: changes related to documenting the Unity API.

* lib/include/unity.h, lib/unity/*: remove a few unused RPCs, add a new
  function used to notify the host of the status of Unity.

* modules/freebsd/vmhgfs/state.c, modules/vmhgfs/freebsd/vnops.c,
   modules/vmhgfs/freebsd/vnopscommon.*: support symlinks on FreeBSD and
   Mac OS.

 * modules/freebsd/vmhgfs/worker.c: fix mutex not being unlocked in some
   error paths.

* modules/linux/dkms.conf: add rudimentary dkms support.

* modules/linux/pvscsi/*: add a driver for VMware's paravirtualized
SCSI
  device.

* modules/linux/*/Makefile, modules/linux/vmci/Makefile.kernel,
  modules/linux/vsock/Makefile.kernel: add support for exporing symbols,
  needed for dependent modules to load if a kernel >= 2.6.26 is compiled
  with CONFIG_MODVERSIONS. Make the vsock module reference the vmci module's
  symbols.

* modules/vmmemctl/freebsd/os.c: add sysctl to get driver status. Information
  can be retrieved with "sysctl vm.vmmemctl".

 * modules/linux/vmci/vmci_defs.h, modules/linux/vmci/vmci_call_defs.h,
   modules/linux/vsock/vmciHostKernelAPI.h: changes related to VMCI work
   on VMware ESX.

* modules/linux/vsock/linux/*: improve performance of some applications by
  improving the poll behavior and sending less packets when waiting
  for a response.

 * modules/linux/vmsnc/sync.c: fix panic on kernels < 2.6.20.

* modules/linux/vmxnet3/vmxnet3.c, modules/linux/vmxnet3/vmxnet3_int.h,
   modules/linux/vmxnet3/vmxnet3_version.h: inherit net device features
to
   avoid having the kernel setting the PSH flag on every TCP packet (among
   other issues).

* modules/*/*/*: Reflected changes from elsewhere.

* scripts/common/vmware-user.desktop: add missing "Type" information; fixes
  auto-start of vmware-user on Ubuntu 8.10.

* toolbox/*: fix a GTK+ warning caused when trying to unref a dialog
  instance from a signal callback.

* vmware-user/copyPaste.c: work around an issue when OpenOffice's "cut"
  command is used; it sets the timestamp of both the clipboard and the
  primary selection, but only puts data in the clipboard.

* Other files: minor refactorings, and changes unrelated to open-vm-tools.

2008-10-13 Adar Dembo <adar@vmware.com>
* Resync with internal trunk (2008.10.09)

* configure.ac, modules/Makefile.am: Added a command-line option to
skip privileged operations during make install (requested by Dennis
Leroy). Integrated new vmxnet3 kernel module.

* configure.ac, lib/guestInfo/Makefile.am,
lib/guestInfo/guestInfoPerfMonLinux.c,
lib/include/vm_procps.h:
Removed open-vm-tools dependency on libproc-dev by providing some procps
bits and pieces in our own vm_procps.h (Sourceforge bug 1960947).

* hgfsmounter/Makefile.am: Removed chown calls. Only call chmod
if we're running as root (requested by Dennis Leroy).

* */foreignVMToolsDaemon.c, */foundryToolsDaemon.[ch],
lib/guestInfo/guestInfo.c, lib/guestInfo/guestInfoServer.c,
lib/include/guestInfoServer.h, lib/include/vixTools.h,
lib/rpcin/rpcin.c, lib/vixTools/vixTools.c, vmware-user/copyPaste.c,
vmware-user/vmware-user.c: More refactoring from the Tools core
services project.

* */foundryToolsDaemon.c: Changed HGFS mounting behavior such that the
global HGFS share is mounted at /mnt/hgfs instead of relying on
"mount -a".

* guestd/toolsDaemon.[ch], lib/include/backdoor_def.h,
lib/include/system.h, lib/include/vm_app.h, lib/system/systemLinux.c:
Added backwards time synchronization functionality. Moved Tools scripts
checking
from VMX to guestd.

* hgfsmounter/hgfsmounter.c: Added handling for multiple "-o" flags on
the command line.

* lib/dynxdr/dynxdr.c: Fixed x_putint32 behavior on 64-bit Solaris.

* lib/file/*, lib/include/codeset.h, lib/include/file.h,
lib/include/fileIO.h, lib/include/hostinfo.h,
lib/include/loglevel_user.h, lib/include/productState.h,
lib/include/timeutil.h, lib/include/unicodeTypes.h,
lib/include/vixCommands.h, lib/include/vix.h,
lib/include/vm_basic_asm.h, lib/include/vm_basic_types.h,
lib/include/vm_legal.h, lib/include/vm_product.h,
lib/include/win32util.h, lib/include/x86cpuid.h, lib/misc/codeset.c,
lib/misc/codesetOld.[ch], lib/misc/posixPosix.c, lib/misc/timeutil.c,
lib/region/region.c, lib/string/bsd_vsnprintf.c, lib/unicode/*,
lib/user/hostinfoPosix.c, modules/freebsd/vmhgfs/sha1.c,
modules/*/*/vm_device_version.h, modules/linux/*/vmci_iocontrols.h,
modules/linux/*/vmci_version.h, modules/linux/vmhgfs/hgfsEscape.h:
Changes from work unrelated to open-vm-tools
on internal trunk.

* lib/ghIntegration/ghIntegrationX11.c: Fixed some bugs in menu-spec and
desktop-entry-spec support in Linux guests.

* lib/guestApp/guestApp.c, lib/include/guestApp.h,
lib/include/statelogger_backdoor_def.h, toolbox/Makefile.am,
toolbox/toolbox-cmd.c, toolbox/toolbox-gtk.c, toolbox/toolboxCmdInt.h,
toolbox/toolboxGtkInt.h, toolbox/toolboxInt.h, toolbox/toolboxRecord.c,
toolbox/toolboxcmd-record.c: Patches from Yiwen Zhang to add basic
record/replay controls to the gtk and command-line toolbox apps.

* lib/guestInfo/guestInfoPosix.c: Fixed a bug where we assumed the
primary interface's addresses were all IPv4 addresses.

* lib/guestInfo/guestInfoServer.c: Fixed a memory leak.

* lib/guestRpc/Makefile.am, lib/guestRpc/unityActive.x,
lib/include/guestCaps.h, lib/include/unityCommon.h, lib/unity/unity.c,
vmware-user/Makefile.am: Added new unityActive xdr protocol, used for
tracking whether Unity is enabled or not.

* lib/hgfsServer/hgfsServer.c, lib/hgfsServer/hgfsServerLinux.c,
lib/hgfsServerPolicyGuest/hgfsServerPolicyGuest.c,
lib/include/hgfsProto.h:
Fixed bug where we were invalidating HGFS
handles on the share of entire drive ("/"). Added optional symlink
following behavior to HGFS server. Fixed a UTF-8 validation issue.
Added volume ID field to attribute fields.

* lib/include/vm_tools_version.h: Bumped internal Tools backdoor
version.

* lib/include/vm_version.h: Bumped TOOLS_VERSION.

* lib/procMgr/progMgrPosix.c: Fixed impersonation behavior so that
uids are passed to setresuid instead of gids. Added alternate way to
list processes in situations where a process lacks a command line.

* lib/region/region.c: Reforked xorg miregion.c and apply open-vm-tools
specific patches.

* lib/unity/*, lib/unityWindowTracker/unityWindowTracker.c: Fixed an
overflow that lead to a panic when a window title exceeded 1024 bytes.
Fixed some initialization assumptions when using virtual desktops.

* lib/unity/unityPlatformX11Window.c:
Fixed an issue with restacking
windows above non-existent windows. Other minor fixes.

* modules/*/*/*: Reflected changes from elsewhere.

* modules/linux/*/Makefile.kernel: Changed clean target to remove
Module.markers and modules.order.

* modules/linux/vsock/include/compat_sock.h,
modules/linux/vsock/*: Fixed several issues in vsock.

2008-09-03 Adar Dembo <adar@vmware.com>
* Resync with internal trunk (2008.08.29)

* Makefile.am, aclocal.m4, m4/*: Moved macros to 'm4' subdir.

* compile, config.guess, config.sub, config/*, depcomp, install-sh,
ltmain.sh, missing: Moved auxiliary build tools to 'config' subdir.

* configure.ac: Moved macros and auxiliary build tools into separate
subdirectories. Added command line option to force the use of gtk1 over
gtk2. Cosmetic fixes. Reworked libicu detection. Switched over to
libtool-2.2. Added library check for new gdk symbol. Added library
check for libnotify. Reworked use of macros from AC_PATH_XTRA and
some X11
library checks.

* */foundryToolsDaemon.c, toolbox/toolbox-cmd.c, guestd/main.c,
lib/guestInfo/guestInfoPerfMonLinux.c, lib/guestInfo/guestInfoPosix.c,
lib/misc/posixPosix.c, lib/panic/panic.c, lib/system/systemLinux.c,
modules/linux/vsock/linux/util.c, xferlogs/xferlogs.c: Added checks for
return codes of certain functions and passed %s to formatted string
functions where appropriate (needed to compile on Ubuntu Intrepid).

* lib/appUtil/appUtilX11.c: Fixed command line skipping logic and added
more icon paths. Removed unnecessary chdir(2) canonicalization logic.

* lib/deployPkg/runDeployPkgPosix.c, lib/file/fileIO.c,
lib/file/fileIOPosix.c, lib/file/fileLockPrimitive.c,
lib/file/filePosix.c, lib/hgfsServer/hgfsServerLinux.c,
lib/include/bsdfmt.h, lib/include/file.h, lib/include/fileIO.h,
lib/include/iovector.h, lib/include/msgfmt.h, lib/include/str.h,
lib/include/vm_basic_defs.h, lib/include/vm_basic_types.h,
lib/misc/hostname.c, lib/misc/idLinux.c, lib/misc/posixPosix.c,
lib/SLPv2Parser/*.c,
lib/wiper/wiperPosix.c, toolbox/toolboxScripts.c:
Added FreeBSD compatibility glue.

* guestd/toolsDaemon.c, lib/file/file.c,
lib/foundryMsg/foundryPropertyListCommon.c, lib/image/imageUtilPng.c,
lib/include/appUtil.h, lib/include/backdoor_def.h, lib/include/conf.h,
lib/include/cpuid_info.h, lib/include/guest_os.h,
lib/include/hostinfo.h, lib/include/imageUtil.h,
lib/include/imageUtilTypes.h, lib/include/log.h,
lib/include/loglevel_user.h, lib/include/netutil.h,
lib/include/posix.h, lib/include/timeutil.h, lib/include/util.h,
lib/include/uuid.h, lib/include/vix.h, lib/include/vixOpenSource.h,
lib/include/vm_atomic.h, lib/include/vm_legal.h,
lib/include/vm_version.h, lib/include/x86cpuid.h,
lib/misc/codesetOld.c, lib/misc/timeutil.c, lib/string/bsd_vsnprintf.c,
lib/user/util.c, lib/user/utilPosix.c, lib/vixTools/vixTools.c,
modules/linux/*/vmci_kernel_if.h, modules/linux/vmxnet/compat_timer.h,
toolbox/toolboxCmdInt.h, toolbox/toolboxcmd-*.c:
Changes
from work unrelated to open-vm-tools on internal trunk.

* lib/ghIntegration/ghIntegration.c,
lib/guestRpc/ghiGetBinaryHandlers.x: Don't send oversized messages.
Increased maximum number of binary handlers.

* lib/ghIntegration/ghIntegrationX11.c, lib/guestApp/guestAppPosix.c,
lib/include/guestApp.h, lib/include/system.h, lib/system/systemLinux.c,
toolbox/toolbox-gtk.c: Improved "run program" functionality by
restoring program environment and stripping any VMware wrapper script
changes to LD_LIBRARY_PATH.

* lib/guestApp/guestAppPosixX11.c: Now using glib to open URLs instead
of system(3). Improved gnome and kde session detection.

* lib/guestApp/Makefile.am: This library needed GTK_CPPFLAGS too.

* lib/guestInfo/guestInfoInt.h, lib/guestInfo/guestInfoPosix.c,
lib/guestInfo/guestInfoServer.c: Added logic to optionally convert
subnet mask to an ASCII string.

* lib/guestRpc/Makefile.am: Cleaned up generated xdr headers better.

* lib/hgfsServer/hgfsServer.c, lib/hgfsServer/hgfsServerInt.h,
lib/hgfsServer/hgfsServerLinux.c:
Fixed problems when packing V3
replies.

* lib/hgfsServer/hgfsServerLinux.c: Fixed UTF-8 normal form D/C
conversions on the root directory.

* lib/include/dndGuest.h: Changed preprocessor usage to allow gtk1 to
access UnityDnD.

* lib/include/dnd.h, vmware-user/copyPaste.c: Code motion.

* lib/include/guestCaps.h: Resort the capabilities table.

* lib/include/rpcin.h, lib/rpcIn/rpcin.c, : Beginnings of the Tools
core services. This is a full-fledged refactoring of the Tools
userlevel apps to a "service" vs. "plugin" programming model.

* lib/include/vmblock.h, modules/*/vmblock/block.c,
modules/*/vmblock/stubs.c, modules/*/vmblock/stubs.h: Changes needed
to support the fuse-based implementation of vmblock (coming soon).

* lib/include/vm_tools_version.h: Some Tools version bumps.

* modules/*/*/*: Reflected changes from elsewhere.

* modules/*/*/compat/compat_stdarg.h: Added compatibility wrappers for
stdarg
features.

* modules/freebsd/vmhgfs/debug.*: Cosmetic fixes.

* modules/freebsd/vmhgfs/*: Make driver compliant with HGFSv3.

* modules/*/vmmemctl/vmballoon.c: Allow module to yield the processor
when allocating many pages.

* modules/linux/*/autoconf/cachector1.c,
modules/linux/*/include/compat_sched.h,
modules/linux/*/include/compat_semaphore.h,
modules/linux/*/include/compat_slab.h,

modules/linux/vmblock/linux/filesystem.c,
modules/linux/*/Makefile.kernel,
modules/linux/vmhgfs/bdhandler.c, modules/linux/vmhgfs/filesystem.c,
modules/linux/vmhgfs/module.h, modules/linux/vmhgfs/request.c,
modules/linux/vmsync/sync.c, modules/linux/vsock/linux/af_vsock.c: Fix
modules for 2.6.27 kernels.

* modules/linux/*/Makefile: Fixed DRIVER target.

* modules/linux/vmci/vmci_drv.c: Moved interrupt registration to be
after driver initialization.

* modules/linux/vsock/linux/af_vsock.c,
modules/linux/vsock/linux/af_vsock.c: Added optimized flow control
protocol.

* toolbox/toolboxScripts.c,
toolbox/toolboxShrink.c: Cosmetic fixes.

* vmware-user/copyPaste.c, vmware-user/dnd.c: Fixed edge case behavior
with file copy paste and DnD.

* vmware-user/modconfig.c, vmware-user/notify.c,
vmware-user/vmware-user.c, vmware-user/vmwareuserInt.h: Added stubbed
modconfig module out-of-date notification framework. Not useful for
open-vm-tools, hence the stubs.

2008-08-08 Adar Dembo <adar@vmware.com>
* Resync with internal trunk (2008.07.24)

* configure.ac, */Makefile.am: Landed support for command line Toolbox,
Unity, vsock, and vmci. Refactored and reformatted a few things.
Improved portability by using $(SED) and AC_PROG_SED instead of "sed",
$(MKDIR_P) and AC_PROG_MKDIR_P instead of "mkdir -p", $(LN_S) and
AC_PROG_LN_S instead of "ln -s". Changed icu feature detection and
linking to rely on C++ linker instead of C linker. Fixed module
compilation checks on FreeBSD. Fixed $(DESTDIR) handling (patch by Mike
Auty). Refactored lib/strUtil into lib/misc.
Changed hgfsmounter
install hook to symlink mount.vmhgfs. Renamed libghIntegrationStub to
libGhIntegrationStub. Fixed compilation of lib/guestApp when using
--without-x (reported by Martin Preishuber). Renamed libunityStub to
libUnityStub. Fix build on FreeBSD by using ":=" instead of "=" when
exporting module directories. The vmware-user desktop link now executes
vmware-user-suid-wrapper. Properly install vmware-user-suid-wrapper.

* */foundryToolsDaemon.c, lib/vixTools/vixTools.c: Use a larger result
packet when handling impersonated HGFS requests (since HGFSv3 uses

larger packets).

* guestd/main.c: Moved foreign VM check.

* guestd/toolsDaemon.*: Added plumbing for HGFS usability library
calls.

* hgfsmounter/hgfsmounter.c: Added support for passing options to
the MacOS HGFS driver.

* lib/appUtil/*, lib/include/appUtil.h: New library for Unity support.

* lib/auth/authPosix.c: Don't try using PAM from the Tools.

* lib/dnd/dndCommon.c, lib/dnd/dndLinux.c, lib/file/file.c,
lib/file/fileIOPosix.c,
lib/file/filePosix.c, lib/include/dnd.h,
lib/include/loglevel_user.h, lib/include/panic.h, lib/include/posix.h,
lib/include/strutil.h, lib/unicode/unicodeBase.h,
lib/include/unicodeOperations.h, lib/include/vix.h,
lib/include/vm_app.h, lib/include/vm_assert.h,
lib/include/vm_product.h, lib/include/x86cpuid.h, lib/misc/codeset.c,
lib/misc/hashTable.c, lib/misc/strutil.c, lib/misc/timeutil.c,
lib/panic/panic.c, lib/string/bsd_vsnprintf.c, lib/strUtil/*,
lib/unicode/unicodeCommon.c, lib/unicode/unicodeSimpleBase.c,
lib/unicode/unicodeStatic.c, lib/user/hostinfoPosix.c,
lib/user/util.c, lib/user/utilPosix.c: Changes from work unrelated to
open-vm-tools on the internal trunk.

* lib/backdoor/backdoorInt.h, lib/deployPkg/runDeployPkgInt.h,
lib/dnd/dndInt.h, lib/file/fileInt.h, lib/guestInfo/guestInfoInt.h,
lib/hgfs/cpNameInt.h, lib/hgfsServer/hgfsServerInt.h,
lib/impersonate/impersonateInt.h, lib/include/backdoorInt.h,
lib/include/bsd_output_int.h,
lib/include/cpNameInt.h,
lib/include/dndInt.h, lib/include/fileInt.h,
lib/include/guestInfoInt.h, lib/hgfsServer/hgfsServerInt.h,
lib/include/impersonateInt.h, lib/include/runDeployPkgInt.h,
lib/include/toolsLoggerInt.h, lib/include/unicodeInt.h,
lib/string/bsd_output_int.h, lib/toolsLogger/toolsLoggerInt.h,
lib/unicode/unicodeInt.h: Moved some internal header files out of
the general include directory and into the appropriate libraries.

* lib/ghIntegration/*: New library for Unity support.

* lib/guestApp/guestAppPosixX11.c: Reset the value of LD_LIBRARY_PATH
before running the web browser.

* lib/guestInfo/guestInfoPosix.c, lib/include/guest_os.h: Fixed a typo
in Mandriva guest detection. Added Asianux.

* lib/guestInfo/guestInfoServer.c: Fixed behavior for sending nicInfo
updates to the host (patch by Jason Lunz).

* lib/guestRpc/ghi*.*: New xdr protocol for Unity support.

* lib/guestRpc/nicinfo.x: Correctly applied LGPL to file.

* lib/hgfs/cpNameLinux.c:
Allow building for versions of Solaris newer
than 10.

* lib/hgfsServer/hgfsServer.c,
lib/hgfsServerPolicyGuest/hgfsServerPolicyGuest.c,
lib/include/hgfsServerPolicy.h: Provide an override setting for
disabling case conversion during file lookups.

* lib/hgfsServer/hgfsServerLinux.c: Only perform case insensitive
file lookups if a case sensitive lookup fails.

* lib/image/imageUtilPng.c, lib/include/imageUtil.h,
lib/include/imageUtilTypes.h: New library for
Unity support.

* lib/include/conf.h, toolbox/toolbox-gtk.c: Robustified the help page
discovery mechanism.

* lib/include/dndGuest.h: Allow inclusion of header into source files
without GTK2 support.

* lib/unity/*, lib/include/guestCaps.h, lib/include/unityCommon.h: New
library for Unity support.

* lib/include/hgfsUtil.h: Fixed a precedence issue in a macro.

* lib/raster/*, lib/include/rasterConv.h: New library for Unity support.

* lib/region/*, lib/include/region.h: New library for Unity support.

* lib/include/system.h:
Added new OS type for WinXP 64-bit, reformatted
enums.

* lib/unityWindowTracker/*, lib/include/unityWindowTracker.h: New
library for Unity support.

* lib/include/vm_version.h: Bumped TOOLS_VERSION.

* lib/wiper/wiperPosix.c: Replaced BSD_VERSION with __FreeBSD_version.

* modules/*/*/*: Reflected changes from elsewhere.

* modules/freebsd/vmhgfs/*: Reflected changes from MacOS HGFS work, and
fixed file permissions so that they're not all owned by root.

* modules/linux/vmblock/linux/dentry.c: Changed d_revalidate to
properly invalidate negative dentries.

* modules/linux/vmci/*: Landed the Virtual Machine Communication
Interface guest module.

* modules/linux/vmmemctl/os.c: Fixed vmmemctl to build on 2.6.26
(reported by Pavol Rusnak).

* modules/linux/vmsync/sync.c: Fixed vmsync to build on 2.6.26
(reported by Pavol Rusnak).

* modules/linux/vsock/*: Landed the VMCI sockets interface module.

* modules/linux/vmxnet/vmxnet.c, modules/linux/vmxnet/vmxnet2_def.h,
modules/linux/vmxnet/vmxnetInt.h:
Increased rx ring size for enhanced
vmxnet2.

* toolbox/*: Refactored pieces of GTK Toolbox and landed the command
line Toolbox. Fixed mnemonic collisions in the GTK Toolbox.

* vmware-user/copyPaste.c: Fixed several bugs with file copy paste
behavior.

* vmware-user/notify.c, vmware-user/vmware-user.c,
vmware-user/vmwareuserInt.h: Added stubs for notification framework.

* vmware-user/pointer.c: Reverted fix for bug with clipboard retry
behavior.

* vmware-user/vmware-user.c: Fixed build with gtk 1.2 (reported by
Stephen Duncan). Added signal handlers for SIGUSR1/SIGUSR2 used by
VMware Tools installer to reload vmware-user cleanly during a Tools
upgrader. Reload vmware-user on a fatal X I/O error. Don't panic if
run outside of a VM. Don't leave Unity mode on a Tools reset.

2008-07-01 Adar Dembo <adar@vmware.com>
* Resync with internal trunk (2008.06.30)

* configure.ac, lib/guestApp/*, toolbox/Makefile.am,
vmware-user/Makefile.am:
Split lib/guestApp into two libraries, one
with X11 functionality, and one without. Improved detection of
gnome-open.

* guestd/*, lib/netUtil/netUtilLinux.c: guestd now compiles for MacOS
guests.

* guestd/main.c, lib/include/system.h, lib/system/systemLinux.c:
Refactored GuestdWritePidfile into System_Daemon.

* guestd/toolsDaemon.c: Fixed a backwards time synchronization issue.
Thanks to Eric Castan for reporting the bug.

* lib/conf/conf.c, lib/include/conf.h: Removed obsolete configuration
keys and values.

* lib/file/*, lib/dict/*, lib/foundryMsg/*, lib/include/backdoor_def.h,
lib/include/codeset.h, lib/include/config.h,
lib/include/file_extensions.h, lib/include/fileInt.h,
lib/include/loglevel_user.h, lib/include/msg.h, lib/include/msgid.h,
lib/include/posix.h, lib/include/preference.h, lib/include/unity.h,
lib/include/vixCommands.h, lib/include/vix.h,
lib/include/vmbackup_def.h, lib/include/vmBackup.h,
lib/include/vm_basic_defs.h, lib/include/vm_basic_types.h,
lib/include/vm_product.h,
lib/include/win32util.h,
lib/include/x86cpuid.h, lib/misc/codeset.c, lib/misc/codesetOld.c,
lib/misc/codesetOld.h, lib/misc/posixPosix.c, lib/strUtil/strutil.c,
lib/user/hostinfoPosix.c, lib/user/util.c,
lib/vmBackupLib/stateMachine.c, modules/*/vmxnet/net.h: Changes from
work unrelated to open-vm-tools on the internal trunk.

* lib/guestRpc/Makefile.am: Added comment about misuse of CFLAGS.

* lib/hgfsServer/hgfsServer.c: Corrected pointer arithmetic so that
new node and search allocation works consistently in 64-bit apps.

* lib/hgfsServer/hgfsServerLinux.c, lib/include/hgfsProto.h: Added
HGFS_ATTR_HIDDEN_FORCED and set it when returning hidden files.

* lib/hgfsServer/*, lib/hgfsServerPolicy/hgfsServerPolicyGuest.c,
lib/include/hgfsServerInt.h, lib/include/hgfsServerPolicy.h:
Refactored and cleaned up some code.

* lib/include/resolution.h, lib/resolution/*,

vmware-user/vmware-user.c: Refactored some functions.

* lib/include/vm_legal.h:
Added another patent to the patent string.

* lib/include/vm_tools_version.h: Added a pair of Tools version macros.

* lib/include/vm_version.h: Bumped Tools product version.

* lib/Makefile.am: Included a fix for compilation --without-x. Thanks to
Mark Foster for reporting the issue.

* lib/misc/Makefile.am, lib/misc/shared/Makefile.am: Realphabetized
some sources and added missing source files.

* lib/misc/posixWin32.c: Removed unneeded file from tree.

* lib/procMgr/procMgrPosix.c: Made safe for -fPIC and for MacOS.

* modules/*/*/*: Reflected changes from elsewhere.

* modules/freebsd/vmhgfs/*: Added some code to handle codeset
conversions between UTF-8 precomposed and decomposed strings.

* modules/linux/vmhgfs/*: Refactored string escaping/unescaping code.

* toolbox/*: Added mnemonics for some buttons.

* vmware-user/pointer.c: Fixed bug in clipboard retry behavior.

* vmware-user/vmware-user.c: Added handlers for SIGUSR1 and SIGUSR2
to facilitate
smooth vmware-user upgrades with respect to the vmblock
kernel module.

2008-06-20 Elliot Lee <elliot@vmware.com>

* Resync with internal trunk (2008.06.13)

* FreeBSD 7/8 fixes from Martin Blapp.

* Fix getpwnam_r etc. on FreeBSD & Solaris.

* configure.ac: Add --without-kernel-modules,
--with-linux-release, and --with-linuxdir (gissa).

* configure.ac, lib/guestRpc/*, lib/guestInfo/guestInfo.c,
lib/guestInfo/guestInfoServer.c, lib/dynxdr/*,

{vmware-user,guestd}/foreignVMToolsNetworking.c, guestd/Makefile.am,
{vmware-user,guestd}/foundryToolsDaemon.c, lib/include/dynxdr.h,
lib/include/guestInfo.h, lib/include/vmxrpc.h,
lib/include/xdrutil.h, lib/Makefile.am, lib/netUtil/*,
lib/vixTools/Makefile.am: Add support for XDR encoding of RPC
values, including the NicInfoV2 structure.

* guestd/stub.c, hgfsclient/Makefile.am, hgfsclient/stub.c,
hgfsclient/stub-user-util.c, hgfsmounter/Makefile.am,
hgfsmounter/stub.c, lib/stubs/*, libguestlib/Makefile.am,
libguestlib/stubs.c,
toolbox/Makefile.am, toolbox/stub.c,
vmware-user/stub.c: Centralize stubs.

* lib/guestInfo/guestInfoPerfMonLinux.c: Convert ioInRate and
ioOutRate to be in terms of KB instead of pages.

* lib/hgfsBd/hgfsBd.c, lib/hgfsServer/hgfsServer.c,
lib/hgfsServer/hgfsServerLinux.c: Large packet support, and
additional case-insensitivity fixes.

* lib/include/hgfsBd.h, lib/include/hgfs.h,
lib/include/hgfsProto.h: Add HGFS error code.

* lib/hgfs/hgfsUtil.c, lib/guestInfo/Makefile.am,
lib/guestInfo/guestInfoPosix.c, lib/guestApp/guestApp.c,
lib/foundryMsg/foundryMsg.c, lib/file/fileLockPrimitive.c,
lib/file/fileIOPosix.c, lib/file/fileLockPosix.c,
guestd/toolsDaemon.c, guestd/debugStdio.c, guestd/main.c,
lib/hgfsServerManagerGuest/hgfsServerManagerGuest.c,
lib/include/codeset.h, lib/include/cpuid_info.h,
lib/include/dnd.h, lib/include/file_extensions.h,
lib/include/fileInt.h, lib/include/ghIntegration.h,
lib/include/guestApp.h, lib/include/guestStats.h,
lib/include/hgfsServerInt.h,
lib/include/hgfsUtil.h,
lib/include/hostinfo.h, lib/include/loglevel_user.h,
lib/include/netutil.h, lib/include/panic.h, lib/include/posix.h,
lib/include/unicode*.h, lib/include/util.h, lib/include/vix.h,
lib/include/vixTools.h, lib/include/vm_app.h,
lib/include/vm_basic_defs.h, lib/include/vm_product.h,
lib/include/vm_tools_version.h, lib/include/vm_version.h,
lib/include/x86cpuid.h, lib/misc/codeset.c, lib/misc/codesetOld.c,
lib/misc/codesetOld.h, lib/misc/hashTable.c, lib/misc/hostname.c,
lib/misc/timeutil.c, lib/panic/panic.c, lib/string/str.c,
lib/sync/syncMutex.c, lib/system/systemLinux.c, lib/unicode/*.c,
lib/unityStub/*, lib/user/hostinfo.c, lib/user/hostinfoPosix.c,
lib/vixTools/*, modules/linux/vmxnet/*, toolbox/debugStdio.c,

vmware-user/debugStdio.c, vmware-user/dnd.c, vmware-user/main.c:
Bug fixes.

* modules/linux/vmxnet/*: Remove unused BPF code. Add ethtool
callbacks to get & set driver settings.

* lib/user/util.c: Add function for getting backtraces.

*
lib/resolution/*, vmware-user/*, lib/Makefile.am, configure.ac:
Move resolution-changing code into separate library.

* guestd/main.c, lib/include/tools.h: Allow disabling tools
version reporting to the host, via config file.

* lib/rpcIn/*, lib/include/rpcin.h, guestd/toolsDaemon.c,
toolbox/toolbox-gtk.c: Updated RPC API

* lib/include/dndGuest.h: Helper API for DnD code

* modules/freebsd/vmhgfs/*, modules/freebsd/vmmemctl/*,
modules/freebsd/vmblock/*, modules/linux/vmhgfs/*,
modules/linux/vmmemctl/*: Reflect changes from main source tree.

* vmware-user/copyPaste.c: Copy/paste cleanup.

* vmware-user/vmware-user.c: Updated locking code to use X11
display instead of lockfiles.

2008-06-03 Adar Dembo <adar@vmware.com>
* Resync with internal trunk (2008.05.28).

* configure.ac, Makefile.am, */Makefile.am: Added rudimentary
`make install` support. Fixes Sourceforge bug 1839981.

* configure.ac, Makefile.am, vmware-user-suid-wrapper/*: Added
vmware-user-suid-wrapper
to help autostart vmware-user. Added some
informational tags to AC_DEFINE macros.

* */debugStdio.c: Fixed a format string vulnerability
in Debug. Allocate fd on the stack in DebugToFile.

* lib/auth/authPosix.c, lib/dnd/dndCommon.c, lib/dnd/dndLinux.c
lib/impersonate/impersonate.c: Add inclusion of vmware.h and refactor
some include statements.

* lib/file/file.c, lib/include/file.h: Added File_UnlinkNoFollow

function.

* lib/file/fileIO.c, lib/file/fileLockPrimitive.c,
lib/include/fileIO.h: Added error case for ENAMETOOLONG to FileIO_Lock.
Constified 'buf' in FileIO_Pwrite.

* lib/file/fileIOPosix.c: Removed coalescing and decoalescing code.
Consolidated some Unicode calls.

* lib/file/filePosix.c: Reworked some error handling logic.

* lib/foundryMsg/foundryMsg.c: Refactored buffer encoding and decoding
logic into a single pair of functions.

* lib/foundryMsg/foundryThreads.c, lib/include/foundryThreads.h
lib/include/util.h, lib/misc/util_misc.c: Changed
generic thread type
from uintptr_t to Util_ThreadID.

* lib/hgfsServer/*, lib/hgfs/hgfsProto.h, modules/linux/vmhgfs/*:
Additional HGFSv3 fixes and refactoring.

* lib/include/dbllnklst.h, lib/misc/dbllnklst.c: Constified argument to
DblLnkLst_IsLinked.

* lib/include/dnd.h: Added support for DnD of RTF.

* lib/include/fileInt.h: Removed prototype of FileLockFileSize.

* lib/include/hashTable.h, lib/misc/hashTable.c: Cosmetic changes.
Added HashTable_ReplaceIfEqual.

* lib/include/loglevel_user.h: Added hpet loglevel.

* lib/include/msg.h: Removed prototype of MsgSetPostStderrBlock.

* lib/include/posix.h: Removed certain includeCheck allowances.

* lib/include/productState.h: Added VDM client product.

* lib/include/unicode*, lib/unicode/*: Ongoing i18n work.

* lib/include/vixCommands.h: Added command to set snapshot information.

* lib/include/vix.h: Added more errors and a new flag.

* lib/include/vixOpenSource.h: Reworked asserts and added VIX_ASSERT.

* lib/include/vm_app.h:
Added Tools tray app.

* lib/include/vm_product.h: Reworked VMRC product definitions and added
VDM client product definitions.

* lib/include/vm_tools_version.h: Added WS65 Tools version.

* lib/include/vm_version.h: Bumped Tools version. Added logic for VMRC
product.

* lib/include/x86cpuid.h: Modified a flag and trimmed an unneeded macro.

* lib/misc/codesetOld.c: Implement UTF-16 codest conversion to UTF-8
for CURRENT_IS_UTF8.

* lib/misc/dynbuf.c: Modified dynbuf growing behavior.

* lib/misc/posixDlopen.c, lib/misc/posixInt.h, lib/misc/posixPosix.h:
Refactored codeset conversion code into PosixConvertToCurrent.

* lib/misc/posixWin32.c: Added some path checks.

* lib/misc/timeutil.c: Win32-wrappified TimeUtil_GetTimeFormat.

* lib/misc/vmstdio.c: Reduce virtual memory usage and add '\r' as a line
ending in StdIO_ReadNextLine.

* lib/rpcout/rpcout.c: Added comments.

* lib/str/str.c: Cosmetic changes.

* lib/vixTools/vixTools.c: Added unlink(2) logic
to avoid deleting
symlink targets. Cosmetic changes.

* modules/*/*/*: Reflect changes from elsewhere in the source tree.

* modules/linux/vmhgfs/super.c: Fix vmhgfs to properly report the
available space on the host (Sourceforge bug 1924246).

* vmware-user/vmware-user.c: Add advisory locking code to help maintain
only one vmware-user instance per X session.

* xferlogs/xferlogs.c: Fix a formatted string vulnerability.

2008-05-12 Elliot Lee <elliot@vmware.com>

* Resync with internal trunk (2008.05.08).

* configure.ac, **/Makefile.am: Use CPPFLAGS instead of
CFLAGS to eliminate warning about proc/sysinfo.h.

* guestd/foreignVMToolsNetworking.c,
vmware-user/foreignVMToolsNetworking.c
lib/hgfsServer/hgfsServerLinux.c, lib/include/hgfsServerInt.h,
modules/linux/vmhgfs/bdhandler.c, modules/linux/vmhgfs/dir.c,
modules/linux/vmhgfs/file.c, modules/linux/vmhgfs/filesystem.h,
modules/linux/vmhgfs/fsutil.h, modules/linux/vmhgfs/inode.c,
modules/linux/vmhgfs/link.c, modules/linux/vmhgfs/module.h,
modules/linux/vmhgfs/page.c,
modules/linux/vmhgfs/request.c,
modules/linux/vmhgfs/request.h: Whitespace cleanups.

* guestd/main.c: Removed "blessed app" code for starting
vmware-user. Hooray!

* lib/deployPkg/deployPkg.c: Remove unneeded Utf8 conversion for
Windows.

* lib/file/filePosix.c: Use new Posix_RealPath implementation.

* lib/guestApp/guestApp.c, lib/include/guestApp.h: Remove/cleanup
UTF-8 related RPC functions.

* lib/guestInfo/guestInfoPerfMonLinux.c,
lib/guestInfo/guestInfoPosix.c, lib/include/guestInfo.h,
lib/include/guestInfoInt.h, lib/include/guestStats.h: Rename
structures to GuestMemInfo, GuestNicInfo, and GuestDiskInfo.

* lib/guestInfo/guestInfoServer.c, lib/include/guest_msg_def.h: As
above, and also GUESTMSG_MAX_IN_SIZE moved to guest_msg_def.h, and
misc locking updates. Also add GuestInfoServer_Main(), and cleanup
whitespace.

* lib/hgfsServer/hgfsServer.c: Cleanup UTF-8 handling.

* lib/include/codeset.h: Update defines
that indicate whether the
current platform is using UTF-8.

* lib/include/dnd.h: Add prototypes for a couple of string
conversion functions.

* lib/include/file_extensions.h: Add OVF and Archived OVF file extensions.

* lib/include/file.h: C++ guard thingies. Update a couple of
function prototypes to work on file descriptors instead of
filenames.

* lib/include/hashTable.h, lib/include/guest_os.h,
lib/include/loglevel_defs.h, lib/include/stats_user_defs.h,
lib/include/stats_user_setup.h, lib/include/str.h,
lib/include/unicodeTypes.h, lib/include/util.h: Allow inclusion in
kernel modules...

* lib/include/loglevel_user.h: As above, and add a couple of
loglevel variables.

* lib/include/util.h, lib/misc/util_misc.c: Allow inclusion in
kernel modules as above, and add some utility functions on Windows
for manipulating canonical paths.

* lib/include/hgfsProto.h, lib/include/hgfsUtil.h: Move
request/reply payload macros to hgfsProto.h.

* lib/include/hgfsServerPolicy.h:
Add ShareList management
prototypes and structure members.

* lib/include/msg.h: Add function prototypes for creating and
posting lists of messages.

* lib/include/system.h: Add types & functions related to desktop
switch monitoring on Windows.

* lib/include/unicodeOperations.h: Add/update inline unicode operations.

* lib/include/vixCommands.h: Add VIX requests and events.

* lib/include/vmbackup_def.h, lib/vmBackupLib/stateMachine.c: Move
backup status enum to public header.

* lib/include/vm_basic_asm_x86_64.h: Div643232 now also works on MSC.

* lib/include/vm_basic_defs.h: Add debug output macros for Windows drivers.

* lib/include/vm_basic_types.h: Update the FMTPD macro, add
SCANF_DECL macro for arg checking on scanf-like functions.

* lib/include/x86cpuid.h: Defines for AMD L2/L3 cache separately, and CPUID for Nehalem.

* lib/misc/codesetOld.c: Bug fixes and general unicode handling updates.

* lib/system/systemLinux.c: Use Posix_Getenv/Posix_Setenv impls.

*
lib/vixTools/vixTools.c, lib/vmBackupLib/scriptOps.c: Bug fixes.

* modules/freebsd/*, modules/linux/*: Updates to correspond to
updates of files in main tree.

* modules/freebsd/vmhgfs/hgfs_kernel.h: Bug fixes.

* modules/freebsd/vmxnet/vm_device_version: Add
SCSI_IDE_HOSTED_CHANNEL define, update SCSI_MAX_CHANNELS.

* modules/freebsd/vmxnet/vmnet.def: Add capabilities for IPv6
checksumming and TSO, and large packet TSO.

* lib/include/vmblock.h, modules/linux/vmblock/linux/control.c,
modules/linux/vmblock/linux/vmblockInt.h: Use a macro to better
abstract the vmblock mount point & device.

* vmware-user/vmware-user.c: Add SIGPIPE to the list of signals
that vmware-user handles.

2008-05-02 Adar Dembo <adar@vmware.com>

* Resync with internal trunk (2008.04.19).

* configure.ac, guestd/Makefile.am, hgfsclient/Makefile.am,
lib/misc/*/Makefile.am, lib/string/*/Makefile.am, toolbox/Makefile.am,
vmware-user/Makefile.am, xferlogs/Makefile.am: Added libicu support
for
codeset conversions. This includes some makefile logic as well as
autoconf arguments for controlling libicu behavior at compile-time.

* */foreignVMToolsNetworking.c, lib/vixTools/vixTools.c: Unicode fixes.

* */foundryToolsDaemon.c, lib/foundryMsg/vixTranslateErrOpenSource.c,
lib/panic/panic.c, lib/printer/printer.c: Added calls to Win32 Unicode
wrappers.

* guestd/main.c: Cleaned up guestInfo server when guestd shuts down.

* guestd/toolsDaemon.c, vmware-user/resolution.c: Disabled multi-mon
advertisement for Win2k.

* lib/auth/authPosix.c, lib/dnd/dndLinux.c, lib/file/*,
lib/impersonate/impersonatePosix.c, lib/include/mntinfo.h,
lib/sync/syncWaitQPosix.c, lib/user/hostinfoPosix.c, lib/user/util.c,

lib/user/utilPosix.c, lib/wiper/wiperPosix.c: Added calls to POSIX Unicode wrappers.

* lib/file/*: Replaced calls to string functions with calls to the "safe" family of string functions.

* lib/dict/dictll.c, lib/include/dictll.h: Detect and tolerate UTF-8 dictionary
files that contain the UTF-8 BOM.

* lib/err/*, lib/include/err.h, lib/include/msgfmt.h, lib/include/msg.h: Added support for localization of error strings.

* lib/foundryMsg/foundryThreads.c, lib/include/foundryThreads.h, lib/misc/util_misc.c: Added opaque type for threads/process IDs.

* lib/guestInfo/guestInfoServer.c: Removed separate thread context.

* lib/hgfsServer/*, lib/include/hgfs*.h: Additional HGFSv3 cleanup.

* lib/hgfsServer/hgfsServerLinux.c: Added calls to POSIX Unicode wrappers. Fixed some alias detection code for MacOS.

* lib/include/backdoor_def.h: Added backdoor call for debugging events.

* lib/include/bsdfmt.h, lib/string/bsd_vsnprintf.c, lib/string/bsd_vsnprintfw.c: Replaced BSDFmt_WCSonv with BSDFmt_WChartoUTF8.

* lib/include/codeset.h, lib/include/codesetOld.h, lib/misc/codeset.c, lib/misc/codesetOld.c, lib/string/convertutf.h: Implemented libicu-backed codeset layer. When building without libicu, fallback on codesetOld.

* lib/include/guestApp.h:
Added wide versions of dictionary functions.

* lib/include/loglevel_user.h: Added two new loglevels.

* lib/include/posix.h, lib/misc/posixPosix.c: Added new POSIX wrappers.

* lib/include/str.h: Clarified the use of some functions.

* lib/include/syncMutex.h, lib/include/syncWaitQ.h: Removed unneeded macros.

* lib/include/unicode*.h, lib/unicode/*: Ongoing Unicode work.

* lib/include/util.h: Added Util_FreeStringList, removed Util_FreeList.

* lib/include/uuid.h: Added new UUID creation scheme.

* lib/include/vix*.h: Tweaked some VIX commands, errors, and properties.

* lib/include/vmBackup.h, lib/vmBackupLib/scriptOps.c,
lib/vmBackupLib/stateMachine.c: Moved disabled targets logic from
library to Windows VSS provider.

* lib/include/vm_basic_asm_x86*.h: Allow emitted FX functions to
modify main memory as a side effect.

* lib/include/vm_tools_version.h: Bump Tools version.

* lib/include/vm_version.h: Added several product versions.

* modules/linux/vmhgfs/*:
Additional cleanup for HGFSv3. Use new kthread
wrapper when possible. Bump module version.

* modules/linux/vmmemctl/*: Use new kthread wrapper when possible.
Remove dead delayed work code. Bump module version.

* modules/linux/*/compat_kthread.c: Added kthread wrapper implementation
for modules that use kernel threads.

* modules/*/*/*: Reflect header file changes from elsewhere in the
source code tree.

* vmware-user/copyPaste.c, vmware-user/pointer.c,
vmware-user/vmwareuserInt.h: Stop wastefully polling for pointer
updates if the VMX is new enough.

* xferlogs/xferlogs.c: Fixed a warning in the call to fwrite.
(Thanks to Denis Leroy for reporting this bug.)

2008-04-14 Elliot Lee <elliot@vmware.com>

* Resync with internal trunk (2008.04.01).

* Fixed legal header on all LGPL-licensed files.

* vmware-user/resolution.c: Normalize the display topology that
comes in from the host, and report 'global_offset' capability.

* toolbox/Makefile.am, vmware-user/Makefile.am,

lib/misc/Makefile.am,
lib/misc/atomic.c, lib/Makefile.am,
lib/atomic/*, hgfsclient/Makefile.am: Move libAtomic stuff into libmisc

* vmware-user/foundryToolsDaemon.c, lib/vixTools/vixTools.c,
lib/include/hgfsServerInt.h, guestd/toolsDaemon.c,
guestd/foundryToolsDaemon.c: Remove WIN9XCOMPAT, and some
SOCKET_MGR code.

* vmware-user/copyPaste.c: Copy/paste fixes for cross-platform
operation.

* modules/linux/vmxnet/vmnet_def.h: Add SG_SPAN_PAGES capability.

* modules/linux/vmxnet/vm_device_version.h: Update some device limits.

* modules/linux/*/compat_sched.h: Add TASK_COMM_LEN define.

* modules/linux/*/compat_kernel.h,
modules/linux/*/kernelStubsLinux.c: Add vsnprintf define.

* modules/linux/*/x86cpuid.h: Add new CPUs.

* modules/linux/vmhgfs/vmhgfs_version.h: Bump HGFS version.

* modules/linux/*/vm_basic_asm_x86.h,
modules/linux/*/vm_basic_asm_x86_64.h,
lib/include/vm_basic_asm_x86.h, lib/include/vm_basic_asm_x86_64.h:
Formatting fixes, and change asm
directives used.

* modules/linux/vmhgfs/module.h,
modules/linux/vmhgfs/filesystem.c,
modules/linux/vmhgfs/bdhandler.c,
modules/linux/*/compat_kthread.h: compat_kthread fixes.

* modules/freebsd/vmxnet/net_compat.h,
modules/freebsd/vmxnet/if_vxn.c: Updates for FreeBSD 7.0.
(Thanks to Martin Blapp for contributing to these changes.)

* lib/misc/util_misc.c, lib/include/loglevel_user.h,
lib/user/hostinfoPosix.c, lib/misc/hostname.c: Bugfix.

* lib/unityStub/unityStub.c, lib/include/unity.h: Add stub and enums
related to DnD support.

* lib/unicode/unicodeSimpleTypes.c,
lib/unicode/unicodeSimpleTransforms.c,

lib/unicode/unicodeSimpleBase.c, lib/unicode/unicodeCommon.c,
lib/include/unicodeTypes.h,
lib/include/unicodeTransforms.h,
lib/include/unicodeBase.h, lib/include/unicodeCommon.h: Add
additional Unicode-related functions.

* lib/sync/syncMutex.c, lib/include/syncMutex.h: Add TryLock method.

* lib/strUtil/strutil.c: Add int64-related functions.

* lib/string/str.c:
Compile fix

* lib/string/bsd_output_shared.c: Better handling of floating
point on Windows.

* lib/include/progMgr.h, lib/procMgr/procMgrPosix.c: Clarify that
the strings are in UTF-8, do conversion as needed.

* lib/include/posix.h, lib/misc/posixPosix.c,
lib/misc/posixWin32.c, lib/file/filePosix.c: Add new Posix_
function implementations, and unicodify existing ones.

* lib/misc/hashTable.c, lib/include/hashTable.h: Add lock-less hash
table functions.

* lib/misc/util_misc.c, lib/include/w32util.h: Add a couple of
Win32 utility functions.

* lib/include/vm_version.h: Add WS5 config version.

* lib/include/vm_atomic.h: Add typecasts to atomic operations to
make compilers stop complaining, and expand the AtomicUseFence option.

* lib/include/vm_app.h: Add a couple of HGFS-related options.

* lib/include/vix.h: Update a few errors and other macros.

* lib/include/vixCommands.h, lib/foundry/foundryMsg.c: Change a
bunch of structure members from int32 to uint32, and add
a parsing
function.

* lib/include/msgfmt.h, lib/include/msg.h: Additional
message-handling prototypes.

* lib/include/guestInfoInt.h, lib/include/guestInfo.h,
lib/guestInfo/Makefile.am, lib/guestInfo/guestInfoServer.c,

lib/guestInfo/guestInfoPosix.c,
lib/guestInfo/guestInfoPerfMonLinux.c: Add IPv6 support, and the
ability to read mem stats on Linux.

* lib/include/fileIO.h, lib/file/fileIOPosix.c: Add MacOS function
related to Time Machine.

* lib/guestApp/guestApp.c: Use Posix_ variants of functions.

* lib/ghIntegrationStub/ghIntegrationStub.c: Add GHI capabilities
stubs.

* lib/dnd/dndCommon.c, lib/file/file.c: Use new Unicode_Format()
function, bugfix.

* guestd/main.c: Fix a security bug.

* configure.ac: Allow calling libdnet 'dumbnet' for Debian
systems. Detect libprocps.

2008-03-19 Adar Dembo <adar@vmware.com>

* Resync with internal trunk (2008.03.13).

* vm_version.h: Updated Tools version.

* configure.ac: Added dynamic dnet detection and --without-dnet
flag.

* guestd/debugStdio.c, lib/include/system.h, lib/system/systemLinux.c:
Modified debugging to file behavior to prepend debug strings with human
readable timestamps.

* guestd/main.c, guestd/toolsDaemon.c, lib/conf/conf.c,
lib/guestApp/guestApp.c, lib/include/guestApp.h: Internationalized
GuestApp_GetInstallPath and GuestApp_GetconfPath.

* lib/auth/authPosix.c, lib/dnd/dndLinux.c, lib/file/*,
lib/impersonate/impersonatePosix.c, lib/include/fileInt.h,
lib/include/posix.h, lib/misc/posix*.c: Refactored, extended, and made
use of the set of POSIX internationalization-safe function wrappers.

* lib/dnd/dndCommon.c, lib/include/dnd.h, lib/include/dndInt.h,
vmware-user/copyPaste.c, vmware-user/dnd.c: Replaced some duplicated
UTF-8 formatting code with calls to lib/unicode.

* lib/guestInfo/guestInfoPosix.c: Replaced the old syscall-based
implementation of nicinfo with a simpler implementation that uses dnet.

* lib/guestInfo/guestInfoServer.c, lib/include/guestInfo.h,
lib/include/guestInfoInt.h:
Added Win32 implementation of
meminfo. POSIX implementation to follow.

* lib/hgfsServer/hgfsServerLinux.c: Replaced a direct readlink(3) call
with a call to the POSIX wrapper for readlink(3). Relax an overeager
ASSERT in symlink checking when using the special empty share.

* lib/include/codeset.h, lib/string/bsd_vsnprintf.c, lib/string/str.c,
lib/unicode/unicodeSimpleOperations.c, lib/unicode/unicodeSimpleUTF16.h:
Refactored ICU routines from unicodeSimpleUtf16.h to codeset.h, which
is now licensed under the ICU license (BSD variant).

* lib/include/file.h, lib/file/file.c: Added function File_StripSlashes.

* lib/include/hgfsProto.h: Removed an A acute from a comment to allow
the file to be built on Windows systems where the default language isn't
English.

* lib/include/hostinfo.h, lib/include/util.h, lib/user/hostinfoPosix.c,
lib/user/util.c, lib/user/utilPosix.c: More conversions to
lib/unicode. Added Util_ZeroFreeStringW function
for Windows in util.h.

* lib/include/msg.h: Removed obsolete NO_MSGFMT macro.

* lib/include/unicodeBase.h, lib/unicode/unicodeCommon.c,
lib/unicode/unicodeSimpleBase.c: Added some more encoding functions.

* lib/include/vixCommands.h, lib/include/vixOpenSource.h: Added another
user credential type, some command flags, some command layouts, some
error codes, some properties, and tweaked existing commands.

* lib/include/vixTools.h: Added VixToolsUserIsMemberOfAdministratorGroup
function.

* lib/include/vm_assert.h, lib/include/vm_basic_defs.h: Move IMPLIES to
vm_basic_defs.h. Removed some vprobes definitions.

* lib/include/vmBackup.h, lib/vmBackupLib/scriptOps.c,
lib/vmBackupLib/stateMachine.c: Added infrastructure to disable
quiescing targets from a config file.

* lib/include/vm_basic_asm.h: Changed __GET_CPUID2 handling for Windows.

* lib/include/vm_produt.h: Added VDM product.

* lib/include/vm_tools_version.h: Bumped internal Tools version.

* lib/include/win32util.h,
lib/misc/hostname.c, lib/misc/util_misc:
Refactored functions to separate set of Win32 wrappers (next to the
POSIX wrappers mentioned earlier).

* lib/misc/codeset.c: Made CodeSetGetCurrentCodeSet non-static.

* lib/misc/*/Makefile.am: Added POSIX wrappers to build system.

* lib/strUtil/strutil.c: Fixed bug in StrUtil_EndsWith function.

* lib/include/unicodeTypes.h, lib/unicode/unicodeSimpleTypes.c: Removed
ISO-8859-11 encoding. Added cross-reference of IANA character set
names, windows code pages, and ICU encodings.

* lib/vixTools/vixTools.c: Impersonation tweaks.

* modules/*/*/*: Reflect header file changes from elsewhere in the
source code tree.

2008-03-11 Adar Dembo <adar@vmware.com>

* vm_version.h: Updated Tools version.

* modules/vmblock/linux/*: Make vmblock build under 2.6.25-rc2.
The dentry and mount objects have been moved out of struct
nameidata and into the new struct path. Also, path_release() is
now path_put().

* modules/vmsync/linux/*:
Make vmsync build under 2.6.25-rc2.
The same changes were needed here as in vmblock above.

2008-03-10 Adar Dembo <adar@vmware.com>

* vm_version.h: Updated Tools version.

* modules/vmhgfs/linux/*: Make vmhgfs build under 2.6.25-rc1.
The iget() function has been removed and filesystems are now
expected to implement it themselves using iget_locked().

2008-02-27 Elliot Lee <elliot@vmware.com>

* configure.ac, guestd/Makefile.am, toolbox/Makefile.am,
vmware-user/Makefile.am: Allow passing custom LDFLAGS in to

build process (patch by Mike Auty).

* Resync with internal trunk (2008.02.27).

* guestd/foundryToolsDaemon.c, lib/vixTools/vixTools.c,
vmware-user/foundryToolsDaemon.c: Win9x compat changes.

* guestd/toolsDaemon.c: Style fixes.

* hgfsmounter/hgfsmounter.c: Bug fixes.

* lib/dnd/dndLinux.c, lib/dnd/dndCommon.c: Move some code to the
platform-independant file, some DnDv3 support.

* lib/include/dnd.h, lib/include/dndInt.h: DnDv3 support.

* lib/file/file.c, lib/file/fileIO.c,
lib/file/fileIOPosix.c,
lib/file/fileLockPrimitive.c, lib/file/filePosix.c,
lib/include/file_extensions.h, lib/include/fileInt.h,
lib/include/fileIO.h: Move functions around, Unicode fixes, misc
fixes.

* lib/foundryMsg/foundryPropertyListCommon.c: Error handling fixes.

* lib/hgfsServer/*.c, lib/include/hgfs*.h,
modules/freebsd/vmhgfs/*, modules/linux/vmhgfs/*: HGFS v3 support,
updates to improve code re-use between the FreeBSD and MacOS X
ports, and updates to make the Linux port build on 2.6.25-rc1 (but
not rc2, yet).

* lib/include/auth.h, lib/include/codeset.h,
lib/include/hostinfo.h, lib/include/str.h, lib/include/unicode*.h,
lib/include/vm_basic_types.h, lib/misc/hostname.c,
lib/unicode/*.c, lib/user/hostinfoPosix.c: Unicode fixes.

* lib/include/backdoor_def.h: Add a new command for use by the
BIOS in checking the GuestOS against Darwin.

* lib/include/dynarray.h, lib/misc/dynarray.c,
lib/misc/Makefile.am, lib/misc/shared/Makefile.am: Add Dynarray
implementation.

*
lib/include/bsdfmt.h, lib/include/bsd_output_int.h,
lib/string/bsd_output_shared.c, lib/string/bs_vsnprintf.c,
lib/string/bsd_vsnwprintf.c, lib/string/str.c: Rework built-in
printf implementation, esp. for Unicode fixes.

* lib/include/ghIntegration.h: Shuffle types around.

* lib/include/loglevel_user.h, lib/include/unity.h,
lib/syncDriver/syncDriverPosix.c, lib/user/util.c,
toolbox/toolbox-gtk.c: Misc fixes.

* lib/include/vmBackup.h, lib/vmBackupLib/scriptOps.c,
lib/vmBackupLib/stateMachine.c, lib/vmBackupLib/vmBackupInt.h:
Rework scripts for freeze & thaw operations.

* lib/include/vm_product.h, lib/include/vm_version.h: Add new
product defs (VMRC).

* lib/include/vm_tools_version.h: Add ESX 3.5U1 product.

* lib/include/vixCommands.h, lib/include/vix.h: Add new VIX
commands and error code.

* lib/include/win32util.h: Add misc Win32 utilities.

* modules/*/*/*: Reflect header file changes from elsewhere in the
source code tree.

2008-02-13
 Adar Dembo <adar@vmware.com>

* Resync with internal trunk (2008.02.12).

* configure.ac, lib/unityStub/*, lib/ghIntegrationStub/*,
lib/Makefile.am, vmware-user/Makefile.am, vmware-user/vmware-user.c:
Added lib/unityStub and lib/ghIntegrationStub. Unity and guest-host
integration features for X11 guests are on the way.

* configure.ac, guestd/Makefile.am, lib/fileUtf8/*,
lib/vixTools/vixTools.c, vmare-user/Makefile.am: lib/file is now fully
internationalized. Removed unneeded lib/fileUtf8.

* foundryToolsDaemon.c: Fixed a leak of the sync driver handle.

* guestd/toolsDaemon.c: Send guestd's "config directory" to the VMX for
publishing.

* hgfsmounter/hgfsmounter.c: Port to MacOS.

* lib/dnd/*, lib/err/err.c, lib/file/*, lib/include/dnd*,
lib/include/file*, lib/include/unicode*, lib/include/util.h,
lib/unicode/*, lib/user/utilPosix.c: More Unicodification.

* lib/file/file.c, lib/include/file.h: Added File_EnsureDirectory.

* lib/foundryMsg/foundryMsg.c, lib/guestInfo/guestInfoServer.c,
lib/misc/codeset.c,
lib/misc/vmstdio.c,
lib/SLPv2Parser/SLPv2MsgAssembler.c, lib/user/util.c: Removed some
unneeded casts.

* lib/foundryMsg/foundryThreads.c, lib/include/foundryThreads.h: Added
FoundryThreads_Free.

* lib/guestInfo/*, lib/include/guest_os.h, lib/include/guestInfo.h:
Refactored GetSystemBitness. Removed osNames.h.

* lib/hgfsServer/hgfsServerLinux.c: Modified MacOS alias resolution code
so as not to mount volumes. Made HGFS query volume code more resilient
to failures.

* lib/include/backdoor_def.h: Added commands for VAssert.

* lib/include/escape.h, lib/misc/escape.c: Escape_Do is no longer
declared inline.

* lib/include/hashTable.h, lib/misc/hashTable.c, lib/misc/Makefile.am,
lib/misc/shared/Makefile.am: Renamed from hash.[ch].

* lib/include/iovector.h, lib/include/vm_basic_types.h: Added
SectorType definition.

* lib/include/loglevel_user.h: Added additional log levels.

* lib/include/msgfmt.h: Modified for use in VMKERNEL.
Added
MsgFmt_GetArgswithBuf.

* lib/include/msg.h: Added Msg_AppendVob for ESX.

* lib/include/stats_user*: Modified some preprocessing steps. Added
SETUP_WANT_GETVAL to retrieve named stat counter values.

* lib/include/str.h: Modified behavior Str_* family of functions for
Windows.

* lib/include/strutil.h, lib/strUtil/strutil.c: Removed Split, Grep,
GrepFd, and GrepFree. Added EndsWith and DecimalStrToUint.

* lib/include/syncWaitQ.h, lib/sync/*: Modified SyncWaitQ_Add and

SyncWaitQ_Remove to use PollDevHandle fd types instead of int fd types.

* lib/include/timeutil.h, lib/misc/timeutil.c: Added
TimeUtil_GetLocalWindowsTimeZoneIndex and some helper functions.

* lib/include/util.h, lib/user/utilPosix.c: Added Util_BumpNoFds.

* lib/include/vixCommands.h: Added commands for device hotplug and
remote debugging.

* lib/include/vix.h, lib/include/vixOpenSource.h: Added some new errors
and properties. Added more VM manipulation functions.

* lib/include/vm_atomic.h:
Comment cleanup and added VMKERNEL-specific
calls for fencing.

* lib/include/vm_basic_asm_x86_64.h: Added inline routines to save and
restore ES1.

* lib/include/vm_basic_types.h: Added some types and cleaned up a bit.

* lib/include/vm_legal.h: Updated COPYRIGHT_YEARS.

* lib/include/vm_product.h: Added hostd service name.

* lib/include/x86cpuid.h: Cleaned up the file and added some definitions
for Penryn processors.

* lib/misc/codeset.c: Added new UTF-16 --> UTF-8 conversion routine.

* lib/misc/util_misc.c, lib/user/util.c: Moved Util_GetCurrentThreadId
and friends to util_misc.c.

* lib/procMgr/procMgrPosix.c: Cleaned up some code and reworked
asynchronous process execution so as to properly track the grandchild's
pid instead of the child's pid.

* lib/string/bsd*: Reorganized BSD formatter.

* lib/string/str.c: Updated unit tests. Added some Windows corner case
behavior for Str_Vsnwprintf.

* lib/strUtil/strutil.c: Fixed some corner cases in existing functions
that
call strtoul.

* lib/vixTools/vixTools.c: Changed signature of VixToolsImpersonateUser.

Changed error code handling in a few places.

* modules/freebsd/vmhgfs/*: Refactored a lot of code so that it can be
safely reused within the MacOS vmhgfs module.

* modules/*/*/kernelStubs*: Removed dead System_Uptime function.

* modules/linux/*/compat_wait.h: Reworked VMW_HAVE_EPOLL macro. Added
waitqueue helper macros for older kernels.

* modules/linux/vmhgfs/file.c, modules/linux/vmhgfs/fsutil.*,
modules/linux/vmhgfs/inode.c: Added HgfsSetUidGid function and used it
to preserve uid/gid after creating a directory.

* modules/linux/vmhgfs/vmhgfs_version.h: Bumped driver version.

* modules/linux/vmsync/compat_workqueue.h: Basic implementation of
work queues and delayed work queues (using taskqueues and timers) for
older kernels.

* modules/linux/vmsync/sync.c: Modified internal state to use new
compatible work queue implementation.

* modules/linux/vmxnet/compat_ioport.h,
modules/linux/vmxnet/compat_netdevice.h,
modules/linux/vmxnet/compat_pci.h,
modules/linux/vmxnet/compat_skbuff.h,
modules/linux/vmxnet/vmxnetInt.h:
Added and refactored
compatibility macros for use in vmxnet3 and vmci sockets modules.

* modules/linux/vmxnet/vmxnet.c: Hide some kernel functions behind
compatibility macros.

2008-01-23 Adar Dembo <adar@vmware.com>

* Resync with internal trunk (2008.01.08).

* configure.ac, guestd/Makefile.am, hgfsclient/Makefile.am,
lib/Makefile.am, toolbox/Makefile.am, vmware-user/Makefile.am:
integrated lib/unicode for internationalizing strings.

* guestd/main.c: Stopped using pgrep for finding existing instances
of guestd. Removed ancient bandwidth test code.

* guestd/toolsDaemon.c: Moved initial send of the guest's uptime from
when guestd sends its version to when guestd registers its
capabilities.

* lib/file/*, lib/include/file*.h : Massive overhaul of lib/file to
integrate the new unicode strings that are i18n-safe. Quite
a bit of
cleanup and refactoring as well.

* lib/file/file.c: Addition of File_PrependToPath function.

* lib/file/fileIOPosix.c: Addition of FileIO_SetExcludedFromTimeMachine
and FileIO_PrivilegedPosixOpen functions.

* lib/fileUTF8/fileUTF8Linux.c, lib/include/fileUTF8.h: Removal of some
casts and addition of FileUTF8_GetSize function.

* lib/foundryMsg/foundryMsg.c, lib/misc/vmstdio.c,
lib/SLPv2Parser/SLPv2MsgAssembler.c: Addition of some casts.

* lib/foundryMsg/foundryPropertyListCommon.c: Robustified some error
cases.

* lib/foundryMsg/vixTranslateErrOpenSource.c,
lib/include/vixOpenSource.h: Added VIX_E_OUT_OF_MEMORY error code.
Added Vix_TranslateCOMError function. ADded VIX_DEBUG macro.

* lib/guestInfo/guestInfoServer.c, lib/include/guestInfo.h: Added some
casts and refactored some functions. Also fixed a crash that hinders
backwards compatibility.

* lib/hgfs/cpNameUtil.c, lib/hgfs/cpNameUtilLinux.c,
lib/hgfsBd/hgfsBd.c, lib/include/cpName.h, lib/include/cpNameLite.h,
lib/include/escBitvector.h,
lib/include/hgfsUtil.h,
lib/message/messageBackdoor.c, lib/message/message.c,
lib/message/messageStub.c, lib/rpcout/rpcout.c,
modules/freebsd/vmhgfs/kernelStubs.h: Made safe for inclusion in MacOS
kernel module code.

* lib/include/backdoor.h: Refactored some type definitions.

* lib/include/bsd_output_int.h, lib/include/safetime.h,
lib/string/bsd_output_shared.c: Made safe for Win64 builds.

* lib/include/dynbuf.h: Added DynBuf_AppendString function.

* lib/include/err.h: Assorted cleanup.

* lib/include/escape.h, lib/misc/escape.c: Converted Escape_Do to be
inline. Some cleanup.

* lib/include/guest_os.h: Assorted cleanup.

* lib/include/hash.h, lib/misc/hash.c, lib/misc/Makefile.am,
lib/misc/shared/Makefile.am: Added basic hash table implementation.

* lib/include/hostinfo.h, lib/user/hostinfoPosix.c: Refactored and
added several timekeeping functions.

* lib/include/localconfig.h, lib/include/util_shared.h: Modified
statements
for include check.

* lib/include/log.h: Changed the value of some macros when debugging.

* lib/include/loglevel_defs.h: Refactoed some code, added macros for
use in the VMM.

* lib/include/loglevel_user.h: Added loglevels for some new components.

* lib/include/msgfmt.h: Added new functions.

* lib/include/msg.h: Added new Msg_LocalizeList function.

* lib/include/netutil.h: Modified prototypes for two Windows-only
functions.

* lib/include/preference.h: Added new Preference_GetInt64 and
Preference_SetFromString functions.

* lib/include/strutil.h, lib/strUtil/strutil.c: Cleaned up and added
some new functions.

* lib/include/su.h: Cleanup.

* lib/include/syncMutex.h, lib/sync/syncMutex.c: Added NetWare
implementation of some synchronization primitives.

* lib/include/unicode*, lib/unicode/*: New library for handling
Unicode-aware strings.

* lib/include/util.h, lib/user/util.c: Assorted refactoring and
addition of some new functions, one related to backtracing.

*
lib/include/vixCommands.h: New commands for vprobes, replay, message
dialogs, and others, plus cleanup of some existing commands.

* lib/include/vm_assert.h: Added IMPLIES macro.

* lib/include/vm_atomic.h, lib/include/vm_basic_asm.h: Refactored for
safe Win64 builds.

* lib/include/vm_basic_defs.h: Added compatibility code for __va_copy.

* lib/include/vm_basic_types.h: Added FMTH for printing the value of
handles. Set a new #pragma to ignore size_t truncation warnings on
Windows. Added several other macros, as well as a ssize_t definition
for some versions of BSD.

* lib/include/vm_legal.h: Added more patents to the patent string.

* lib/include/vm_product.h: Added new macros for some products.

* lib/include/vm_tools_version.h: Added macros for certain older Tools
versions and for PRODUCT_BUILD_NUMBER refactoring.

* lib/include/vm_version.h: Tweaked some product expiration dates and
versions. Refactored many uses of BUILD_NUMBER to PRODUCT_BUILD_NUMBER.

* lib/include/x86cpuid.h:
Tweaked definition of RDTSCP flag. Refactored
BIT_MASK macro to VMW_BIT_MASK.

* lib/misc/base64.c: Modified calling contract for Base64_EasyEncode.

* lib/misc/codeset.c: Tweaked casts and preprocessor conditioning.

* lib/misc/idLinux.c: Added IdAuthCreateWithFork and reworked several
other functions to work around a bug in Apple's detection of GUI
processes.

* lib/misc/util_misc.c: Moved W32Util_GetLongPathName and
W32UTil_LookupSidForAccount elsewhere.

* lib/rpcin/rpcin.c: Addition of a ping GuestRPC callback.

* lib/string/str.c: Removed a comment.

* lib/sync/syncWaitQPosix.c: Added code to disable a workaround for a
MacOS bug when appropriate (it was fixed in Leopard).

* lib/vixTools/vixTools.c: Refactored some code, added code to modify
the guest's networking configuration, added some casts, and added
code to prevent renaming a file to itself.

* modules/freebsd/*/Makefile, modules/linux/*/Makefile.normal: Set a
make variable so the module
file will be build in the parent directory.
Removed some unused rules.

* modules/freebsd/vmhgfs/kernelStubsBSD.c,
modules/linux/vmhgfs/kernelStubsLinux.c: Removed unused function.

* modules/linux/*/include/driver-config.h: Added check to prevent
uintptr_t from being declared twice.

* modules/linux/vmblock/linux/filesystem.c,
modules/linux/vmblock/Makefile.kernel: Added check for newer kernels
where the slab allocator's constructor function expects three
arguments. Makes it work with 2.6.25-rc1 (but not rc2, yet).

* modules/linux/vmblock/linux/vmblock_version.h: Bumped module version.

* modules/linux/vmhgfs/filesystem.c, modules/linux/vmhgfs/inode.c,
modules/linux/vmhgfs/module.h, modules/linux/vmhgfs/page.c: Added
support for writeback caching in conformant kernels.

* modules/linux/vmhgfs/vmhgfs_version.h: Bumped module version.

* modules/linux/vmxnet/vmxnetInt.h: Renamed a type and removed the
inclusion of unnecessary headers. Pruned said headers from codebase.

2007-11-15
 Elliot Lee <elliot@vmware.com>

* Bandsaw release (2007.11.15).

* configure.ac: Handle building modules for multiple OS's. Improve
X detection to allow building --without-x. Improve Gtk+
detection. Detect libdnet on Solaris. Detect which -Wwarning flags
the compiler can handle.

* vmware-user/foreignVMToolsNetworking.c, lib/vixTools/vixTools.c,
guestd/foreignVMToolsNetworking.c, lib/include/netutil.h,
lib/include/guestInfo.h, lib/netUtil/netUtilLinux.c,
lib/include/guestInfoInt.h, lib/guestInfo/guestInfoPosix.c,
lib/guestInfo/guestInfoServer.c: Move to new NicInfo structures.

* vmware-user/foundryToolsDaemon.c, guestd/foundryToolsDaemon.c:
Make sure requestMsg is not NULL before looking inside it.

* guestd/main.c: Cleanup of HGFS pserver and mounting code. Check
for some type of signal when sending an RPC.

* guestd/toolsDaemon.c, vmware-user/resolution.c: Have the guest
tell the host whether screen resolution changes should be sent,
instead of having
the host guess it based on the OS type set in
the .vmx file. Better timeout checking to avoid problems when
host & guest time diverge.

* hgfsmounter/hgfsmounter.c: FreeBSD support. Fixes to compile on
old systems.

* lib/backdoor/backdoor.c: Tweak for FreeBSD kernel modules.

* lib/include/mntinfo.h, lib/dnd/dndLinux.c,
lib/wiper/wiperPosix.c, lib/syncDriver/syncDriverPosix.c: Fixes to
compile on new systems w/gcc 4.2.

* lib/err/err.c, lib/err/errPosix.c, lib/err/Makefile.am: Move
Err_Errno2String function into POSIX-specific source file.

* lib/file/fileIOPosix.c: Handle EDQUOT if applicable. Fixes to
compile on new systems where SYS__llseek may not be
available. Better reporting of errors, by translating errno into
FILEIO_* error codes.

* lib/file/fileLockPosix.c: Fixes to compile on old systems. Add a
bunch of functions to the FileLock* API.

* lib/file/fileLockPrimitive.c, lib/include/fileInt.h: Bunch of
file locking cleanups and bug fixes.

* lib/file/filePosix.c:
Bunch of MacOS-related fixes. Add
File_GetTimes(), FilePosixGetParent(), FilePosixGetBlockDevice(),
etc.

* lib/fileUtf8/fileUTF8Linux.c: Add FileUTF8_GetTimes() function.

* lib/foundry/foundryMsg.c, lib/include/vixCommands.h: Add
VIX_USER_CREDENTIAL_HOST_CONFIG_HASHED_SECRET credential type, and
a bunch of VIX commands relating to record-replay.

* lib/foundryMsg/vixTranslateErrOpenSource.c: Translate a couple
more error codes.

* lib/guestInfo/guestInfoPosix.c, lib/guestInfo/Makefile.am: Use
libdnet on Solaris to retrieve networking info.

* lib/hgfs/cpNameUtil.c, lib/hgfs/cpNameUtilInt.h,
lib/hgfs/cpNameUtilLinux.c: Couple more CPName <-> UTF8 conversion
routines. Some MacOS changes as well.

* lib/hgfs/hgfsUtil.c, lib/include/hgfs.h,
modules/linux/vmhgfs/fsutil.c: Handle ENAMETOOLONG.

* lib/hgfs/staticEscape.c, lib/hgfs/hgfsBd.c: Handle FreeBSD as
well.

* lib/hgfsServer/hgfsServer.c: Tie in the cpNameUtil UTF8 changes
on MacOS.

* lib/hgfsServer/hgfsServerLinux.c:
Make the getdents() wrapper
work on a wider range of Linux systems. Add "alias" resolution on
MacOS, and tie in the cpNameUtil UTF8 changes on MacOS.

* lib/hgfsServer/hgfsServerPolicyGuest.c: Handle FreeBSD.

* lib/include/backdoor_def.h: Add BDOOR_CMD_LAZYTIMEREMULATION and
BDOOR_CMD_BIOSBBS.

* lib/include/str.h, lib/include/bsd_output.h,
lib/include/bsd_output_int.h: include compat_stdarg.h, change
vsnwprintf prototype, add HAVE_BSD_WPRINTF define, other compat
fixups.

* lib/include/cpNameUtil.h, lib/include/codeset.h,
lib/misc/codeset.c: Changes to correspond to cpNameUtil UTF8
changes.

* lib/include/compat/compat_stdarg.h: New header for doing stdarg
easily across platforms.

* lib/include/cpName.h: FreeBSD fixes.

* lib/include/dnd.h: Add Dnd_SetClipboard and Dnd_GetFileList().

* lib/include/escBitvector.h: FreeBSD fixes.

* lib/include/file.h, lib/include/fileUTF8.h: Add new MacOS
routines and File_GetTimes/FileUTF8_GetTimes.

* lib/include/hgfsProto.h:
Explanation of the whole cpNameUtil and
codeset UTF8 changes and how they tie in with HGFS.

* lib/include/hgfsUtil.h: Random compatibility changes.

* lib/include/loglevel_user.h: Add a few LOGLEVEL_VAR definitions.

* lib/include/msg.h: s/USE_MSGFMT/NO_MSGFMT/

* lib/include/osNames.h: Add Windows 2003 Datacenter Edition, and
user-visible 64bit suffix macro.

* lib/misc/random.c, lib/include/random.h: Add Random_Quick() and
Random_QuickSeed() routines.

* lib/misc/idLinux.c, lib/include/su.h: Add Id_AuthGetLocal() and
Id_GetAuthExternal() routines, and compat fixes.

* lib/misc/timeutil.c, lib/include/timeutil.h: Add
TimeUtil_UnixTimeToNtTime() routine.

* lib/include/util.h: Add a couple of MacOS routines.

* lib/include/vmBackup.h, lib/vmBackupLib/stateMachine.c: add a
couple of structure elements for Windows backup fixes.

* lib/include/vm_basic_asm.h: fixes for reading TSC on 64-bit
platforms.

* lib/include/vm_basic_defs.h: Add other va_copy macros.

*
lib/include/vm_basic_types.h: Fixes for compiling on a wide
range of systems.

* lib/include/vm_legal.h: Change the PATENTS_STRING

* lib/include/vm_product.h: Add "License Infrastructure" product.

* lib/include/vm_tools_version.h: Change tools versions listed for
various upcoming product releases.

* lib/include/vm_version.h: Update the versions.

* lib/include/x86cpuid.h: Define more CPU flags & fields, add new
CPU models. Fixes for fully writable TSC detection.

* lib/message/message.c, lib/message/messageBackdoor.c: Fixes for
FreeBSD.

* lib/misc/util_misc.c: Handle MacOS.

* lib/rpcIn/rpcin.c: Fail a badly-formed RPC instead of
ASSERT()'ing into oblivion.

* lib/string/bsd_vsnprintf.c: Various fixes to synchronize with
bsd_vsnwprintf.c.

* lib/string/Makefile.am, lib/string/shared/Makefile.am,
lib/string/str.c lib/string/bsd_vsnwprintf.c: New file to
implement vsnwprintf() for compat purposes.

* lib/vixTools/vixTools.c: New FileUTF8 routines.

* Makefile.am,
modules/Makefile.am: --without-x fixes, add
xferlogs, move kernel module building into separate Makefile.am

* modules/freebsd/*: Add FreeBSD kernel modules (vmblock, vmhgfs,
vmmemctl, vmxnet).

* modules/linux/*/include/compat_*.h,
modules/linux/*/autoconf/cachector.c,
modules/linux/*/autoconf/cachecreate.c,
modules/linux/*/backdoor.c, modules/linux/vmhgfs/filesystem.c,
modules/linux/vmhgfs/hgfsBd.c, lib/procMgr/procMgrPosix.c,
lib/rpcOut/rpcout.c, lib/user/util.c, lib/vmCheck/vmcheck.c,
libguestlib/Makefile.am, lib/deployPkg/runDeployPkgPosix.c,
lib/include/vm_atomic.h: Compat fixes.

* modules/linux/*/kernelStubs.h: Update for FreeBSD.

* modules/linux/*/include/*.h, modules/linux/*/backdoor_def.h,
modules/linux/*/cpName.h, modules/linux/*/hgfs.h,
modules/linux/*/hgfsProto.h, modules/linux/*/hgfsUtil.[ch],
modules/linux/*/kernelStubsLinux.c,
modules/linux/*/messageBackdoor.c, modules/linux/*/message.c,
modules/linux/*/rpcout.c, modules/linux/*/rpcin.c,
modules/linux/*/staticEscape.c,
modules/linux/*/vm_basic_asm.h,
modules/linux/*/vm_basic_defs.h, modules/linux/*/vm_basic_types.h,
modules/linux/*/x86cpuid.h, modules/linux/*/compat_*.h: Pull in
updated files from main source tree.

* modules/linux/*/Makefile.kernel: Remove CC_WARNINGS/CC_OPTS
gunk.

* modules/linux/*/README, modules/linux/*/Makefile.normal: Build
foo.o driver by default on systems with VM_KBUILD=no.

* modules/linux/vmhgfs/vmhgfs_version.h: Updated VMHGFS driver
version.

* modules/linux/vmmemctl/os.[ch],
modules/linux/vmmemctl/vmballoon.c: Implement and use os_yield()
to deprioritize the Balloon_Deallocate operation.

* modules/linux/vmsync/*: New sync driver to make VM snapshots
consistent.

* modules/linux/vmxnet/bpf_meta.h: New file.

* modules/linux/vmxnet/net_dist.h: Update NET_MAX_IMPL_PKT_OVHD
value.

* modules/linux/vmxnet/vm_device_version.h: Mention VMXNET3

* modules/linux/vmxnet/vmkapi_status.h: Updated VMK_ERR codes.

* modules/linux/vmxnet/vmkapi_types.h:
Add VMK_CONST64(U) macros.

* modules/linux/vmxnet/vmxnet2_def.h,
modules/linux/vmxnet/vmnet_def.h,
modules/linux/vmxnet/vmxnet_def.h,
modules/linux/vmxnet/vmxnetInt.h, modules/linux/vmxnet/vmxnet.c:
Add (optional) BPF support.

* modules/linux/vmxnet/vmxnetInt.h, modules/linux/vmxnet/vmxnet.c:
Add vmxnet_link_check to propagate device link status to netdev.

* common/vm-support: New script to gather support info from a VM.

* scripts/*/*-default: New poweron/poweroff/suspend/resume scripts
for a VM. Add support for dropping user-provided scripts into a
subdirectory.

* toolbox/toolboxAbout.c: Eliminate warnings about unused
variables.

* toolbox/toolboxShrink.c: Update wording of message.

* toolbox/copyPaste.c: Try cutting & pasting UTF8 text if we can.

* xferlogs/*: New log transfer utility.

2007-10-26 Elliot Lee <elliot@vmware.com>

* Initial import of 2007.09.04-56574 code ("Axe" release).

* Import 2007.10.08 snapshot, which includes patches
to fix the
--without-x flag, and compilation with gcc 4.2.

Found in path(s):
* /clearlinux-pkgs-open-vm-tools-10-3-5-23-0-ge2ce082-tar-gz/clearlinux-pkgs-open-vm-tools-e2ce082/ChangeLog

1.177 syslinux 6.02

1.177.1 Available under license :

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```
/* nicstar.c  v0.22  Jawaid Bazyar (bazyar@hypermall.com)
* nicstar.c, M. Welsh (matt.welsh@cl.cam.ac.uk)
*
* Hacked October, 1997 by Jawaid Bazyar, Interlink Advertising Services Inc.
*  http://www.hypermall.com/
* 10/1/97 - commented out CFG_PHYIE bit - we don't care when the PHY
* interrupts us (except possibly for removal/insertion of the cable?)
* 10/4/97 - began heavy inline documentation of the code. Corrected typos
* and spelling mistakes.
* 10/5/97 - added code to handle PHY interrupts, disable PHY on
* loss of link, and correctly re-enable PHY when link is
* re-established. (put back CFG_PHYIE)
*
*   Modified to work with the IDT7721 nicstar -- AAL5 (tested) only.
*
* R. D. Rechenmacher <ron@fnal.gov>, Aug. 6, 1997
*
* Linux driver for the IDT77201 NICStAR PCI ATM controller.
* PHY component is expected to be 155 Mbps S/UNI-Lite or IDT 77155;
* see init_nicstar() for PHY initialization to change this. This driver
* expects the Linux ATM stack to support scatter-gather
 lists
* (skb->atm.iovcnt != 0) for Rx skb's passed to vcc->push.
*
* Implementing minimal-copy of received data:
*   IDT always receives data into a small buffer, then large buffers
*     as needed. This means that data must always be copied to create
*     the linear buffer needed by most non-ATM protocol stacks (e.g. IP)
*     Fix is simple: make large buffers large enough to hold entire
*     SDU, and leave <small_buffer_data> bytes empty at the start. Then
```

```
*     copy small buffer contents to head of large buffer.
*   Trick is to avoid fragmenting Linux, due to need for a lot of large
*     buffers. This is done by 2 things:
*       1) skb->destructor / skb->atm.recycle_buffer
*            combined, allow nicstar_free_rx_skb to be called to
*            recycle large data buffers
*       2) skb_clone of received buffers
*   See nicstar_free_rx_skb and linearize_buffer for implementation
*     details.
*
*
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*
* M. Welsh, 6 July 1996
*
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The End

1.180 jansi---java-library-for-generating-and-interpreting-ansi-escape-sequences. 1.7.0

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1.181 libpng 1.6.37

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* Hudson (tjh@cryptsoft.com).
*
*/

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* by Eric Young (eay@cryptsoft.com).

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1.184 expat 2.5.0

1.184.1 Available under license :

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1.185 tftp-hpa 5.2

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No license file was found, but licenses were detected in source scan.

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*/

Found
 in path(s):
* /tftp-hpa-5-2-r0-tar-bz2/tftp-hpa-5.2-r0/tftp-hpa-5.2/tftp-hpa-5.2/tftpd/tftpd.c
No license file was found, but licenses were detected in source scan.

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Found in path(s):
* /tftp-hpa-5-2-r0-tar-bz2/tftp-hpa-5.2-r0/tftp-hpa-5.2/tftp-hpa-5.2/tftp/tftp.c
*
 /tftp-hpa-5-2-r0-tar-bz2/tftp-hpa-5.2-r0/tftp-hpa-5.2/tftp-hpa-5.2/tftp/main.c
* /tftp-hpa-5-2-r0-tar-bz2/tftp-hpa-5.2-r0/tftp-hpa-5.2/tftp-hpa-5.2/common/tftpsubs.c
No license file was found, but licenses were detected in source scan.

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*   This program is free software available under the same license
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*
* -- */

Found in path(s):
* /tftp-hpa-5-2-r0-tar-bz2/tftp-hpa-5.2-r0/tftp-hpa-5.2/tftp-hpa-5.2/tftpd/remap.h
* /tftp-hpa-5-2-r0-tar-bz2/tftp-hpa-5.2-r0/tftp-hpa-5.2/tftp-hpa-5.2/tftpd/misc.c
* /tftp-hpa-5-2-r0-tar-bz2/tftp-hpa-5.2-r0/tftp-hpa-5.2/tftp-hpa-5.2/tftpd/remap.c
No license file was found, but licenses were detected in source scan.

Summary: The client for the Trivial File Transfer Protocol (TFTP).
Name: tftp
Version: 5.2
Release: 1
License: BSD
Group: Applications/Internet

```
Source0: http://www.kernel.org/pub/software/network/tftp/tftp-hpa-%{version}.tar.gz
BuildRequires: tcp_wrappers-devel
BuildRoot: %{_tmppath}/%{name}-root

%description
The Trivial File Transfer Protocol (TFTP) is normally used only for
booting diskless workstations.  The tftp package provides the user
interface for TFTP, which allows users to transfer files to and from a
remote machine.  This program and TFTP provide very little security,
and should not be enabled unless it is expressly needed.

%package server
Group: System Environment/Daemons
Summary: The server for the Trivial File Transfer Protocol (TFTP).
Requires: xinetd

%description server
The Trivial File Transfer Protocol (TFTP) is normally used only for
booting diskless workstations.  The tftp-server package provides
 the
server for TFTP, which allows users to transfer files to and from a
remote machine. TFTP provides very little security, and should not be
enabled unless it is expressly needed.  The TFTP server is run from
/etc/xinetd.d/tftp, and is disabled by default on Red Hat Linux systems.

%prep
%setup -q -n tftp-hpa-%{version}

%build

%configure
make %{?_smp_mflags}

%install
rm -rf ${RPM_BUILD_ROOT}
mkdir -p ${RPM_BUILD_ROOT}%{_bindir}
mkdir -p ${RPM_BUILD_ROOT}%{_mandir}/man{1,8}
mkdir -p ${RPM_BUILD_ROOT}%{_sbindir}

make INSTALLROOT=${RPM_BUILD_ROOT} \
   SBINDIR=%{_sbindir} MANDIR=%{_mandir} \
 install
install -m755 -d ${RPM_BUILD_ROOT}%{_sysconfdir}/xinetd.d/ ${RPM_BUILD_ROOT}/tftpboot
install -m644 tftp-xinetd ${RPM_BUILD_ROOT}%{_sysconfdir}/xinetd.d/tftp

%post server
/sbin/service xinetd reload > /dev/null 2>&1 || :
```

```
%postun server
if [ $1 = 0 ]; then
   /sbin/service xinetd reload > /dev/null 2>&1 || :
fi

%clean
rm -rf ${RPM_BUILD_ROOT}

%files
%defattr(-,root,root)
%{_bindir}/tftp
%{_mandir}/man1/*

%files
 server
%defattr(-,root,root)
%config(noreplace) %{_sysconfdir}/xinetd.d/tftp
%dir /tftpboot
%{_sbindir}/in.tftpd
%{_mandir}/man8/*

%changelog
* Tue Sep 14 2004 H. Peter Anvin <hpa@zytor.com>
- removed completely broken "Malta" patch.
- integrated into build machinery so rpm -ta works.

* Fri Feb 13 2004 Elliot Lee <sopwith@redhat.com>
- rebuilt

* Wed Jun 04 2003 Elliot Lee <sopwith@redhat.com>
- rebuilt

* Fri Apr 11 2003 Elliot Lee <sopwith@redhat.com>
- 0.33
- Add /tftpboot directory (#88204)

* Mon Feb 24 2003 Elliot Lee <sopwith@redhat.com>
- rebuilt

* Sun Feb 23 2003 Tim Powers <timp@redhat.com>
- add BuildPreReq on tcp_wrappers

* Wed Jan 22 2003 Tim Powers <timp@redhat.com>
- rebuilt

* Mon Nov 11 2002 Elliot Lee <sopwith@redhat.com> 0.32-1
- Update to 0.32
```

* Wed Oct 23 2002 Elliot Lee <sopwith@redhat.com> 0.30-1
- Fix #55789
- Update to 0.30

* Thu Jun 27 2002 Elliot Lee <sopwith@redhat.com>
- Try applying HJ's patch from #65476

* Fri Jun
21 2002 Tim Powers <timp@redhat.com>
- automated rebuild

* Mon Jun 17 2002 Elliot Lee <sopwith@redhat.com>
- Update to 0.29

* Thu May 23 2002 Tim Powers <timp@redhat.com>
- automated rebuild

* Wed Jan 09 2002 Tim Powers <timp@redhat.com>
- automated rebuild

* Tue Dec 18 2001 Elliot Lee <sopwith@redhat.com> 0.17-15
- Add patch4: netkit-tftp-0.17-defaultport.patch for bug #57562
- Update to tftp-hpa-0.28 (bug #56131)
- Remove include/arpa/tftp.h to fix #57259
- Add resource limits in tftp-xinetd (#56722)

* Sun Jun 24 2001 Elliot Lee <sopwith@redhat.com>
- Bump release + rebuild.

* Tue Jun 12 2001 Helge Deller <hdeller@redhat.de> (0.17-13)
- updated tftp-hpa source to tftp-hpa-0.17
- tweaked specfile with different defines for tftp-netkit and tftp-hpa version
- use hpa's tftpd.8 man page instead of the netkits one

* Mon May 07 2001 Helge Deller <hdeller@redhat.de>
- rebuilt in 7.1.x

* Wed Apr 18 2001 Helge Deller <hdeller@redhat.de>
- fix tftp client's put problems (#29529)
- update
to tftp-hpa-0.16

* Wed Apr 4 2001 Jakub Jelinek <jakub@redhat.com>
- don't let configure to guess compiler, it can pick up egcs

* Thu Feb 08 2001 Helge Deller <hdeller@redhat.de>
- changed "wait" in xinetd file to "yes" (hpa-tftpd forks and exits) (#26467)
- fixed hpa-tftpd to handle files greater than 32MB (#23725)

- added "-l" flag to hpa-tftpd for file-logging (#26467)
- added description for "-l" to the man-page

* Thu Feb 08 2001 Helge Deller <hdeller@redhat.de>
- updated tftp client to 0.17 stable (#19640),
- drop dependency on xinetd for tftp client (#25051),

* Wed Jan 17 2001 Jeff Johnson <jbj@redhat.com>
- xinetd shouldn't wait on tftp (which forks) (#23923).

* Sat Jan 6 2001 Jeff Johnson <jbj@redhat.com>
- fix to permit tftp put's (#18128).
- startup as root with chroot to /tftpboot with early reversion to nobody
 is preferable to starting as nobody w/o ability to chroot.
- %%post is needed by server, not client. Add %%postun for erasure as well.

* Wed Aug 23 2000
 Nalin Dahyabhai <nalin@redhat.com>
- default to being disabled

* Thu Aug 17 2000 Jeff Johnson <jbj@redhat.com>
- correct group.

* Tue Jul 25 2000 Nalin Dahyabhai <nalin@redhat.com>
- change user from root to nobody

* Sat Jul 22 2000 Jeff Johnson <jbj@redhat.com>
- update to tftp-hpa-0.14 (#14003).
- add server_args (#14003).
- remove -D_BSD_SOURCE (#14003).

* Fri Jul 21 2000 Nalin Dahyabhai <nalin@redhat.com>
- cook up an xinetd config file for tftpd

* Wed Jul 12 2000 Prospector <bugzilla@redhat.com>
- automatic rebuild

* Sun Jun 18 2000 Jeff Johnson <jbj@redhat.com>
- FHS packaging.
- update to 0.17.

* Fri May 5 2000 Matt Wilson <msw@redhat.com>
- use _BSD_SOURCE for hpa's tftpd so we get BSD signal semantics.

* Fri Feb 11 2000 Bill Nottingham <notting@redhat.com>
- fix description

* Wed Feb 9 2000 Jeff Johnson <jbj@redhat.com>

- compress man pages (again).

* Wed Feb 02 2000 Cristian Gafton <gafton@redhat.com>
- man pages are compressed
- fix description and summary

* Tue
Jan 4 2000 Bill Nottingham <notting@redhat.com>
- split client and server

* Tue Dec 21 1999 Jeff Johnson <jbj@redhat.com>
- update to 0.16.

* Sat Aug 28 1999 Jeff Johnson <jbj@redhat.com>
- update to 0.15.

* Wed Apr 7 1999 Jeff Johnson <jbj@redhat.com>
- tftpd should truncate file when overwriting (#412)

* Sun Mar 21 1999 Cristian Gafton <gafton@redhat.com>
- auto rebuild in the new build environment (release 22)

* Mon Mar 15 1999 Jeff Johnson <jbj@redhat.com>
- compile for 6.0.

* Fri Aug 7 1998 Jeff Johnson <jbj@redhat.com>
- build root

* Mon Apr 27 1998 Prospector System <bugs@redhat.com>
- translations modified for de, fr, tr

* Mon Sep 22 1997 Erik Troan <ewt@redhat.com>
- added check for getpwnam() failure

* Tue Jul 15 1997 Erik Troan <ewt@redhat.com>
- initial build

Found in path(s):
* /tftp-hpa-5-2-r0-tar-bz2/tftp-hpa-5.2-r0/tftp-hpa-5.2/tftp-hpa-5.2/tftp.spec
No license file was found, but licenses were detected in source scan.

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* http://www.openbsd.org/.

```
*
* ---------------------------------------------------------------------- */
```

Found in path(s):
* /tftp-hpa-5-2-r0-tar-bz2/tftp-hpa-5.2-r0/tftp-hpa-5.2/tftp-hpa-5.2/config.h
No license file was found, but licenses were detected in source scan.

Summary: The client for the Trivial File Transfer Protocol (TFTP).
Name: tftp
Version: @@VERSION@@
Release: 1
License: BSD
Group: Applications/Internet
Source0: http://www.kernel.org/pub/software/network/tftp/tftp-hpa-%{version}.tar.gz
BuildRequires: tcp_wrappers-devel
BuildRoot: %{_tmppath}/%{name}-root

%description
The Trivial File Transfer Protocol (TFTP) is normally used only for
booting diskless workstations. The tftp package provides the user
interface for TFTP, which allows users to transfer files to and from a
remote machine. This program and TFTP provide very little security,
and should not be enabled unless it is expressly needed.

%package server
Group: System Environment/Daemons
Summary: The server for the Trivial File Transfer Protocol (TFTP).
Requires: xinetd

%description server
The Trivial File Transfer Protocol (TFTP) is normally used only for
booting diskless workstations. The tftp-server package
 provides the
server for TFTP, which allows users to transfer files to and from a
remote machine. TFTP provides very little security, and should not be
enabled unless it is expressly needed. The TFTP server is run from
/etc/xinetd.d/tftp, and is disabled by default on Red Hat Linux systems.

%prep
%setup -q -n tftp-hpa-%{version}

%build

%configure
make %{?_smp_mflags}

%install
rm -rf ${RPM_BUILD_ROOT}

```
mkdir -p ${RPM_BUILD_ROOT}%{_bindir}
mkdir -p ${RPM_BUILD_ROOT}%{_mandir}/man{1,8}
mkdir -p ${RPM_BUILD_ROOT}%{_sbindir}

make INSTALLROOT=${RPM_BUILD_ROOT} \
  SBINDIR=%{_sbindir} MANDIR=%{_mandir} \
 install
install -m755 -d ${RPM_BUILD_ROOT}%{_sysconfdir}/xinetd.d/ ${RPM_BUILD_ROOT}/tftpboot
install -m644 tftp-xinetd ${RPM_BUILD_ROOT}%{_sysconfdir}/xinetd.d/tftp

%post server
/sbin/service xinetd reload > /dev/null 2>&1 || :

%postun server
if [ $1 = 0 ]; then
  /sbin/service xinetd reload > /dev/null 2>&1 || :
fi

%clean
rm -rf ${RPM_BUILD_ROOT}

%files
%defattr(-,root,root)
%{_bindir}/tftp
%{_mandir}/man1/*

%files
 server
%defattr(-,root,root)
%config(noreplace) %{_sysconfdir}/xinetd.d/tftp
%dir /tftpboot
%{_sbindir}/in.tftpd
%{_mandir}/man8/*

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- 0.33
- Add /tftpboot directory (#88204)
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* Mon Nov 11 2002 Elliot Lee <sopwith@redhat.com> 0.32-1
- Update to 0.32

* Wed Oct 23 2002 Elliot Lee <sopwith@redhat.com> 0.30-1
- Fix #55789
- Update to 0.30

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- automated rebuild

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 update to tftp-hpa-0.16

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- startup as root with chroot to /tftpboot with early reversion to nobody
 is preferable to starting as nobody w/o ability to chroot.
- %%post is needed by server, not client. Add %%postun for erasure as well.

* Wed Aug
 23 2000 Nalin Dahyabhai <nalin@redhat.com>
- default to being disabled

* Thu Aug 17 2000 Jeff Johnson <jbj@redhat.com>
- correct group.

* Tue Jul 25 2000 Nalin Dahyabhai <nalin@redhat.com>
- change user from root to nobody

* Sat Jul 22 2000 Jeff Johnson <jbj@redhat.com>
- update to tftp-hpa-0.14 (#14003).
- add server_args (#14003).
- remove -D_BSD_SOURCE (#14003).

* Fri Jul 21 2000 Nalin Dahyabhai <nalin@redhat.com>
- cook up an xinetd config file for tftpd

* Wed Jul 12 2000 Prospector <bugzilla@redhat.com>

- automatic rebuild

* Sun Jun 18 2000 Jeff Johnson <jbj@redhat.com>
- FHS packaging.
- update to 0.17.

* Fri May 5 2000 Matt Wilson <msw@redhat.com>
- use _BSD_SOURCE for hpa's tftpd so we get BSD signal semantics.

* Fri Feb 11 2000 Bill Nottingham <notting@redhat.com>
- fix description

* Wed Feb 9 2000 Jeff Johnson <jbj@redhat.com>
- compress man pages (again).

* Wed Feb 02 2000 Cristian Gafton <gafton@redhat.com>
- man pages are compressed
- fix description and summary

*
 Tue Jan 4 2000 Bill Nottingham <notting@redhat.com>
- split client and server

* Tue Dec 21 1999 Jeff Johnson <jbj@redhat.com>
- update to 0.16.

* Sat Aug 28 1999 Jeff Johnson <jbj@redhat.com>
- update to 0.15.

* Wed Apr 7 1999 Jeff Johnson <jbj@redhat.com>
- tftpd should truncate file when overwriting (#412)

* Sun Mar 21 1999 Cristian Gafton <gafton@redhat.com>
- auto rebuild in the new build environment (release 22)

* Mon Mar 15 1999 Jeff Johnson <jbj@redhat.com>
- compile for 6.0.

* Fri Aug 7 1998 Jeff Johnson <jbj@redhat.com>
- build root

* Mon Apr 27 1998 Prospector System <bugs@redhat.com>
- translations modified for de, fr, tr

* Mon Sep 22 1997 Erik Troan <ewt@redhat.com>
- added check for getpwnam() failure

* Tue Jul 15 1997 Erik Troan <ewt@redhat.com>

- initial build

Found in path(s):
* /tftp-hpa-5-2-r0-tar-bz2/tftp-hpa-5.2-r0/tftp-hpa-5.2/tftp-hpa-5.2/tftp.spec.in
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* -- */

Found in path(s):
* /tftp-hpa-5-2-r0-tar-bz2/tftp-hpa-5.2-r0/tftp-hpa-5.2/tftp-hpa-5.2/tftpd/tftpd.h
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* /tftp-hpa-5-2-r0-tar-bz2/tftp-hpa-5.2-r0/tftp-hpa-5.2/tftp-hpa-5.2/tftpd/recvfrom.c
* /tftp-hpa-5-2-r0-tar-bz2/tftp-hpa-5.2-r0/tftp-hpa-5.2/tftp-hpa-5.2/tftpd/recvfrom.h
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* /tftp-hpa-5-2-r0-tar-bz2/tftp-hpa-5.2-r0/tftp-hpa-5.2/tftp-hpa-5.2/tftp/tftp.1.in
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Found in path(s):
* /tftp-hpa-5-2-r0-tar-bz2/tftp-hpa-5.2-r0/tftp-hpa-5.2/tftp-hpa-5.2/MCONFIG.in
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*/

Found in path(s):
* /tftp-hpa-5-2-r0-tar-bz2/tftp-hpa-5.2-r0/tftp-hpa-5.2/tftp-hpa-5.2/common/tftpsubs.h
*
/tftp-hpa-5-2-r0-tar-bz2/tftp-hpa-5.2-r0/tftp-hpa-5.2/tftp-hpa-5.2/tftp/extern.h

1.186 util-linux 2.20.0

1.186.1 Available under license :

NR START END SECTORS SIZE NAME UUID
1 32 7679 7648 3.7M 8f8378c0-01
2 7680 16383 8704 4.3M 8f8378c0-02
5 7936 12799 4864 2.4M
6 12544 16127 3584 1.8M

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Version 3, 29 June 2007

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#!/usr/bin/env bash
MIT licenses will each have a unique MD5 sum since they contain a unique copyright.
This script will read the license file into memory, strip out the copyright, and then
generate an MD5 that is not unique and can be matched against a known MIT MD5 sum.
set -e

calculate_md5_sum() {
 local FILE="$1"

 # Read the contents of the file into a variable
 local raw_license_text=$(<"$FILE")

 # Convert to lowercase
 local lowercase_license_text="${raw_license_text,,}"

 # Remove anything before the beginning of the license
 local stripped_license_text=$(awk '/permission is hereby granted,/{p=1} p' <<< "$lowercase_license_text")

 # Replace line breaks (Windows or Linux) with a single space
 local replaced_linebreaks=$(tr '\r\n' ' ' <<< "$stripped_license_text")

 # Replace multiple spaces with a single space
 local normalized_license_text=$(tr -s ' ' <<< "$replaced_linebreaks")

 # Strip away any non-printable, non-whitespace characters
 local clean_unprintable_license_text=$(tr
 -cd '[:print:][:space:]' <<< "$normalized_license_text")

 # Remove punctuation and special characters

```
 local clean_license_text=$(echo "$clean_unprintable_license_text" | sed 's/[^a-zA-Z ]//g')

 # Calculate the MD5 sum of the cleaned license text
 local MD5SUM=$(echo -n "$clean_license_text" | md5sum | awk '{print $1}')

 # Output the MD5 sum
 echo "$MD5SUM"
}

# Check if the FILE argument is provided
if [ -z "$1" ]; then
 echo "Please provide a FILE as an argument."
 exit 1
fi

# Invoke the function with the provided FILE argument
calculate_md5_sum "$1"
WEV @@ WEV[B  "1
x   ?"U@,5  @mISmIN<GimCN7g1u|E
43mI,5WEV @@ WEV   @mImImIAmImImI0mImImI*mImI
A0mImImI...
lost+found...

;9GimCN7g

!"#$%&'()*+,-
./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz{|}~

!"#$%&'()*+,-
./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz{|}~

!"#$%&'()*+,-
./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz{|}~

!"#$%&'()*+,-
./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz{|}~WEV @@
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Python was created in the early 1990s by Guido van Rossum at Stichting Mathematisch Centrum (CWI, see http://www.cwi.nl) in the Netherlands as a successor of a language called ABC. Guido remains Python's principal author, although it includes many contributions from others.

In 1995, Guido continued his work on Python at the Corporation for National Research Initiatives (CNRI, see http://www.cnri.reston.va.us) in Reston, Virginia where he released several versions of the software.

In May 2000, Guido and the Python core development team moved to BeOpen.com to form the BeOpen PythonLabs team. In October of the same

year, the PythonLabs team moved to Digital Creations, which became Zope Corporation. In 2001, the Python Software Foundation (PSF, see https://www.python.org/psf/) was formed, a non-profit organization created specifically to own Python-related Intellectual Property. Zope Corporation was a sponsoring member of the PSF.

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2.0	1.6	2000	BeOpen.com	no
1.6.1	1.6	2001	CNRI	yes (2)
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2.1.1	2.1+2.0.1	2001	PSF	yes
2.1.2	2.1.1	2002	PSF	yes
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1.191 c-ares 1.12.1-DEV

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1.192 e2fsprogs 1.43.7

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file system consistency checker (e2fsck.static). The EXT2 utilities
were written by Theodore Ts'o <tytso@mit.edu> and Remy Card
<card@masi.ibp.fr>.

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Index: tdbsa/tdb.c
===
--- tdbsa.orig/tdb.c
+++ tdbsa/tdb.c
@@ -4,11 +4,11 @@ Rev: 23371
Last Changed Date: 2007-06-06 20:14:06 -0400 (Wed, 06 Jun 2007)
*/
 /*
-   Unix SMB/CIFS implementation.
+   trivial database library - standalone version

-   trivial database library - private includes
-
-   Copyright (C) Andrew Tridgell   2005
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     ** library. This does NOT imply that all of Samba is released
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Gadi Oxman, August 1995

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system utilities (e2fsck, mke2fs, etc.). The EXT2 utilities were
written by Theodore Ts'o <tytso@mit.edu> and Remy Card <card@masi.ibp.fr>.

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#
This is a Makefile stub which handles the creation of BSD shared
libraries.
#
In order to use this stub, the following makefile variables must be defined.
#
BSDLIB_VERSION = 1.0
BSDLIB_IMAGE = libce
BSDLIB_MYDIR = et
BSDLIB_INSTALL_DIR = $(SHLIBDIR)
#

all:: image

real-subdirs:: Makefile
 @echo " MKDIR pic"
 @mkdir -p pic

BSD_LIB = $(BSDLIB_IMAGE).so.$(BSDLIB_VERSION)
BSDLIB_PIC_FLAG = -fpic

```
image:  $(BSD_LIB)

$(BSD_LIB): $(OBJS)
 (cd pic; ld -Bshareable -o $(BSD_LIB) $(LDFLAGS_SHLIB) $(OBJS))
 $(MV) pic/$(BSD_LIB) .
 $(RM) -f ../$(BSD_LIB)
 (cd ..; $(LN) $(LINK_BUILD_FLAGS) \
  `echo $(my_dir) | sed -e 's;lib/;;'`/$(BSD_LIB) $(BSD_LIB))

install-shlibs install:: $(BSD_LIB)
 @echo " INSTALL_PROGRAM $(BSDLIB_INSTALL_DIR)/$(BSD_LIB)"
 @$(INSTALL_PROGRAM) $(BSD_LIB) \
  $(DESTDIR)$(BSDLIB_INSTALL_DIR)/$(BSD_LIB)
 @-$(LDCONFIG)

install-strip: install

install-shlibs-strip: install-shlibs

uninstall-shlibs uninstall::
 $(RM) -f $(DESTDIR)$(BSDLIB_INSTALL_DIR)/$(BSD_LIB)

clean::
 $(RM)
 -rf pic
 $(RM) -f $(BSD_LIB)
 $(RM) -f ../$(BSD_LIB)
```

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This is the Debian GNU/Linux prepackaged version of the ss
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distributed together with the EXT2 file system utilities, which are
otherwise packaged as "e2fsprogs".

This package was put together by Yann Dirson <dirson@debian.org>,
from sources obtained from a mirror of:
tsx-11.mit.edu:/pub/linux/packages/ext2fs/

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Theodore Ts'o
23-June-2007

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Python was created in the early 1990s by Guido van Rossum at Stichting
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as a successor of a language called ABC. Guido remains Python's
principal author, although it includes many contributions from others.

In 1995, Guido continued his work on Python at the Corporation for
National Research Initiatives (CNRI, see http://www.cnri.reston.va.us)
in Reston, Virginia where he released several versions of the
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In May 2000, Guido and the Python core development team moved to
BeOpen.com to form the BeOpen PythonLabs team. In October of the same
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xwd v1.0.7

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CUP Parser Generator for Java v 0.11b

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Mesa 3-D Graphics Library v21.0.3

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Ext headers       GL/glext.h           Khronos
                  GL/glxext.h          Khronos
                  GL/wglext.h          Khronos
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KHR/khrplatform.h Khronos

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---
include/GL/gl.h :

Mesa 3-D
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include/GL/glxext.h
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Theodore Ts'o <tytso@mit.edu> on Sat Mar 15 15:33:37 EST 2003

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This is the Debian GNU/Linux prepackaged version of the static EXT2
file system consistency checker (e2fsck.static). The EXT2 utilities
were written by Theodore Ts'o <tytso@mit.edu> and Remy Card
<card@masi.ibp.fr>.

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Index: tdbsa/tdb.c
===
--- tdbsa.orig/tdb.c
+++ tdbsa/tdb.c
@@ -4,11 +4,11 @@ Rev: 23371
Last Changed Date: 2007-06-06 20:14:06 -0400 (Wed, 06 Jun 2007)
*/
/*
- Unix SMB/CIFS implementation.

+ trivial database library - standalone version

- trivial database library - private includes
-
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Gadi Oxman, August 1995

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This is the Debian GNU/Linux prepackaged version of the EXT2 file
system utilities (e2fsck, mke2fs, etc.). The EXT2 utilities were
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#
# This is a Makefile stub which handles the creation of BSD shared
# libraries.
#
# In order to use this stub, the following makefile variables must be defined.
#
# BSDLIB_VERSION = 1.0
# BSDLIB_IMAGE = libce
# BSDLIB_MYDIR = et
# BSDLIB_INSTALL_DIR = $(SHLIBDIR)
#

all:: image

real-subdirs:: Makefile
 @echo " MKDIR pic"
 @mkdir -p pic

BSD_LIB = $(BSDLIB_IMAGE).so.$(BSDLIB_VERSION)
BSDLIB_PIC_FLAG = -fpic

image:  $(BSD_LIB)

$(BSD_LIB): $(OBJS)
 (cd pic; ld -Bshareable -o $(BSD_LIB) $(LDFLAGS_SHLIB) $(OBJS))
 $(MV) pic/$(BSD_LIB) .
 $(RM) -f ../$(BSD_LIB)
 (cd ..; $(LN) $(LINK_BUILD_FLAGS) \
  `echo $(my_dir) | sed -e 's;lib/;;'`/$(BSD_LIB) $(BSD_LIB))

install-shlibs install:: $(BSD_LIB)
 @echo " INSTALL_PROGRAM $(BSDLIB_INSTALL_DIR)/$(BSD_LIB)"
 @$(INSTALL_PROGRAM) $(BSD_LIB) \
  $(DESTDIR)$(BSDLIB_INSTALL_DIR)/$(BSD_LIB)
 @-$(LDCONFIG)

install-strip: install
```

install-shlibs-strip: install-shlibs

uninstall-shlibs uninstall::
 $(RM) -f $(DESTDIR)$(BSDLIB_INSTALL_DIR)/$(BSD_LIB)

clean::
 $(RM)
 -rf pic
 $(RM) -f $(BSD_LIB)
 $(RM) -f ../$(BSD_LIB)
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This is the Debian GNU/Linux prepackaged version of the ss
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This package was put together by Yann Dirson <dirson@debian.org>,
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tsx-11.mit.edu:/pub/linux/packages/ext2fs/

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Theodore Ts'o
23-June-2007

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"Source code" for a work means the preferred form of the work for making modifications to it. For a library, complete source code means

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(For example, a function in a library to compute square roots has

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This package was put together by Yann Dirson <dirson@debian.org>,
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This package was added to the e2fsprogs debian source package by
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1.204 busybox 1.25.0

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jseward@bzip.org
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1.205 init-system-helpers 1.60

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1.206 tftp-hpa 5.2

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*
/tftp-hpa-5-2-r0-tar-bz2/tftp-hpa-5.2-r0/tftp-hpa-5.2/tftp-hpa-5.2/tftp/main.c
* /tftp-hpa-5-2-r0-tar-bz2/tftp-hpa-5.2-r0/tftp-hpa-5.2/tftp-hpa-5.2/tftp/tftp.c
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* /tftp-hpa-5-2-r0-tar-bz2/tftp-hpa-5.2-r0/tftp-hpa-5.2/tftp-hpa-5.2/tftpd/recvfrom.c
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Summary: The client for the Trivial File Transfer Protocol (TFTP).
Name: tftp
Version: 5.2
Release: 1
License: BSD
Group: Applications/Internet
Source0: http://www.kernel.org/pub/software/network/tftp/tftp-hpa-%{version}.tar.gz
BuildRequires: tcp_wrappers-devel
BuildRoot: %{_tmppath}/%{name}-root

%description
The Trivial File Transfer Protocol (TFTP) is normally used only for
booting diskless workstations. The tftp package provides the user
interface for TFTP, which allows users to transfer files to and from a
remote machine. This program and TFTP provide very little security,
and should not be enabled unless it is expressly needed.

%package server
Group: System Environment/Daemons
Summary: The server for the Trivial File Transfer Protocol (TFTP).

```
Requires: xinetd

%description server
The Trivial File Transfer Protocol (TFTP) is normally used only for
booting diskless workstations.  The tftp-server package provides
 the
server for TFTP, which allows users to transfer files to and from a
remote machine. TFTP provides very little security, and should not be
enabled unless it is expressly needed.  The TFTP server is run from
/etc/xinetd.d/tftp, and is disabled by default on Red Hat Linux systems.

%prep
%setup -q -n tftp-hpa-%{version}

%build

%configure
make %{?_smp_mflags}

%install
rm -rf ${RPM_BUILD_ROOT}
mkdir -p ${RPM_BUILD_ROOT}%{_bindir}
mkdir -p ${RPM_BUILD_ROOT}%{_mandir}/man{1,8}
mkdir -p ${RPM_BUILD_ROOT}%{_sbindir}

make INSTALLROOT=${RPM_BUILD_ROOT} \
   SBINDIR=%{_sbindir} MANDIR=%{_mandir} \
 install
install -m755 -d ${RPM_BUILD_ROOT}%{_sysconfdir}/xinetd.d/ ${RPM_BUILD_ROOT}/tftpboot
install -m644 tftp-xinetd ${RPM_BUILD_ROOT}%{_sysconfdir}/xinetd.d/tftp

%post server
/sbin/service xinetd reload > /dev/null 2>&1 || :

%postun server
if [ $1 = 0 ]; then
   /sbin/service xinetd reload > /dev/null 2>&1 || :
fi

%clean
rm -rf ${RPM_BUILD_ROOT}

%files
%defattr(-,root,root)
%{_bindir}/tftp
%{_mandir}/man1/*

%files
```

server
%defattr(-,root,root)
%config(noreplace) %{_sysconfdir}/xinetd.d/tftp
%dir /tftpboot
%{_sbindir}/in.tftpd
%{_mandir}/man8/*

%changelog
* Tue Sep 14 2004 H. Peter Anvin <hpa@zytor.com>
- removed completely broken "Malta" patch.
- integrated into build machinery so rpm -ta works.

* Fri Feb 13 2004 Elliot Lee <sopwith@redhat.com>
- rebuilt

* Wed Jun 04 2003 Elliot Lee <sopwith@redhat.com>
- rebuilt

* Fri Apr 11 2003 Elliot Lee <sopwith@redhat.com>
- 0.33
- Add /tftpboot directory (#88204)

* Mon Feb 24 2003 Elliot Lee <sopwith@redhat.com>
- rebuilt

* Sun Feb 23 2003 Tim Powers <timp@redhat.com>
- add BuildPreReq on tcp_wrappers

* Wed Jan 22 2003 Tim Powers <timp@redhat.com>
- rebuilt

* Mon Nov 11 2002 Elliot Lee <sopwith@redhat.com> 0.32-1
- Update to 0.32

* Wed Oct 23 2002 Elliot Lee <sopwith@redhat.com> 0.30-1
- Fix #55789
- Update to 0.30

* Thu Jun 27 2002 Elliot Lee <sopwith@redhat.com>
- Try applying HJ's patch from #65476

* Fri Jun
21 2002 Tim Powers <timp@redhat.com>
- automated rebuild

* Mon Jun 17 2002 Elliot Lee <sopwith@redhat.com>
- Update to 0.29

* Thu May 23 2002 Tim Powers <timp@redhat.com>
- automated rebuild

* Wed Jan 09 2002 Tim Powers <timp@redhat.com>
- automated rebuild

* Tue Dec 18 2001 Elliot Lee <sopwith@redhat.com> 0.17-15
- Add patch4: netkit-tftp-0.17-defaultport.patch for bug #57562
- Update to tftp-hpa-0.28 (bug #56131)
- Remove include/arpa/tftp.h to fix #57259
- Add resource limits in tftp-xinetd (#56722)

* Sun Jun 24 2001 Elliot Lee <sopwith@redhat.com>
- Bump release + rebuild.

* Tue Jun 12 2001 Helge Deller <hdeller@redhat.de> (0.17-13)
- updated tftp-hpa source to tftp-hpa-0.17
- tweaked specfile with different defines for tftp-netkit and tftp-hpa version
- use hpa's tftpd.8 man page instead of the netkits one

* Mon May 07 2001 Helge Deller <hdeller@redhat.de>
- rebuilt in 7.1.x

* Wed Apr 18 2001 Helge Deller <hdeller@redhat.de>
- fix tftp client's put problems (#29529)
- update
 to tftp-hpa-0.16

* Wed Apr 4 2001 Jakub Jelinek <jakub@redhat.com>
- don't let configure to guess compiler, it can pick up egcs

* Thu Feb 08 2001 Helge Deller <hdeller@redhat.de>
- changed "wait" in xinetd file to "yes" (hpa-tftpd forks and exits) (#26467)
- fixed hpa-tftpd to handle files greater than 32MB (#23725)
- added "-l" flag to hpa-tftpd for file-logging (#26467)
- added description for "-l" to the man-page

* Thu Feb 08 2001 Helge Deller <hdeller@redhat.de>
- updated tftp client to 0.17 stable (#19640),
- drop dependency on xinetd for tftp client (#25051),

* Wed Jan 17 2001 Jeff Johnson <jbj@redhat.com>
- xinetd shouldn't wait on tftp (which forks) (#23923).

* Sat Jan 6 2001 Jeff Johnson <jbj@redhat.com>
- fix to permit tftp put's (#18128).
- startup as root with chroot to /tftpboot with early reversion to nobody
 is preferable to starting as nobody w/o ability to chroot.

- %%post is needed by server, not client. Add %%postun for erasure as well.

* Wed Aug 23 2000
Nalin Dahyabhai <nalin@redhat.com>
- default to being disabled

* Thu Aug 17 2000 Jeff Johnson <jbj@redhat.com>
- correct group.

* Tue Jul 25 2000 Nalin Dahyabhai <nalin@redhat.com>
- change user from root to nobody

* Sat Jul 22 2000 Jeff Johnson <jbj@redhat.com>
- update to tftp-hpa-0.14 (#14003).
- add server_args (#14003).
- remove -D_BSD_SOURCE (#14003).

* Fri Jul 21 2000 Nalin Dahyabhai <nalin@redhat.com>
- cook up an xinetd config file for tftpd

* Wed Jul 12 2000 Prospector <bugzilla@redhat.com>
- automatic rebuild

* Sun Jun 18 2000 Jeff Johnson <jbj@redhat.com>
- FHS packaging.
- update to 0.17.

* Fri May 5 2000 Matt Wilson <msw@redhat.com>
- use _BSD_SOURCE for hpa's tftpd so we get BSD signal semantics.

* Fri Feb 11 2000 Bill Nottingham <notting@redhat.com>
- fix description

* Wed Feb 9 2000 Jeff Johnson <jbj@redhat.com>
- compress man pages (again).

* Wed Feb 02 2000 Cristian Gafton <gafton@redhat.com>
- man pages are compressed
- fix description and summary

* Tue
Jan 4 2000 Bill Nottingham <notting@redhat.com>
- split client and server

* Tue Dec 21 1999 Jeff Johnson <jbj@redhat.com>
- update to 0.16.

* Sat Aug 28 1999 Jeff Johnson <jbj@redhat.com>

- update to 0.15.

* Wed Apr 7 1999 Jeff Johnson <jbj@redhat.com>
- tftpd should truncate file when overwriting (#412)

* Sun Mar 21 1999 Cristian Gafton <gafton@redhat.com>
- auto rebuild in the new build environment (release 22)

* Mon Mar 15 1999 Jeff Johnson <jbj@redhat.com>
- compile for 6.0.

* Fri Aug 7 1998 Jeff Johnson <jbj@redhat.com>
- build root

* Mon Apr 27 1998 Prospector System <bugs@redhat.com>
- translations modified for de, fr, tr

* Mon Sep 22 1997 Erik Troan <ewt@redhat.com>
- added check for getpwnam() failure

* Tue Jul 15 1997 Erik Troan <ewt@redhat.com>
- initial build

Found in path(s):
* /tftp-hpa-5-2-r0-tar-bz2/tftp-hpa-5.2-r0/tftp-hpa-5.2/tftp-hpa-5.2/tftp.spec
No license file was found, but licenses were detected in source scan.

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*
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*
*   This program is free software available under the same license
*   as the "OpenBSD" operating system, distributed at
*   http://www.openbsd.org/.
*
* --- */

Found in path(s):
* /tftp-hpa-5-2-r0-tar-bz2/tftp-hpa-5.2-r0/tftp-hpa-5.2/tftp-hpa-5.2/config.h
No license file was found, but licenses were detected in source scan.

Summary: The client for the Trivial File Transfer Protocol (TFTP).
Name: tftp
Version: @@VERSION@@
Release: 1
License: BSD
Group: Applications/Internet
Source0: http://www.kernel.org/pub/software/network/tftp/tftp-hpa-%{version}.tar.gz

```
BuildRequires: tcp_wrappers-devel
BuildRoot: %{_tmppath}/%{name}-root

%description
The Trivial File Transfer Protocol (TFTP) is normally used only for
booting diskless workstations.  The tftp package provides the user
interface for TFTP, which allows users to transfer files to and from a
remote machine.  This program and TFTP provide very little security,
and should not be enabled unless it is expressly needed.

%package server
Group: System Environment/Daemons
Summary: The server for the Trivial File Transfer Protocol (TFTP).
Requires: xinetd

%description server
The Trivial File Transfer Protocol (TFTP) is normally used only for
booting diskless workstations.  The tftp-server package
 provides the
server for TFTP, which allows users to transfer files to and from a
remote machine. TFTP provides very little security, and should not be
enabled unless it is expressly needed.  The TFTP server is run from
/etc/xinetd.d/tftp, and is disabled by default on Red Hat Linux systems.

%prep
%setup -q -n tftp-hpa-%{version}

%build

%configure
make %{?_smp_mflags}

%install
rm -rf ${RPM_BUILD_ROOT}
mkdir -p ${RPM_BUILD_ROOT}%{_bindir}
mkdir -p ${RPM_BUILD_ROOT}%{_mandir}/man{1,8}
mkdir -p ${RPM_BUILD_ROOT}%{_sbindir}

make INSTALLROOT=${RPM_BUILD_ROOT} \
   SBINDIR=%{_sbindir} MANDIR=%{_mandir} \
 install
install -m755 -d ${RPM_BUILD_ROOT}%{_sysconfdir}/xinetd.d/ ${RPM_BUILD_ROOT}/tftpboot
install -m644 tftp-xinetd ${RPM_BUILD_ROOT}%{_sysconfdir}/xinetd.d/tftp

%post server
/sbin/service xinetd reload > /dev/null 2>&1 || :

%postun server
```

```
if [ $1 = 0 ]; then
  /sbin/service xinetd reload > /dev/null 2>&1 || :
fi

%clean
rm -rf ${RPM_BUILD_ROOT}

%files
%defattr(-,root,root)
%{_bindir}/tftp
%{_mandir}/man1/*

%files
 server
%defattr(-,root,root)
%config(noreplace) %{_sysconfdir}/xinetd.d/tftp
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- Update to 0.32

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- Fix #55789
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- update to 0.17.

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* Mon Sep 22 1997 Erik Troan <ewt@redhat.com>
- added check for getpwnam() failure

* Tue Jul 15 1997 Erik Troan <ewt@redhat.com>
- initial build

Found in path(s):
* /tftp-hpa-5-2-r0-tar-bz2/tftp-hpa-5.2-r0/tftp-hpa-5.2/tftp-hpa-5.2/tftp.spec.in
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*
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* http://www.openbsd.org/.
*

* -- */

Found in path(s):
* /tftp-hpa-5-2-r0-tar-bz2/tftp-hpa-5.2-r0/tftp-hpa-5.2/tftp-hpa-5.2/tftpd/tftpd.h
No license file was found, but licenses were detected in source scan.

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Found in path(s):
* /tftp-hpa-5-2-r0-tar-bz2/tftp-hpa-5.2-r0/tftp-hpa-5.2/tftp-hpa-5.2/tftpd/tftpd.8.in
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.\" 3. Neither the name of the University nor the names of its contributors
.\"   without specific prior written permission.

Found in path(s):
* /tftp-hpa-5-2-r0-tar-bz2/tftp-hpa-5.2-r0/tftp-hpa-5.2/tftp-hpa-5.2/tftp/tftp.1.in
No license file was found, but licenses were detected in source scan.

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Found in path(s):
* /tftp-hpa-5-2-r0-tar-bz2/tftp-hpa-5.2-r0/tftp-hpa-5.2/tftp-hpa-5.2/MCONFIG.in
No license file was found, but licenses were detected in source scan.

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*
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*   http://www.openbsd.org/.
*
* -- */

Found in path(s):
* /tftp-hpa-5-2-r0-tar-bz2/tftp-hpa-5.2-r0/tftp-hpa-5.2/tftp-hpa-5.2/tftpd/remap.h
* /tftp-hpa-5-2-r0-tar-bz2/tftp-hpa-5.2-r0/tftp-hpa-5.2/tftp-hpa-5.2/tftpd/remap.c
* /tftp-hpa-5-2-r0-tar-bz2/tftp-hpa-5.2-r0/tftp-hpa-5.2/tftp-hpa-5.2/tftpd/misc.c
No license file was found, but licenses were detected in source scan.

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*/

Found in path(s):
* /tftp-hpa-5-2-r0-tar-bz2/tftp-hpa-5.2-r0/tftp-hpa-5.2/tftp-hpa-5.2/tftp/extern.h
* /tftp-hpa-5-2-r0-tar-bz2/tftp-hpa-5.2-r0/tftp-hpa-5.2/tftp-hpa-5.2/common/tftpsubs.h

1.207 libvmtools 12.2.5.43614

1.207.1 Available under license :

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Version 2.1, February 1999

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[This is the first released version of the Lesser GPL. It also counts
as the successor of the GNU Library Public License, version 2, hence
the version number 2.1.]

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free software--to make sure the software is free for all its users.

This license, the Lesser General Public License, applies to some
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this license or the ordinary General Public License is the better
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We call this license the "Lesser" General Public License because it does Less to protect the user's freedom than the ordinary General Public License. It also provides other free software developers Less

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For example, on rare occasions, there may be a special need to encourage the widest possible use of a certain library, so that it becomes a de-facto standard. To achieve this, non-free programs must be allowed to use the library. A more frequent case is that a free library does the same job as widely used non-free libraries. In this case, there is little to gain by limiting the free library to free software only, so we use
the Lesser General Public License.

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its purpose remains meaningful.

(For example, a function in a library to compute square roots has
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>>> freebsd-base64-4.8
>>>
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==

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>>> freebsd-base64-4.8

base64.c -- routines to encode/decode base64 data
$OpenLDAP: pkg/ldap/libraries/liblutil/base64.c,v 1.15 2006/01/03 22:12:11 kurt Exp $ /
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>>> unicode-5.0

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1.208 dhcpcd 9.1.1

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1.209 openssh 9.6p1

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* @version 3.0 (December 2000)
*
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*
* @author Vincent Rijmen <vincent.rijmen@esat.kuleuven.ac.be>
* @author Antoon Bosselaers <antoon.bosselaers@esat.kuleuven.ac.be>
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1.210 jq 1.4

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1.213 pcre 10.32

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1.214 webrtc m89

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```

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```
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//*
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//*
//* Enhancements by Stanley Yamane:
//*   o reverse lookup table for the decode function
//*   o reserve string buffer space in advance
```
```

//*
//***

```

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```

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```
/*
* SpanDSP - a series of DSP components for telephony
*
* g711.h - In line A-law and u-law conversion routines
*
* Written by Steve Underwood <steveu@coppice.org>
*
* Copyright (C) 2001 Steve Underwood
*
* Despite my general liking of the GPL, I place this code in the
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* public domain for the benefit of all mankind - even the slimy
* ones who might try to proprietize my work and use it to my
* detriment.
*/

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# g722
```
/*
* SpanDSP - a series of DSP components for telephony
*
* g722_decode.c - The ITU G.722 codec, decode part.
*
* Written by Steve Underwood <steveu@coppice.org>
*
* Copyright (C) 2005 Steve Underwood
*
* Despite my general liking of the GPL, I place my own contributions
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*
* Based in part on a single channel G.722 codec which is:
*
* Copyright (c) CMU 1993
* Computer Science, Speech Group
* Chengxiang Lu and Alex Hauptmann
*/

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```
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```
```

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```

# sigslot
```
// sigslot.h: Signal/Slot classes
//
// Written by Sarah Thompson (sarah@telergy.com) 2002.
//
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// the proviso that the author takes on no responsibility or liability for any
// use.

```

# spl_sqrt_floor
```
/*
* Written by Wilco Dijkstra, 1996. The following email exchange establishes the
* license.
```
```

*
* From: Wilco Dijkstra <Wilco.Dijkstra@ntlworld.com>
* Date: Fri, Jun 24, 2011 at 3:20 AM
* Subject: Re: sqrt routine
* To: Kevin Ma <kma@google.com>
* Hi Kevin,
* Thanks for asking. Those routines are public domain (originally posted to
* comp.sys.arm a long time ago), so you can use them freely for any purpose.
* Cheers,
* Wilco
*
* -----
Original Message -----
* From: "Kevin Ma" <kma@google.com>
* To: <Wilco.Dijkstra@ntlworld.com>
* Sent: Thursday, June 23, 2011 11:44 PM
* Subject: Fwd: sqrt routine
* Hi Wilco,
* I saw your sqrt routine from several web sites, including
* http://www.finesse.demon.co.uk/steven/sqrt.html.
* Just wonder if there's any copyright information with your Successive
* approximation routines, or if I can freely use it for any purpose.
* Thanks.
* Kevin
*/

```

# usrsctp
```
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```

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```
version 1.2.11, January 15th, 2017

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```

# 1.215 systemd 231

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1.221 gvfs 1.28.2-1ubuntu1~16.04.2

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Because of this blurred distinction, using the ordinary General Public License for libraries did not effectively promote software sharing, because most developers did not use the libraries. We concluded that weaker conditions might promote sharing better.

However, unrestricted linking of non-free programs would deprive the users of those programs of all benefit from the free status of the libraries themselves. This Library General Public License is intended to permit developers of non-free programs to use free libraries, while preserving your freedom as a user of such programs to change the free libraries that are incorporated in them. (We have not seen how to achieve this as regards changes in header files, but we have achieved it as regards changes in the actual functions of the Library.) The hope is that this will lead to faster development of free libraries.

The precise terms and conditions for copying, distribution and modification follow. Pay close attention to the difference between a "work based on the library" and a "work that uses the library". The former contains code derived from the library, while the latter only works together with the library.

Note that it is possible for a library to be covered by the ordinary General Public License rather than by this special one.

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0. This License Agreement applies to any software library which contains a notice placed by the copyright holder or other authorized party saying it may be distributed under the terms of this Library General Public License (also called "this License"). Each licensee is addressed as "you".

A "library" means a collection of software functions and/or data prepared so as to be conveniently linked with application programs (which use some of those functions and data) to form executables.

The "Library", below, refers to any such software library or work which has
been distributed under these terms. A "work based on the Library" means either the Library or any derivative work under copyright law: that is to say, a work containing the Library or a portion of it, either verbatim or with modifications and/or translated straightforwardly into another language. (Hereinafter, translation is included without limitation in the term "modification".)

"Source code" for a work means the preferred form of the work for making modifications to it. For a library, complete source code means all the source code for all modules it contains, plus any associated interface definition files, plus the scripts used to control compilation and installation of the library.

Activities other than copying, distribution and modification are not covered by this License; they are outside its scope. The act of running a program using the Library is not restricted, and output from such a program is covered only if its contents constitute a work based on the Library (independent
of the use of the Library in a tool for
writing it). Whether that is true depends on what the Library does and what the program that uses the Library does.

1. You may copy and distribute verbatim copies of the Library's complete source code as you receive it, in any medium, provided that you conspicuously and appropriately publish on each copy an appropriate copyright notice and disclaimer of warranty; keep intact all the notices that refer to this License and to the absence of any warranty; and distribute a copy of this License along with the Library.

You may charge a fee for the physical act of transferring a copy, and you may at your option offer warranty protection in exchange for a fee.

2. You may modify your copy or copies of the Library or any portion

of it, thus forming a work based on the Library, and copy and distribute such modifications or work under the terms of Section 1 above, provided that you also meet all of these conditions:

a) The modified work must itself be a software library.

b) You must cause the files modified to carry prominent notices stating that you changed the files and the date of any change.

c) You must cause the whole of the work to be licensed at no charge to all third parties under the terms of this License.

d) If a facility in the modified Library refers to a function or a table of data to be supplied by an application program that uses the facility, other than as an argument passed when the facility is invoked, then you must make a good faith effort to ensure that, in the event an application does not supply such function or table, the facility still operates, and performs whatever part of its purpose remains meaningful.

(For example, a function in a library to compute square roots has a purpose that is entirely well-defined independent of the application. Therefore, Subsection 2d requires that any application-supplied function or table used by this function must be optional: if the application does not supply it, the square root function must still compute square roots.)

These requirements apply to the modified work as a whole. If identifiable sections of that work are not derived from the Library, and can be reasonably considered independent and separate works in themselves, then this License, and its terms, do not apply to those sections when you distribute them as separate works. But when you distribute the same sections as part of a whole which is a work based on the Library, the distribution of the whole must be on the terms of this License, whose permissions for other licensees extend to the entire whole, and thus to each and every part regardless of who wrote it.

Thus, it is not the intent of this section to claim rights or contest your rights to work written entirely by you; rather, the intent is to exercise the right to control the distribution of derivative or collective works based on the Library.

In addition, mere aggregation of another work not based on the Library with the Library (or with a work based on the Library) on a volume of

a storage or distribution medium does not bring the other work under the scope of this License.

3. You may opt to apply the terms of the ordinary GNU General Public License instead of this License to a given copy of the Library. To do this, you must alter all the notices that refer to this License, so that they refer to the ordinary GNU General Public License, version 2, instead of to this License. (If a newer version than version 2 of the ordinary GNU General Public License has appeared, then you can specify that version instead if you wish.) Do not make any other change in these notices.

Once this change is made in a given copy, it is irreversible for that copy, so the ordinary GNU General Public License applies to all subsequent copies and derivative works made from that copy.

This option is useful when you wish to copy part of
the code of
the Library into a program that is not a library.

4. You may copy and distribute the Library (or a portion or derivative of it, under Section 2) in object code or executable form under the terms of Sections 1 and 2 above provided that you accompany it with the complete corresponding machine-readable source code, which must be distributed under the terms of Sections 1 and 2 above on a medium customarily used for software interchange.

If distribution of object code is made by offering access to copy from a designated place, then offering equivalent access to copy the source code from the same place satisfies the requirement to distribute the source code, even though third parties are not compelled to copy the source along with the object code.

5. A program that contains no derivative of any portion of the Library, but is designed to work with the Library by being compiled or linked with it, is called a "work that uses the Library". Such a work, in isolation, is not
a derivative work of the Library, and
therefore falls outside the scope of this License.

However, linking a "work that uses the Library" with the Library creates an executable that is a derivative of the Library (because it contains portions of the Library), rather than a "work that uses the library". The executable is therefore covered by this License. Section 6 states terms for distribution of such executables.

When a "work that uses the Library" uses material from a header file that is part of the Library, the object code for the work may be a

derivative work of the Library even though the source code is not. Whether this is true is especially significant if the work can be linked without the Library, or if the work is itself a library. The threshold for this to be true is not precisely defined by law.

If such an object file uses only numerical parameters, data structure layouts and accessors, and small macros and small inline functions (ten lines or less in length), then the use of the object file is unrestricted, regardless of whether it is legally a derivative work. (Executables containing this object code plus portions of the Library will still fall under Section 6.)

Otherwise, if the work is a derivative of the Library, you may distribute the object code for the work under the terms of Section 6. Any executables containing that work also fall under Section 6, whether or not they are linked directly with the Library itself.

6. As an exception to the Sections above, you may also compile or link a "work that uses the Library" with the Library to produce a work containing portions of the Library, and distribute that work under terms of your choice, provided that the terms permit modification of the work for the customer's own use and reverse engineering for debugging such modifications.

You must give prominent notice with each copy of the work that the Library is used in it and that the Library and its use are covered by this License. You must supply a copy of this License. If the work during execution displays copyright notices, you must include the copyright notice for the Library among them, as well as a reference directing the user to the copy of this License. Also, you must do one of these things:

a) Accompany the work with the complete corresponding machine-readable source code for the Library including whatever changes were used in the work (which must be distributed under Sections 1 and 2 above); and, if the work is an executable linked with the Library, with the complete machine-readable "work that uses the Library", as object code and/or source code, so that the user can modify the Library and then relink to produce a modified executable containing the modified Library. (It is understood that the user who changes the contents of definitions files in the Library will not necessarily be able to recompile the application to use the modified definitions.)

b) Accompany

the work with a written offer, valid for at
least three years, to give the same user the materials
specified in Subsection 6a, above, for a charge no more
than the cost of performing this distribution.

c) If distribution of the work is made by offering access to copy
from a designated place, offer equivalent access to copy the above
specified materials from the same place.

d) Verify that the user has already received a copy of these
materials or that you have already sent this user a copy.

For an executable, the required form of the "work that uses the
Library" must include any data and utility programs needed for
reproducing the executable from it. However, as a special exception,
the source code distributed need not include anything that is normally
distributed (in either source or binary form) with the major
components (compiler, kernel, and so on) of the operating system on
which the executable runs, unless that component itself accompanies
the
executable.

It may happen that this requirement contradicts the license
restrictions of other proprietary libraries that do not normally
accompany the operating system. Such a contradiction means you cannot
use both them and the Library together in an executable that you
distribute.

7. You may place library facilities that are a work based on the
Library side-by-side in a single library together with other library
facilities not covered by this License, and distribute such a combined
library, provided that the separate distribution of the work based on
the Library and of the other library facilities is otherwise
permitted, and provided that you do these two things:

a) Accompany the combined library with a copy of the same work
based on the Library, uncombined with any other library
facilities. This must be distributed under the terms of the
Sections above.

b) Give prominent notice with the combined library of the fact
that part of it is a work based
on the Library, and explaining
where to find the accompanying uncombined form of the same work.

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END OF TERMS AND CONDITIONS

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To apply these terms, attach the following notices to the library. It is safest to attach them to the start of each source file to most effectively convey the exclusion of warranty; and each file should have at least the "copyright" line and a pointer to where the full notice is found.

<one line to give the library's name and a brief idea of what it does.>
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You should also get your employer (if you work as a programmer) or your
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necessary.
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library `Frob' (a library for tweaking knobs) written by James Random Hacker.

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Ty Coon, President of Vice

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Version 3, 29 June 2007

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For example, if you distribute copies of such a program, whether gratis or for a fee, you must pass on to the recipients the same freedoms that you received. You must make sure that they, too, receive or can get the source code. And you must show them these terms so they know their rights.

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assert copyright on the software, and (2) offer you this License giving you legal permission to copy, distribute and/or modify it.

For the developers' and authors' protection, the GPL clearly explains that there is no warranty for this free software. For both users' and authors' sake, the GPL requires that modified versions be marked as changed, so that their problems will not be attributed erroneously to authors of previous versions.

Some devices are designed to deny users access to install or run modified versions of the software inside them, although the manufacturer can do so. This is fundamentally incompatible with the aim of protecting users' freedom to change the software. The systematic pattern of such abuse occurs in the area of products for individuals to use, which is precisely where it is most unacceptable. Therefore, we have designed this version of the GPL to prohibit the practice for those products. If such problems arise substantially in other domains, we stand
ready to extend this provision to those domains in future versions of the GPL, as needed to protect the freedom of users.

Finally, every program is threatened constantly by software patents. States should not allow patents to restrict development and use of software on general-purpose computers, but in those that do, we wish to avoid the special danger that patents applied to a free program could make it effectively proprietary. To prevent this, the GPL assures that patents cannot be used to render the program non-free.

The precise terms and conditions for copying, distribution and modification follow.

TERMS AND CONDITIONS

0. Definitions.

"This License" refers to version 3 of the GNU General Public License.

"Copyright" also means copyright-like laws that apply to other kinds of

works, such as semiconductor masks.

"The Program" refers to any copyrightable work licensed under this License. Each licensee is addressed as "you". "Licensees" and "recipients" may be individuals or organizations.

To "modify" a work means to copy from or adapt all or part of the work in a fashion requiring copyright permission, other than the making of an exact copy. The resulting work is called a "modified version" of the earlier work or a work "based on" the earlier work.

A "covered work" means either the unmodified Program or a work based on the Program.

To "propagate" a work means to do anything with it that, without permission, would make you directly or secondarily liable for infringement under applicable copyright law, except executing it on a computer or modifying a private copy. Propagation includes copying, distribution (with or without modification), making available to the public, and in some countries other activities as well.

To "convey" a work means any kind of propagation that enables other parties to make or receive copies. Mere interaction with a user through a computer network, with no transfer of a copy, is not conveying.

An interactive user interface displays "Appropriate Legal Notices" to the extent that it includes a convenient and prominently visible feature that (1) displays an appropriate copyright notice, and (2) tells the user that there is no warranty for the work (except to the extent that warranties are provided), that licensees may convey the work under this License, and how to view a copy of this License. If the interface presents a list of user commands or options, such as a menu, a prominent item in the list meets this criterion.

1. Source Code.

The "source code" for a work means the preferred form of the work for making modifications to it. "Object code" means any non-source form of a work.

A "Standard Interface" means an interface that either is an official standard defined by a recognized standards body, or, in the case of interfaces specified for a particular programming language, one that is widely used among developers working in that language.

The

"System Libraries" of an executable work include anything, other than the work as a whole, that (a) is included in the normal form of packaging a Major Component, but which is not part of that Major Component, and (b) serves only to enable use of the work with that Major Component, or to implement a Standard Interface for which an implementation is available to the public in source code form. A "Major Component", in this context, means a major essential component (kernel, window system, and so on) of the specific operating system (if any) on which the executable work runs, or a compiler used to produce the work, or an object code interpreter used to run it.

The "Corresponding Source" for a work in object code form means all the source code needed to generate, install, and (for an executable work) run the object code and to modify the work, including scripts to control those activities. However, it does not include the work's System Libraries, or general-purpose tools or generally available free programs which are used unmodified in performing those activities but which are not part of the work. For example, Corresponding Source includes interface definition files associated with source files for the work, and the source code for shared libraries and dynamically linked subprograms that the work is specifically designed to require, such as by intimate data communication or control flow between those subprograms and other parts of the work.

The Corresponding Source need not include anything that users can regenerate automatically from other parts of the Corresponding Source.

The Corresponding Source for a work in source code form is that same work.

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section 10
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You may convey verbatim copies of the Program's source code as you receive it, in any medium, provided that you conspicuously and appropriately
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5. Conveying Modified Source Versions.

You may convey a work based on the Program, or the modifications to produce it from the Program, in the form of source code under the terms of section 4, provided that you also meet all of these conditions:

a) The work must carry prominent notices stating that you modified

it, and giving a relevant date.

b) The work must carry prominent notices stating that it is released under this License and any conditions added under section 7. This requirement modifies the requirement in section 4 to "keep intact all notices".

c) You must license the entire work, as a whole, under this License to anyone who comes into possession of a copy. This License will therefore apply, along with any applicable section 7 additional terms, to the whole of the work, and all its parts, regardless of how they are packaged. This License gives no permission to license the work in any other way, but it does not invalidate such permission if you have separately received it.

d) If the work has interactive user interfaces, each must display Appropriate Legal Notices; however, if the Program has interactive interfaces that do not display Appropriate Legal Notices, your work need not make them do so.

A compilation of a covered work with other separate and independent works, which are not by their nature extensions of the covered work, and which are not combined with it such as to form a larger program, in or on a volume of a storage or distribution medium, is called an "aggregate" if the compilation and its resulting copyright are not used to limit the access or legal rights of the compilation's users beyond what the individual works permit. Inclusion of a covered work in an aggregate does not cause this License to apply to the other parts of the aggregate.

6. Conveying Non-Source Forms.

You may convey a covered work in object code form under the terms of sections 4 and 5, provided that you also convey the machine-readable Corresponding Source under the terms of this License, in one of these ways:

a) Convey the object code in, or embodied in, a physical product (including a physical distribution medium), accompanied by the Corresponding Source fixed on a durable physical medium customarily used for software interchange.

b) Convey the object code in, or embodied in, a physical product (including a physical distribution medium), accompanied by a written offer, valid for at least three years

and valid for as
long as you offer spare parts or customer support for that product model, to give anyone who possesses the object code either (1) a copy of the Corresponding Source for all the software in the product that is covered by this License, on a durable physical medium customarily used for software interchange, for a price no more than your reasonable cost of physically performing this conveying of source, or (2) access to copy the Corresponding Source from a network server at no charge.

c) Convey individual copies of the object code with a copy of the written offer to provide the Corresponding Source. This alternative is allowed only occasionally and noncommercially, and only if you received the object code with such an offer, in accord with subsection 6b.

d) Convey the object code by offering access from a designated place (gratis or for a charge), and offer equivalent access to the Corresponding Source in
the same way through the same place at no
further charge. You need not require recipients to copy the Corresponding Source along with the object code. If the place to copy the object code is a network server, the Corresponding Source may be on a different server (operated by you or a third party) that supports equivalent copying facilities, provided you maintain clear directions next to the object code saying where to find the Corresponding Source. Regardless of what server hosts the Corresponding Source, you remain obligated to ensure that it is available for as long as needed to satisfy these requirements.

e) Convey the object code using peer-to-peer transmission, provided you inform other peers where the object code and Corresponding Source of the work are being offered to the general public at no charge under subsection 6d.

A separable portion of the object code, whose source code is excluded from the Corresponding Source
as a System Library, need not be
included in conveying the object code work.

A "User Product" is either (1) a "consumer product", which means any tangible personal property which is normally used for personal, family, or household purposes, or (2) anything designed or sold for incorporation into a dwelling. In determining whether a product is a consumer product, doubtful cases shall be resolved in favor of coverage. For a particular product received by a particular user, "normally used" refers to a typical or common use of that class of product, regardless of the status of the particular user or of the way in which the particular user

actually uses, or expects or is expected to use, the product. A product is a consumer product regardless of whether the product has substantial commercial, industrial or non-consumer uses, unless such uses represent the only significant mode of use of the product.

"Installation Information" for a User Product means any methods, procedures, authorization keys, or other information required to install and execute modified versions of a covered work in that User Product from a modified version of its Corresponding Source. The information must suffice to ensure that the continued functioning of the modified object code is in no case prevented or interfered with solely because modification has been made.

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1.229 bean-validation-api 2.0.1.Final

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1.230 wheel 0.42.0

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1.231 libatomic 10.3.0-1ubuntu1-20.04

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Julian Seward, jseward@bzip.org
bzip2/libbzip2 version 1.0.6 of 6 September 2010

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git://git.savannah.gnu.org/gm2.git (for Modula-2)

The current gcc-10 source package is taken from the SVN gcc-10-branch.

Changes: See changelog.Debian.gz

Debian splits the GNU Compiler Collection into packages for each language, library, and documentation as follows:

Language	Compiler package	Library package	Documentation
Ada	gnat-10	libgnat-10	gnat-10-doc
BRIG	gccbrig-10	libhsail-rt0	
C	gcc-10		gcc-10-doc
C++	g++-10	libstdc++6	libstdc++6-10-doc
D	gdc-10		
Fortran 95	gfortran-10	libgfortran5	gfortran-10-doc
Go	gccgo-10	libgo0	
Objective C	gobjc-10	libobjc4	
Objective C++	gobjc++-10		
Modula-2	gm2-10	libgm2	

For some language run-time libraries, Debian provides source files, development files, debugging symbols and libraries containing position-independent code in separate packages:

Language	Sources	Development	Debugging	Position-Independent
C++			libstdc++6-10-dbg	libstdc++6-10-pic
D	libphobos-10-dev			

Additional packages include:

All languages:

libgcc1, libgcc2, libgcc4	GCC intrinsics (platform-dependent)
gcc-10-base	Base files common to all compilers
gcc-10-soft-float	Software floating point (ARM only)
gcc-10-source	The sources with patches

Ada:

libgnat-util10-dev, libgnat-util10	GNAT version library

C:

cpp-10, cpp-10-doc	GNU C Preprocessor
libssp0-dev, libssp0	GCC stack smashing protection library
libquadmath0	Math routines for the __float128 type

fixincludes Fix non-ANSI header files

C, C++ and Fortran 95:
libgomp1-dev, libgomp1 GCC OpenMP (GOMP) support library
libitm1-dev, libitm1 GNU Transactional Memory Library

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The D source package is made up of the following components.

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========

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However, linking a "work that uses the Library" with the Library

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When a "work that uses the Library" uses material from a header file that is part of the Library, the object code for the work may be a derivative work of the Library even though the source code is not. Whether this is true is especially significant if the work can be linked without the Library, or if the work is itself a library. The threshold for this to be true is not precisely defined by law.

If such an object file uses only numerical parameters, data structure layouts and accessors, and small macros and small inline functions (ten lines or less in length), then the use of the object file is unrestricted, regardless of whether it is legally a derivative work. (Executables containing this object code plus portions of the Library will still fall under Section 6.)

Otherwise, if the work is a derivative of the Library, you may distribute the object code for the work under the terms of Section 6. Any
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Accompany the work with the complete corresponding machine-readable source code for the Library including whatever changes were used in the work (which must be distributed under Sections 1 and 2 above); and, if the work is an executable linked with the Library, with the complete

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The precise terms and conditions for copying, distribution and modification follow.

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@enumerate 0
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The ``source code'' for a work means the preferred form of the work for
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produce the work, or an object code interpreter used to run it.

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work) run the object code and to modify the work, including scripts to
control those activities. However,
it does not include the work's
System Libraries, or general-purpose tools or generally available free
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which are not part of the work. For example, Corresponding Source
includes interface definition files associated with source files for
the work, and the source code for shared libraries and dynamically
linked subprograms that the work is specifically designed to require,

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@item
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@item
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6b.

@item
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1.232 flyway-core 6.4.4

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* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/resource/filesystem/package-info.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/oracle/OracleDatabase.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/util/TimeFormat.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/resolver/CompositeMigrationResolver.java
*
/flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/firebird/FirebirdDatabase.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/mysql/MySQLParser.java
* /flyway-core-6-4-4-sources-
jar/org/flywaydb/core/internal/jdbc/CockroachRetryingTransactionalExecutionTemplate.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/sqlite/SQLiteParser.java
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* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/base/Database.java

* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/h2/package-info.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/util/FileCopyUtils.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/derby/DerbyDatabase.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/sqlscript/SqlScriptExecutor.java
*
/flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/clazz/ClassProvider.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/license/package-info.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/package-info.java
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* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/util/ExceptionUtils.java
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* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/hsqldb/HSQLDBDatabase.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/schemahistory/package-info.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/scanner/filesystem/FileSystemScanner.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/derby/DerbySchema.java
*
/flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/schemahistory/SchemaHistory.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/sqlscript/SqlStatement.java
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* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/hsqldb/package-info.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/scanner/classpath/UrlResolver.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/api/migration/BaseJavaMigration.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/redshift/RedshiftDatabase.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/logging/package-info.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/db2/DB2Table.java
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/flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/saphana/SAPHANASchema.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/util/StopWatch.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/api/InfoOutputProvider.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/scanner/classpath/DefaultUrlResolver.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/jdbc/RowMapper.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/license/FlywayEditionUpgradeRequiredException.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/parser/PlaceholderReplacingReader.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/sqlscript/package-info.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/parser/ParsingContext.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/resource/LoadableResource.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/sqlserver/SQLServerTable.java
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* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/license/VersionPrinter.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/util/StringUtils.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/saphana/SAPHANADatabase.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/scanner/classpath/package-info.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/derby/package-info.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/scanner/classpath/ClassPathLocationScanner.java

* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/sqlscript/SqlScript.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/sybasease/SybaseASETable.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/mysql/MySQLConnection.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/jdbc/WarningImpl.java
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 /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/db2/DB2Connection.java
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* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/postgresql/PostgreSQLConnection.java
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* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/h2/H2Table.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/parser/Recorder.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/api/migration/package-info.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/util/BomFilter.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/jdbc/TransactionalExecutionTemplate.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/base/SchemaObject.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/schemahistory/JdbcTableSchemaHistory.java
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 /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/informix/InformixConnection.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/scanner/classpath/jboss/package-info.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/util/CloseableIterator.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/oracle/package-info.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/jdbc/ExecutionTemplate.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/api/executor/Context.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/api/migration/JavaMigration.java
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* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/configuration/ConfigUtils.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/resolver/package-info.java
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* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/h2/H2Schema.java
* /flyway-core-6-4-4-sources-
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* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/parser/PeekingReader.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/scanner/ResourceNameCache.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/command/DbClean.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/firebird/package-info.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/parser/PositionTrackingReader.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/api/MigrationInfoService.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/snowflake/SnowflakeSchema.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/snowflake/SnowflakeConnection.java
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 /flyway-core-6-4-4-sources-
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* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/scanner/classpath/jboss/JBossVFSv2UrlResolver.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/h2/H2Database.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/parser/Statement.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/api/android/ContextHolder.java

* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/postgresql/PostgreSQLSchema.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/cockroachdb/CockroachDBParser.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/base/Schema.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/api/configuration/ClassicConfiguration.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/resource/ResourceProvider.java
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 /flyway-core-6-4-4-sources-jar/org/flywaydb/core/api/ErrorCode.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/oracle/OracleResults.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/info/MigrationInfoContext.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/scanner/LocationScannerCache.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/sqlserver/package-info.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/schemahistory/AppliedMigration.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/oracle/OracleSqlScriptExecutor.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/callback/CallbackExecutor.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/cockroachdb/CockroachDBSchema.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/resource/Resource.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/api/executor/package-info.java
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 /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/postgresql/package-info.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/db2/DB2Parser.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/sqlscript/SqlScriptMetadata.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/redshift/RedshiftSchema.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/parser/StatementType.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/sqlscript/DefaultSqlScriptExecutor.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/resource/ResourceNameValidator.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/sqlite/package-info.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/oracle/OracleTable.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/oracle/OracleConnection.java
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 /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/hsqldb/HSQLDBConnection.java
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* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/saphana/SAPHANATable.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/resolver/java/JavaMigrationExecutor.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/resource/package-info.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/license/Edition.java
* /flyway-core-6-4-4-sources-
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* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/api/callback/Statement.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/cockroachdb/CockroachDBDatabase.java
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* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/postgresql/PostgreSQLParser.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/sqlscript/SqlStatementIterator.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/logging/slf4j/Slf4jLog.java
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* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/cockroachdb/CockroachDBConnection.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/api/FlywayException.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/base/package-info.java
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 /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/logging/javautil/JavaUtilLog.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/logging/slf4j/package-info.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/db2/DB2Database.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/package-info.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/command/DbRepair.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/firebird/FirebirdParser.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/parser/Parser.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/jdbc/PlainExecutionTemplate.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/info/MigrationInfoDumper.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/resource/ResourceName.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/mysql/MySQLDatabase.java
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 /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/base/Type.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/base/Table.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/api/configuration/FluentConfiguration.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/util/Locations.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/hsqldb/HSQLDBSchema.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/package-info.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/resolver/MigrationInfoHelper.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/informix/InformixSchema.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/api/logging/Log.java
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 /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/sqlscript/ParsedSqlStatement.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/logging/android/AndroidLog.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/sqlscript/SqlScriptFactory.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/license/FlywayProUpgradeRequiredException.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/scanner/android/package-info.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/snowflake/SnowflakeDatabase.java
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* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/base/Function.java
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* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/api/resolver/ResolvedMigration.java
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* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/api/MigrationInfo.java
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* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/jdbc/ErrorImpl.java
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* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/util/DateUtils.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/callback/NoopCallbackExecutor.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/DatabaseExecutionStrategy.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/resolver/sql/SqlMigrationExecutorFactory.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/informix/package-info.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/sqlserver/SQLServerParser.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/output/InfoOutputFactory.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/jdbc/Results.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/db2/package-info.java
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* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/command/DbBaseline.java
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* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/sqlserver/SQLServerSchema.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/logging/javautil/package-info.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/resolver/ChecksumCalculator.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/resolver/sql/SqlMigrationExecutor.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/callback/NoopCallback.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/util/BomStrippingReader.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/callback/package-info.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/resolver/java/ResolvedJavaMigration.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/logging/javautil/JavaUtilLogCreator.java
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/flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/output/ErrorOutput.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/cockroachdb/CockroachDBTable.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/saphana/SAPHANAConnection.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/clazz/NoopClassProvider.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/redshift/RedshiftType.java

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* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/redshift/RedshiftParser.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/oracle/OracleSchema.java
* /flyway-core-6-4-4-sources-
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* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/configuration/ConfigurationValidator.java
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 /flyway-core-6-4-4-sources-jar/org/flywaydb/core/api/callback/package-info.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/resolver/ResolvedMigrationImpl.java
* /flyway-core-6-4-4-sources-
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* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/db2/DB2Type.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/util/UrlUtils.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/api/logging/LogCreator.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/db2/DB2Schema.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/jdbc/DriverDataSource.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/sqlite/SQLiteSchema.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/jdbc/TableLockingExecutionTemplate.java
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 /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/resolver/ResolvedMigrationComparator.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/postgresql/PostgreSQLDatabase.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/jdbc/JdbcUtils.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/output/MigrationOutput.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/h2/H2Parser.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/api/logging/package-info.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/api/callback/Callback.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/resource/android/AndroidResource.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/scanner/package-info.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/api/MigrationVersion.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/derby/DerbyTable.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/scanner/classpath/JarUtils.java
*
 /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/resolver/java/ScanningJavaMigrationResolver.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/snowflake/package-info.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/redshift/package-info.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/jdbc/Result.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/sqlite/SQLiteConnection.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/info/MigrationInfoImpl.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/informix/InformixParser.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/command/DbValidate.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/mysql/MySQLSchema.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/firebird/FirebirdSchema.java
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 /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/sqlite/SQLiteTable.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/api/callback/BaseCallback.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/sqlserver/SQLServerDatabase.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/mysql/package-info.java

* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/resolver/sql/package-info.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/saphana/SAPHANAParser.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/output/package-info.java
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* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/redshift/RedshiftTable.java
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* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/resource/NoopResourceProvider.java
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* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/clazz/package-info.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/scanner/classpath/OsgiClassPathLocationScanner.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/firebird/FirebirdTable.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/scanner/classpath/ResourceAndClassScanner.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/sybasease/SybaseASEDatabase.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/parser/Token.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/jdbc/JdbcTemplate.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/postgresql/PostgreSQLTable.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/api/android/package-info.java
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/flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/info/package-info.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/api/resolver/ChecksumMatcher.java
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* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/resolver/java/FixedJavaMigrationResolver.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/jdbc/ExecutionTemplateFactory.java
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* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/sqlscript/Delimiter.java
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* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/jdbc/JdbcConnectionFactory.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/resource/ResourceType.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/api/callback/Context.java
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/flyway-core-6-4-4-sources-jar/org/flywaydb/core/api/configuration/package-info.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/sybasease/SybaseASEParser.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/util/package-info.java

* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/sqlscript/ParserSqlScript.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/callback/SimpleContext.java
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* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/resource/classpath/package-info.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/util/AbbreviationUtils.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/exception/FlywayDbUpgradeRequiredException.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/snowflake/SnowflakeParser.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/api/package-info.java
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 /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/sqlite/SQLiteDatabase.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/scanner/classpath/ClassPathScanner.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/util/IOUtils.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/api/callback/Event.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/sybasease/SybaseASESchema.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/resource/StringResource.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/resource/ResourceNameParser.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/output/InfoOutput.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/util/ClassUtils.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/hsqldb/HSQLDBTable.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/parser/PositionTracker.java
*
 /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/logging/apachecommons/package-info.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/util/Pair.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/resource/filesystem/FileSystemResource.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/exception/FlywaySqlException.java
* /flyway-core-6-4-4-sources-
jar/org/flywaydb/core/internal/database/sqlserver/SQLServerApplicationLockTemplate.java
* /flyway-core-6-4-4-sources-jar/org/flywaydb/core/internal/database/sybasease/package-info.java
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* /flyway-core-6-4-4-sources-jar/META-INF/maven/org.flywaydb/flyway-core/pom.xml

1.233 jaxb-runtime 2.3.3

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* Project: https://maven.apache.org/resolver/maven-resolver-transport-file/
* Source:
  https://github.com/apache/maven-resolver/tree/master/maven-resolver-transport-file

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1.234 junixsocket-native-common 2.3.2

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1.235 jakarta xml bind api 2.3.3

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1.236 hdrhistogram 2.1.12

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* /hdrhistogram-2-1-12-sources-jar/org/HdrHistogram/Base64Helper.java
* /hdrhistogram-2-1-12-sources-jar/org/HdrHistogram/IntCountsHistogram.java
* /hdrhistogram-2-1-12-sources-jar/org/HdrHistogram/DoubleLinearIterator.java
* /hdrhistogram-2-1-12-sources-jar/org/HdrHistogram/PackedConcurrentDoubleHistogram.java
* /hdrhistogram-2-1-12-sources-jar/org/HdrHistogram/SynchronizedHistogram.java
* /hdrhistogram-2-1-12-sources-jar/org/HdrHistogram/packedarray/PackedArraySingleWriterRecorder.java
* /hdrhistogram-2-1-12-sources-jar/org/HdrHistogram/Histogram.java
*

/hdrhistogram-2-1-12-sources-jar/org/HdrHistogram/LogarithmicIterator.java
* /hdrhistogram-2-1-12-sources-jar/org/HdrHistogram/Version.java
* /hdrhistogram-2-1-12-sources-jar/org/HdrHistogram/RecordedValuesIterator.java
* /hdrhistogram-2-1-12-sources-jar/org/HdrHistogram/LinearIterator.java
* /hdrhistogram-2-1-12-sources-jar/org/HdrHistogram/PackedDoubleHistogram.java
* /hdrhistogram-2-1-12-sources-jar/org/HdrHistogram/AtomicHistogram.java
* /hdrhistogram-2-1-12-sources-jar/org/HdrHistogram/HistogramIterationValue.java
* /hdrhistogram-2-1-12-sources-jar/org/HdrHistogram/Recorder.java
* /hdrhistogram-2-1-12-sources-jar/org/HdrHistogram/ConcurrentDoubleHistogram.java
* /hdrhistogram-2-1-12-sources-jar/org/HdrHistogram/HistogramLogReader.java
* /hdrhistogram-2-1-12-sources-jar/org/HdrHistogram/HistogramLogProcessor.java
* /hdrhistogram-2-1-12-sources-jar/org/HdrHistogram/PackedHistogram.java
* /hdrhistogram-2-1-12-sources-jar/org/HdrHistogram/SingleWriterDoubleRecorder.java
*
/hdrhistogram-2-1-12-sources-jar/org/HdrHistogram/DoubleRecorder.java
* /hdrhistogram-2-1-12-sources-jar/org/HdrHistogram/DoubleHistogramIterationValue.java
* /hdrhistogram-2-1-12-sources-jar/org/HdrHistogram/AbstractHistogramIterator.java
* /hdrhistogram-2-1-12-sources-jar/org/HdrHistogram/SynchronizedDoubleHistogram.java
* /hdrhistogram-2-1-12-sources-jar/org/HdrHistogram/PercentileIterator.java
* /hdrhistogram-2-1-12-sources-jar/org/HdrHistogram/PackedConcurrentHistogram.java
* /hdrhistogram-2-1-12-sources-jar/org/HdrHistogram/DoubleRecordedValuesIterator.java
* /hdrhistogram-2-1-12-sources-jar/org/HdrHistogram/DoubleAllValuesIterator.java
* /hdrhistogram-2-1-12-sources-jar/org/HdrHistogram/SingleWriterRecorder.java
* /hdrhistogram-2-1-12-sources-jar/org/HdrHistogram/DoubleLogarithmicIterator.java
* /hdrhistogram-2-1-12-sources-jar/org/HdrHistogram/ShortCountsHistogram.java
* /hdrhistogram-2-1-12-sources-jar/org/HdrHistogram/EncodableHistogram.java
*
/hdrhistogram-2-1-12-sources-jar/org/HdrHistogram/HistogramLogScanner.java
* /hdrhistogram-2-1-12-sources-jar/org/HdrHistogram/packedarray/PackedArrayRecorder.java
* /hdrhistogram-2-1-12-sources-jar/org/HdrHistogram/ConcurrentHistogram.java
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/*
* package-info.java
* Written by Gil Tene of Azul Systems, and released to the public domain,
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*/

Found in path(s):
* /hdrhistogram-2-1-12-sources-jar/org/HdrHistogram/package-info.java
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* Written by Gil Tene of Azul Systems, and released to the public domain,
* as explained at http://creativecommons.org/publicdomain/zero/1.0/
*
* @author Gil Tene
*/

```
package org.HdrHistogram;

final class Version {
  public static final String version="$VERSION$";
  public static final String build_time="$BUILD_TIME$";
}
```

Found in path(s):
* /hdrhistogram-2-1-12-sources-jar/org/HdrHistogram/Version.java.template
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```
/**
* Written by Gil Tene of Azul Systems, and released to the public domain,
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*/
```

Found in path(s):
* /hdrhistogram-2-1-12-sources-jar/org/HdrHistogram/WriterReaderPhaser.java

1.237 jackson-datatype-jsr310 2.11.2

1.237.1 Available under license :

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1.238 spring-web 5.2.24.RELEASE

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```
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*/

Found in path(s):
* /spring-web-5-2-24-release-sources-jar/org/springframework/remoting/caucho/HessianClientInterceptor.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/bind/support/WebDataBinderFactory.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/http/client/support/HttpRequestWrapper.java
*
/spring-web-5-2-24-release-sources-jar/org/springframework/http/client/BufferingClientHttpResponseWrapper.java
* /spring-web-5-2-24-release-sources-
jar/org/springframework/web/method/support/HandlerMethodReturnValueHandler.java
* /spring-web-5-2-24-release-sources-
jar/org/springframework/web/context/request/async/DeferredResultProcessingInterceptorAdapter.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/client/AsyncRequestCallback.java
* /spring-web-5-2-24-release-sources-
jar/org/springframework/web/method/annotation/SessionStatusMethodArgumentResolver.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/http/client/support/ProxyFactoryBean.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/multipart/support/StringMultipartFileEditor.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/remoting/jaxws/JaxWsPortClientInterceptor.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/http/client/OkHttp3AsyncClientHttpRequest.java
*
/spring-web-5-2-24-release-sources-
jar/org/springframework/web/context/request/async/CallableProcessingInterceptorAdapter.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/http/client/SimpleClientHttpRequestFactory.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/jsf/el/SpringBeanFacesELResolver.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/http/HttpCookie.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/http/client/OkHttp3ClientHttpRequest.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/bind/support/DefaultDataBinderFactory.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/bind/support/WebArgumentResolver.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/http/converter/json/GsonFactoryBean.java
* /spring-web-5-2-24-release-sources-
jar/org/springframework/http/converter/smile/MappingJackson2SmileHttpMessageConverter.java
*
/spring-web-5-2-24-release-sources-
jar/org/springframework/http/server/ServletServerHttpAsyncRequestControl.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/HttpMediaTypeNotSupportedException.java
* /spring-web-5-2-24-release-sources-
jar/org/springframework/web/context/request/async/TimeoutCallableProcessingInterceptor.java
* /spring-web-5-2-24-release-sources-
jar/org/springframework/web/method/annotation/MethodArgumentTypeMismatchException.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/http/codec/multipart/FormFieldPart.java
* /spring-web-5-2-24-release-sources-
jar/org/springframework/web/context/support/ServletContextAwareProcessor.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/multipart/MultipartException.java

* /spring-web-5-2-24-release-sources-jar/org/springframework/web/context/support/WebApplicationObjectSupport.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/remoting/jaxws/LocalJaxWsServiceFactoryBean.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/http/client/AsyncClientHttpRequestExecution.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/multipart/MaxUploadSizeExceededException.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/context/support/ServletContextParameterFactoryBean.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/server/i18n/LocaleContextResolver.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/http/client/AsyncClientHttpRequestFactory.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/http/client/BufferingClientHttpRequestWrapper.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/http/client/AsyncClientHttpRequest.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/http/converter/feed/RssChannelHttpMessageConverter.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/bind/ServletRequestUtils.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/bind/MethodArgumentNotValidException.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/context/support/StaticWebApplicationContext.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/remoting/caucho/HessianProxyFactoryBean.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/bind/EscapedErrors.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/client/AsyncRestOperations.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/util/AbstractUriTemplateHandler.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/http/client/HttpComponentsAsyncClientHttpResponse.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/context/request/async/AsyncWebRequest.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/http/converter/json/GsonBuilderUtils.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/context/request/AsyncWebRequestInterceptor.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/http/client/AsyncClientHttpRequestInterceptor.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/bind/annotation/RestController.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/context/support/ContextExposingHttpServletRequest.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/context/request/NativeWebRequest.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/http/server/RequestPath.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/context/support/ServletContextAttributeFactoryBean.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/http/client/AbstractAsyncClientHttpRequest.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/bind/annotation/ResponseStatus.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/context/request/async/CallableProcessingInterceptor.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/multipart/support/ByteArrayMultipartFileEditor.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/remoting/jaxws/JaxWsPortProxyFactoryBean.java

* /spring-web-5-2-24-release-sources-jar/org/springframework/http/codec/multipart/Part.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/bind/support/DefaultSessionAttributeStore.java
* /spring-web-5-2-24-release-sources-
jar/org/springframework/web/context/request/AbstractRequestAttributesScope.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/context/request/RequestAttributes.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/http/client/Netty4ClientHttpResponse.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/http/client/OkHttp3ClientHttpResponse.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/cors/reactive/CorsProcessor.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/server/session/WebSessionStore.java
*
/spring-web-5-2-24-release-sources-jar/org/springframework/http/client/AbstractBufferingClientHttpRequest.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/filter/DelegatingFilterProxy.java
* /spring-web-5-2-24-release-sources-
jar/org/springframework/http/client/AbstractBufferingAsyncClientHttpRequest.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/bind/support/SessionAttributeStore.java
* /spring-web-5-2-24-release-sources-
jar/org/springframework/remoting/httpinvoker/HttpInvokerServiceExporter.java
* /spring-web-5-2-24-release-sources-
jar/org/springframework/http/client/HttpComponentsAsyncClientHttpRequest.java
* /spring-web-5-2-24-release-sources-
jar/org/springframework/http/converter/json/MappingJacksonInputMessage.java
* /spring-web-5-2-24-release-sources-
jar/org/springframework/web/method/annotation/MethodArgumentConversionNotSupportedException.java
*
/spring-web-5-2-24-release-sources-jar/org/springframework/web/method/support/UriComponentsContributor.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/context/support/LiveBeansViewServlet.java
* /spring-web-5-2-24-release-sources-
jar/org/springframework/web/context/support/HttpRequestHandlerServlet.java
* /spring-web-5-2-24-release-sources-
jar/org/springframework/web/context/request/async/DeferredResultProcessingInterceptor.java
* /spring-web-5-2-24-release-sources-
jar/org/springframework/http/client/HttpComponentsStreamingClientHttpRequest.java
* /spring-web-5-2-24-release-sources-
jar/org/springframework/remoting/httpinvoker/HttpInvokerProxyFactoryBean.java
* /spring-web-5-2-24-release-sources-
jar/org/springframework/http/client/support/InterceptingAsyncHttpAccessor.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/server/ServerWebInputException.java
* /spring-web-5-2-24-release-sources-
jar/org/springframework/remoting/httpinvoker/HttpInvokerClientInterceptor.java
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* /spring-web-5-2-24-release-sources-jar/org/springframework/web/util/ContentCachingRequestWrapper.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/context/ServletConfigAware.java
* /spring-web-5-2-24-release-sources-
jar/org/springframework/web/multipart/commons/CommonsMultipartResolver.java
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 /spring-web-5-2-24-release-sources-jar/org/springframework/web/filter/RelativeRedirectResponseWrapper.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/http/HttpMethod.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/server/WebSession.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/http/client/HttpComponentsClientHttpRequest.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/http/codec/json/Jackson2SmileDecoder.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/http/client/SimpleBufferingClientHttpRequest.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/bind/MissingMatrixVariableException.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/context/request/async/WebAsyncUtils.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/method/support/ModelAndViewContainer.java
* /spring-web-5-2-24-release-sources-
jar/org/springframework/remoting/httpinvoker/HttpComponentsHttpInvokerRequestExecutor.java
*

/spring-web-5-2-24-release-sources-jar/org/springframework/web/bind/MissingPathVariableException.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/http/codec/ServerSentEvent.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/util/pattern/PathElement.java
* /spring-web-5-2-24-release-sources-
jar/org/springframework/http/converter/xml/AbstractXmlHttpMessageConverter.java
* /spring-web-5-2-24-release-sources-
jar/org/springframework/web/multipart/support/StandardMultipartHttpServletRequest.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/server/ServerErrorException.java
* /spring-web-5-2-24-release-sources-
jar/org/springframework/web/server/UnsupportedMediaTypeStatusException.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/context/support/ServletContextResource.java
* /spring-web-5-2-24-release-sources-
jar/org/springframework/web/jsf/el/WebApplicationContextFacesELResolver.java
*
/spring-web-5-2-24-release-sources-
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* /spring-web-5-2-24-release-sources-jar/org/springframework/web/accept/HeaderContentNegotiationStrategy.java
* /spring-web-5-2-24-release-sources-
jar/org/springframework/http/client/InterceptingAsyncClientHttpRequestFactory.java
* /spring-web-5-2-24-release-sources-
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* /spring-web-5-2-24-release-sources-jar/org/springframework/web/filter/CharacterEncodingFilter.java
* /spring-web-5-2-24-release-sources-
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* /spring-web-5-2-24-release-sources-
jar/org/springframework/http/converter/ObjectToStringHttpMessageConverter.java
* /spring-web-5-2-24-release-sources-
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* /spring-web-5-2-24-release-sources-jar/org/springframework/web/HttpSessionRequiredException.java
*
/spring-web-5-2-24-release-sources-jar/org/springframework/web/bind/MissingRequestHeaderException.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/server/i18n/FixedLocaleContextResolver.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/http/HttpInputMessage.java
* /spring-web-5-2-24-release-sources-
jar/org/springframework/http/client/SimpleBufferingAsyncClientHttpRequest.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/http/codec/HttpMessageDecoder.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/bind/annotation/ExceptionHandler.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/client/ResponseErrorHandler.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/http/client/ClientHttpRequestInterceptor.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/bind/annotation/RequestHeader.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/context/ContextLoader.java
*
/spring-web-5-2-24-release-sources-jar/org/springframework/web/multipart/MultipartFileResource.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/util/CookieGenerator.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/context/ServletContextAware.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/http/client/reactive/ClientHttpRequestDecorator.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/context/request/ServletWebRequest.java
* /spring-web-5-2-24-release-sources-

jar/org/springframework/web/server/session/CookieWebSessionIdResolver.java
* /spring-web-5-2-24-release-sources-
jar/org/springframework/http/converter/json/Jackson2ObjectMapperFactoryBean.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/context/AbstractContextLoaderInitializer.java
* /spring-web-5-2-24-release-sources-
jar/org/springframework/http/client/reactive/ClientHttpResponseDecorator.java
*
/spring-web-5-2-24-release-sources-
jar/org/springframework/web/context/support/ServletRequestHandledEvent.java
* /spring-web-5-2-24-release-sources-
jar/org/springframework/remoting/httpinvoker/SimpleHttpInvokerServiceExporter.java
* /spring-web-5-2-24-release-sources-
jar/org/springframework/web/context/support/XmlWebApplicationContext.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/server/handler/FilteringWebHandler.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/http/client/BufferingClientHttpRequestFactory.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/http/HttpLogging.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/bind/annotation/RequestBody.java
* /spring-web-5-2-24-release-sources-
jar/org/springframework/http/converter/ResourceRegionHttpMessageConverter.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/client/AsyncRestTemplate.java
* /spring-web-5-2-24-release-sources-
jar/org/springframework/http/client/InterceptingClientHttpRequestFactory.java
*
/spring-web-5-2-24-release-sources-jar/org/springframework/http/HttpOutputMessage.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/context/ContextLoaderListener.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/remoting/jaxws/LocalJaxWsServiceFactory.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/http/server/reactive/ServletHttpHandlerAdapter.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/filter/reactive/HiddenHttpMethodFilter.java
* /spring-web-5-2-24-release-sources-
jar/org/springframework/web/multipart/support/AbstractMultipartHttpServletRequest.java
* /spring-web-5-2-24-release-sources-
jar/org/springframework/http/converter/support/AllEncompassingFormHttpMessageConverter.java
* /spring-web-5-2-24-release-sources-
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* /spring-web-5-2-24-release-sources-
jar/org/springframework/web/context/request/async/CallableInterceptorChain.java
*
/spring-web-5-2-24-release-sources-jar/org/springframework/web/multipart/MultipartFile.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/http/client/reactive/ClientHttpConnector.java
* /spring-web-5-2-24-release-sources-
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* /spring-web-5-2-24-release-sources-
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* /spring-web-5-2-24-release-sources-jar/org/springframework/http/server/reactive/JettyHttpHandlerAdapter.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/bind/MissingRequestCookieException.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/client/RequestCallback.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/http/client/reactive/AbstractClientHttpRequest.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/http/converter/GenericHttpMessageConverter.java

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 /spring-web-5-2-24-release-sources-
jar/org/springframework/web/method/support/HandlerMethodReturnValueHandlerComposite.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/util/HtmlCharacterEntityReferences.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/multipart/support/MultipartFilter.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/http/server/reactive/DefaultSslInfo.java
* /spring-web-5-2-24-release-sources-
jar/org/springframework/web/bind/support/ConfigurableWebBindingInitializer.java
* /spring-web-5-2-24-release-sources-
jar/org/springframework/web/context/support/AbstractRefreshableWebApplicationContext.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/http/codec/json/Jackson2JsonEncoder.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/remoting/jaxws/AbstractJaxWsServiceExporter.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/http/client/Netty4ClientHttpRequest.java
*
 /spring-web-5-2-24-release-sources-jar/org/springframework/web/context/request/AbstractRequestAttributes.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/client/ResponseExtractor.java
* /spring-web-5-2-24-release-sources-
jar/org/springframework/web/bind/UnsatisfiedServletRequestParameterException.java
* /spring-web-5-2-24-release-sources-
jar/org/springframework/web/accept/AbstractMappingContentNegotiationStrategy.java
* /spring-web-5-2-24-release-sources-
jar/org/springframework/web/method/annotation/SessionAttributesHandler.java
* /spring-web-5-2-24-release-sources-
jar/org/springframework/web/server/session/HeaderWebSessionIdResolver.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/bind/annotation/RequestParam.java
* /spring-web-5-2-24-release-sources-
jar/org/springframework/remoting/caucho/SimpleHessianServiceExporter.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/http/client/Netty4ClientHttpRequestFactory.java
*
 /spring-web-5-2-24-release-sources-jar/org/springframework/web/bind/annotation/PathVariable.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/http/client/SimpleStreamingClientHttpRequest.java
* /spring-web-5-2-24-release-sources-
jar/org/springframework/http/server/reactive/UndertowHttpHandlerAdapter.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/WebApplicationInitializer.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/remoting/jaxws/SimpleJaxWsServiceExporter.java
* /spring-web-5-2-24-release-sources-
jar/org/springframework/http/converter/xml/Jaxb2CollectionHttpMessageConverter.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/http/server/reactive/TomcatHeadersAdapter.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/http/server/reactive/NettyHeadersAdapter.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/client/ExtractingResponseErrorHandler.java
*
 /spring-web-5-2-24-release-sources-
jar/org/springframework/web/accept/ParameterContentNegotiationStrategy.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/http/client/reactive/JettyResourceFactory.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/http/server/reactive/UndertowHeadersAdapter.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/bind/annotation/MatrixVariable.java
* /spring-web-5-2-24-release-sources-
jar/org/springframework/http/converter/json/MappingJackson2HttpMessageConverter.java

* /spring-web-5-2-24-release-sources-jar/org/springframework/http/converter/HttpMessageNotReadableException.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/http/codec/multipart/FilePart.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/SpringServletContainerInitializer.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/filter/ForwardedHeaderFilter.java
*
 /spring-web-5-2-24-release-sources-jar/org/springframework/http/client/reactive/ClientHttpRequest.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/method/annotation/ErrorsMethodArgumentResolver.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/http/server/reactive/AbstractListenerServerHttpResponse.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/method/annotation/AbstractCookieValueMethodArgumentResolver.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/http/client/HttpComponentsClientHttpResponse.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/client/support/RestGatewaySupport.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/method/annotation/ExceptionHandlerMethodResolver.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/multipart/commons/CommonsFileUploadSupport.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/method/annotation/RequestHeaderMethodArgumentResolver.java
*
 /spring-web-5-2-24-release-sources-jar/org/springframework/web/bind/annotation/ResponseBody.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/filter/HttpPutFormContentFilter.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/context/support/ServletContextAttributeExporter.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/http/server/reactive/SslInfo.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/filter/FormContentFilter.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/context/request/async/DeferredResultInterceptorChain.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/util/NestedServletException.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/bind/annotation/RequestPart.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/method/annotation/ExpressionValueMethodArgumentResolver.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/http/codec/protobuf/ProtobufHttpMessageWriter.java
*
 /spring-web-5-2-24-release-sources-jar/org/springframework/http/converter/json/MappingJacksonValue.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/accept/ContentNegotiationStrategy.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/util/UriTemplateHandler.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/http/ZeroCopyHttpOutputMessage.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/http/converter/AbstractGenericHttpMessageConverter.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/filter/HiddenHttpMethodFilter.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/http/client/InterceptingAsyncClientHttpRequest.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/http/server/reactive/HttpHandler.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/context/support/GroovyWebApplicationContext.java

*
/spring-web-5-2-24-release-sources-jar/org/springframework/http/StreamingHttpOutputMessage.java
* /spring-web-5-2-24-release-sources-
jar/org/springframework/web/bind/ServletRequestParameterPropertyValues.java
* /spring-web-5-2-24-release-sources-
jar/org/springframework/remoting/jaxws/SimpleHttpServerJaxWsServiceExporter.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/http/codec/CodecConfigurerFactory.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/util/TagUtils.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/http/codec/LoggingCodecSupport.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/http/codec/protobuf/ProtobufCodecSupport.java
* /spring-web-5-2-24-release-sources-
jar/org/springframework/web/method/annotation/InitBinderDataBinderFactory.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/util/DefaultUriTemplateHandler.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/jsf/DelegatingNavigationHandlerProxy.java
*
/spring-web-5-2-24-release-sources-jar/org/springframework/http/server/ServletServerHttpResponse.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/filter/GenericFilterBean.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/http/server/DefaultRequestPath.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/cors/CorsProcessor.java
* /spring-web-5-2-24-release-sources-
jar/org/springframework/web/multipart/support/StandardServletMultipartResolver.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/remoting/caucho/HessianExporter.java
* /spring-web-5-2-24-release-sources-
jar/org/springframework/web/multipart/support/DefaultMultipartHttpServletRequest.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/http/codec/HttpMessageEncoder.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/filter/RelativeRedirectFilter.java
*
/spring-web-5-2-24-release-sources-jar/org/springframework/web/context/request/async/WebAsyncTask.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/http/InvalidMediaTypeException.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/http/HttpRequest.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/remoting/caucho/HessianServiceExporter.java
* /spring-web-5-2-24-release-sources-
jar/org/springframework/web/HttpRequestMethodNotSupportedException.java
* /spring-web-5-2-24-release-sources-
jar/org/springframework/web/method/annotation/RequestParamMapMethodArgumentResolver.java
* /spring-web-5-2-24-release-sources-
jar/org/springframework/http/converter/protobuf/ExtensionRegistryInitializer.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/util/JavaScriptUtils.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/http/server/reactive/ReactorHttpHandlerAdapter.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/http/client/support/AsyncHttpAccessor.java
*
/spring-web-5-2-24-release-sources-jar/org/springframework/http/codec/HttpMessageReader.java
* /spring-web-5-2-24-release-sources-
jar/org/springframework/remoting/httpinvoker/SimpleHttpInvokerRequestExecutor.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/http/HttpEntity.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/server/DefaultServerWebExchangeBuilder.java
* /spring-web-5-2-24-release-sources-
jar/org/springframework/http/client/support/BasicAuthorizationInterceptor.java

* /spring-web-5-2-24-release-sources-jar/org/springframework/web/context/request/FacesRequestAttributes.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/util/OpaqueUriComponents.java
* /spring-web-5-2-24-release-sources-
jar/org/springframework/http/server/reactive/ContextPathCompositeHandler.java
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Found in path(s):
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/bind/annotation/RequestMethod.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/context/request/RequestContextListener.java
* /spring-web-5-2-24-release-sources-
jar/org/springframework/web/bind/support/SpringWebConstraintValidatorFactory.java
*
 /spring-web-5-2-24-release-sources-
jar/org/springframework/http/client/AbstractClientHttpRequestFactoryWrapper.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/bind/annotation/SessionAttributes.java
* /spring-web-5-2-24-release-sources-
jar/org/springframework/http/converter/HttpMessageConversionException.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/util/HttpSessionMutexListener.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/server/WebFilter.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/filter/CommonsRequestLoggingFilter.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/filter/RequestContextFilter.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/http/HttpMessage.java
* /spring-web-5-2-24-release-sources-
jar/org/springframework/http/converter/HttpMessageNotWritableException.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/multipart/MultipartResolver.java
*
 /spring-web-5-2-24-release-sources-jar/org/springframework/web/server/WebFilterChain.java
* /spring-web-5-2-24-release-sources-
jar/org/springframework/web/context/request/DestructionCallbackBindingListener.java
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/*

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* distributed under the License is distributed on an "AS IS" BASIS,
* WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.
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* limitations under the License.
*/
/**
  * Return the web session for the current request. Always guaranteed  to
  * return an instance either matching to the session id requested by the
  * client, or with a new session id either because the client did not
  * specify one or because the underlying session had expired. Use of this
  * method
 does not automatically create a session. See {@link WebSession}
  * for more details.
  */
```

Found in path(s):
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/server/ServerWebExchange.java
No license file was found, but licenses were detected in source scan.

```
# This file maps Internet media types to unique file extension(s).
# Although created for httpd, this file is used by many software systems
# and has been placed in the public domain for unlimited redistribution.
#
# The table below contains both registered and (common) unregistered types.
# A type that has no unique extension can be ignored -- they are listed
# here to guide configurations toward known types and to make it easier to
# identify "new" types.  File extensions are also commonly used to indicate
# content languages and encodings, so choose them carefully.
#
# Internet media types should be registered as described in RFC 4288.
# The registry is at <https://www.iana.org/assignments/media-types/>.
#
# This file was retrieved from
https://svn.apache.org/viewvc/httpd/httpd/trunk/docs/conf/mime.types?revision=1752884&view=co
#
# MIME type (lowercased)   Extensions
# ============================================ ==========
#
```

```
 application/1d-interleaved-parityfec
# application/3gpdash-qoe-report+xml
# application/3gpp-ims+xml
# application/a2l
# application/activemessage
# application/alto-costmap+json
# application/alto-costmapfilter+json
# application/alto-directory+json
# application/alto-endpointcost+json
# application/alto-endpointcostparams+json
# application/alto-endpointprop+json
# application/alto-endpointpropparams+json
# application/alto-error+json
# application/alto-networkmap+json
# application/alto-networkmapfilter+json
# application/aml
application/andrew-inset   ez
# application/applefile
application/applixware    aw
# application/atf
# application/atfx
application/atom+xml    atom
application/atomcat+xml    atomcat
# application/atomdeleted+xml
# application/atomicmail
application/atomsvc+xml    atomsvc
# application/atxml
# application/auth-policy+xml
# application/bacnet-xdd+zip
# application/batch-smtp
# application/beep+xml
# application/calendar+json
# application/calendar+xml
#
 application/call-completion
# application/cals-1840
# application/cbor
# application/ccmp+xml
application/ccxml+xml    ccxml
# application/cdfx+xml
application/cdmi-capability   cdmia
application/cdmi-container   cdmic
application/cdmi-domain    cdmid
application/cdmi-object    cdmio
application/cdmi-queue    cdmiq
# application/cdni
# application/cea
# application/cea-2018+xml
```

```
# application/cellml+xml
# application/cfw
# application/cms
# application/cnrp+xml
# application/coap-group+json
# application/commonground
# application/conference-info+xml
# application/cpl+xml
# application/csrattrs
# application/csta+xml
# application/cstadata+xml
# application/csvm+json
application/cu-seeme    cu
# application/cybercash
# application/dash+xml
# application/dashdelta
application/davmount+xml    davmount
# application/dca-rft
# application/dcd
# application/dec-dx
# application/dialog-info+xml
# application/dicom
# application/dii
# application/dit
# application/dns
application/docbook+xml    dbk
#
 application/dskpp+xml
application/dssc+der    dssc
application/dssc+xml    xdssc
# application/dvcs
application/ecmascript    ecma
# application/edi-consent
# application/edi-x12
# application/edifact
# application/efi
# application/emergencycalldata.comment+xml
# application/emergencycalldata.deviceinfo+xml
# application/emergencycalldata.providerinfo+xml
# application/emergencycalldata.serviceinfo+xml
# application/emergencycalldata.subscriberinfo+xml
application/emma+xml    emma
# application/emotionml+xml
# application/encaprtp
# application/epp+xml
application/epub+zip    epub
# application/eshop
# application/example
```

```
application/exi     exi
# application/fastinfoset
# application/fastsoap
# application/fdt+xml
# application/fits
# application/font-sfnt
application/font-tdpfr    pfr
application/font-woff    woff
# application/framework-attributes+xml
# application/geo+json
application/gml+xml    gml
application/gpx+xml    gpx
application/gxf     gxf
# application/gzip
#
 application/h224
# application/held+xml
# application/http
application/hyperstudio    stk
# application/ibe-key-request+xml
# application/ibe-pkg-reply+xml
# application/ibe-pp-data
# application/iges
# application/im-iscomposing+xml
# application/index
# application/index.cmd
# application/index.obj
# application/index.response
# application/index.vnd
application/inkml+xml    ink inkml
# application/iotp
application/ipfix    ipfix
# application/ipp
# application/isup
# application/its+xml
application/java-archive   jar
application/java-serialized-object  ser
application/java-vm    class
application/javascript    js
# application/jose
# application/jose+json
# application/jrd+json
application/json    json
# application/json-patch+json
# application/json-seq
application/jsonml+json    jsonml
# application/jwk+json
# application/jwk-set+json
```

```
# application/jwt
# application/kpml-request+xml
# application/kpml-response+xml
# application/ld+json
# application/lgr+xml
# application/link-format
#
 application/load-control+xml
application/lost+xml    lostxml
# application/lostsync+xml
# application/lxf
application/mac-binhex40   hqx
application/mac-compactpro   cpt
# application/macwriteii
application/mads+xml    mads
application/marc    mrc
application/marcxml+xml    mrcx
application/mathematica    ma nb mb
application/mathml+xml    mathml
# application/mathml-content+xml
# application/mathml-presentation+xml
# application/mbms-associated-procedure-description+xml
# application/mbms-deregister+xml
# application/mbms-envelope+xml
# application/mbms-msk+xml
# application/mbms-msk-response+xml
# application/mbms-protection-description+xml
# application/mbms-reception-report+xml
# application/mbms-register+xml
# application/mbms-register-response+xml
# application/mbms-schedule+xml
# application/mbms-user-service-description+xml
application/mbox    mbox
# application/media-policy-dataset+xml
# application/media_control+xml
application/mediaservercontrol+xml  mscml
# application/merge-patch+json
application/metalink+xml   metalink
application/metalink4+xml   meta4
application/mets+xml    mets
#
 application/mf4
# application/mikey
application/mods+xml    mods
# application/moss-keys
# application/moss-signature
# application/mosskey-data
# application/mosskey-request
```

application/mp21 m21 mp21
application/mp4 mp4s
application/mpeg4-generic
application/mpeg4-iod
application/mpeg4-iod-xmt
application/mrb-consumer+xml
application/mrb-publish+xml
application/msc-ivr+xml
application/msc-mixer+xml
application/msword doc dot
application/mxf mxf
application/nasdata
application/news-checkgroups
application/news-groupinfo
application/news-transmission
application/nlsml+xml
application/nss
application/ocsp-request
application/ocsp-response
application/octet-stream bin dms lrf mar so dist distz pkg bpk dump elc deploy
application/oda oda
application/odx
application/oebps-package+xml opf
application/ogg ogx
application/omdoc+xml omdoc
application/onenote onetoc
onetoc2 onetmp onepkg
application/oxps oxps
application/p2p-overlay+xml
application/parityfec
application/patch-ops-error+xml xer
application/pdf pdf
application/pdx
application/pgp-encrypted pgp
application/pgp-keys
application/pgp-signature asc sig
application/pics-rules prf
application/pidf+xml
application/pidf-diff+xml
application/pkcs10 p10
application/pkcs12
application/pkcs7-mime p7m p7c
application/pkcs7-signature p7s
application/pkcs8 p8
application/pkix-attr-cert ac
application/pkix-cert cer
application/pkix-crl crl
application/pkix-pkipath pkipath

application/pkixcmp pki
application/pls+xml pls
application/poc-settings+xml
application/postscript ai eps ps
application/ppsp-tracker+json
application/problem+json
application/problem+xml
application/provenance+xml
application/prs.alvestrand.titrax-sheet
application/prs.cww cww
application/prs.hpub+zip
#
application/prs.nprend
application/prs.plucker
application/prs.rdf-xml-crypt
application/prs.xsf+xml
application/pskc+xml pskcxml
application/qsig
application/raptorfec
application/rdap+json
application/rdf+xml rdf
application/reginfo+xml rif
application/relax-ng-compact-syntax rnc
application/remote-printing
application/reputon+json
application/resource-lists+xml rl
application/resource-lists-diff+xml rld
application/rfc+xml
application/riscos
application/rlmi+xml
application/rls-services+xml rs
application/rpki-ghostbusters gbr
application/rpki-manifest mft
application/rpki-roa roa
application/rpki-updown
application/rsd+xml rsd
application/rss+xml rss
application/rtf rtf
application/rtploopback
application/rtx
application/samlassertion+xml
application/samlmetadata+xml
application/sbml+xml sbml
application/scaip+xml
application/scim+json
application/scvp-cv-request scq
application/scvp-cv-response scs
application/scvp-vp-request spq

application/scvp-vp-response spp
application/sdp sdp
#
application/sep+xml
application/sep-exi
application/session-info
application/set-payment
application/set-payment-initiation setpay
application/set-registration
application/set-registration-initiation setreg
application/sgml
application/sgml-open-catalog
application/shf+xml shf
application/sieve
application/simple-filter+xml
application/simple-message-summary
application/simplesymbolcontainer
application/slate
application/smil
application/smil+xml smi smil
application/smpte336m
application/soap+fastinfoset
application/soap+xml
application/sparql-query rq
application/sparql-results+xml srx
application/spirits-event+xml
application/sql
application/srgs gram
application/srgs+xml grxml
application/sru+xml sru
application/ssdl+xml ssdl
application/ssml+xml ssml
application/tamp-apex-update
application/tamp-apex-update-confirm
application/tamp-community-update
#
application/tamp-community-update-confirm
application/tamp-error
application/tamp-sequence-adjust
application/tamp-sequence-adjust-confirm
application/tamp-status-query
application/tamp-status-response
application/tamp-update
application/tamp-update-confirm
application/tei+xml tei teicorpus
application/thraud+xml tfi
application/timestamp-query
application/timestamp-reply

application/timestamped-data tsd
application/ttml+xml
application/tve-trigger
application/ulpfec
application/urc-grpsheet+xml
application/urc-ressheet+xml
application/urc-targetdesc+xml
application/urc-uisocketdesc+xml
application/vcard+json
application/vcard+xml
application/vemmi
application/vividence.scriptfile
application/vnd.3gpp-prose+xml
application/vnd.3gpp-prose-pc3ch+xml
application/vnd.3gpp.access-transfer-events+xml
application/vnd.3gpp.bsf+xml
application/vnd.3gpp.mid-call+xml
application/vnd.3gpp.pic-bw-large plb
application/vnd.3gpp.pic-bw-small psb
application/vnd.3gpp.pic-bw-var pvb
#
application/vnd.3gpp.sms
application/vnd.3gpp.sms+xml
application/vnd.3gpp.srvcc-ext+xml
application/vnd.3gpp.srvcc-info+xml
application/vnd.3gpp.state-and-event-info+xml
application/vnd.3gpp.ussd+xml
application/vnd.3gpp2.bcmcsinfo+xml
application/vnd.3gpp2.sms
application/vnd.3gpp2.tcap tcap
application/vnd.3lightssoftware.imagescal
application/vnd.3m.post-it-notes pwn
application/vnd.accpac.simply.aso aso
application/vnd.accpac.simply.imp imp
application/vnd.acucobol acu
application/vnd.acucorp atc acutc
application/vnd.adobe.air-application-installer-package+zip air
application/vnd.adobe.flash.movie
application/vnd.adobe.formscentral.fcdt fcdt
application/vnd.adobe.fxp fxp fxpl
application/vnd.adobe.partial-upload
application/vnd.adobe.xdp+xml xdp
application/vnd.adobe.xfdf xfdf
application/vnd.aether.imp
application/vnd.ah-barcode
application/vnd.ahead.space ahead
application/vnd.airzip.filesecure.azf azf
application/vnd.airzip.filesecure.azs azs

application/vnd.amazon.ebook azw
#
application/vnd.amazon.mobi8-ebook
application/vnd.americandynamics.acc acc
application/vnd.amiga.ami ami
application/vnd.amundsen.maze+xml
application/vnd.android.package-archive apk
application/vnd.anki
application/vnd.anser-web-certificate-issue-initiation cii
application/vnd.anser-web-funds-transfer-initiation fti
application/vnd.antix.game-component atx
application/vnd.apache.thrift.binary
application/vnd.apache.thrift.compact
application/vnd.apache.thrift.json
application/vnd.api+json
application/vnd.apple.installer+xml mpkg
application/vnd.apple.mpegurl m3u8
application/vnd.arastra.swi
application/vnd.aristanetworks.swi swi
application/vnd.artsquare
application/vnd.astraea-software.iota iota
application/vnd.audiograph aep
application/vnd.autopackage
application/vnd.avistar+xml
application/vnd.balsamiq.bmml+xml
application/vnd.balsamiq.bmpr
#
application/vnd.bekitzur-stech+json
application/vnd.biopax.rdf+xml
application/vnd.blueice.multipass mpm
application/vnd.bluetooth.ep.oob
application/vnd.bluetooth.le.oob
application/vnd.bmi bmi
application/vnd.businessobjects rep
application/vnd.cab-jscript
application/vnd.canon-cpdl
application/vnd.canon-lips
application/vnd.cendio.thinlinc.clientconf
application/vnd.century-systems.tcp_stream
application/vnd.chemdraw+xml cdxml
application/vnd.chess-pgn
application/vnd.chipnuts.karaoke-mmd mmd
application/vnd.cinderella cdy
application/vnd.cirpack.isdn-ext
application/vnd.citationstyles.style+xml
application/vnd.claymore cla
application/vnd.cloanto.rp9 rp9
application/vnd.clonk.c4group c4g c4d c4f c4p c4u

application/vnd.cluetrust.cartomobile-config c11amc
application/vnd.cluetrust.cartomobile-config-pkg c11amz
application/vnd.coffeescript
application/vnd.collection+json
application/vnd.collection.doc+json
application/vnd.collection.next+json
#
application/vnd.comicbook+zip
application/vnd.commerce-battelle
application/vnd.commonspace csp
application/vnd.contact.cmsg cdbcmsg
application/vnd.coreos.ignition+json
application/vnd.cosmocaller cmc
application/vnd.crick.clicker clkx
application/vnd.crick.clicker.keyboard clkk
application/vnd.crick.clicker.palette clkp
application/vnd.crick.clicker.template clkt
application/vnd.crick.clicker.wordbank clkw
application/vnd.criticaltools.wbs+xml wbs
application/vnd.ctc-posml pml
application/vnd.ctct.ws+xml
application/vnd.cups-pdf
application/vnd.cups-postscript
application/vnd.cups-ppd ppd
application/vnd.cups-raster
application/vnd.cups-raw
application/vnd.curl
application/vnd.curl.car car
application/vnd.curl.pcurl pcurl
application/vnd.cyan.dean.root+xml
application/vnd.cybank
application/vnd.dart dart
application/vnd.data-vision.rdz rdz
application/vnd.debian.binary-package
application/vnd.dece.data uvf uvvf
uvd uvvd
application/vnd.dece.ttml+xml uvt uvvt
application/vnd.dece.unspecified uvx uvvx
application/vnd.dece.zip uvz uvvz
application/vnd.denovo.fcselayout-link fe_launch
application/vnd.desmume.movie
application/vnd.dir-bi.plate-dl-nosuffix
application/vnd.dm.delegation+xml
application/vnd.dna dna
application/vnd.document+json
application/vnd.dolby.mlp mlp
application/vnd.dolby.mobile.1
application/vnd.dolby.mobile.2

```
# application/vnd.doremir.scorecloud-binary-document
application/vnd.dpgraph    dpg
application/vnd.dreamfactory   dfac
# application/vnd.drive+json
application/vnd.ds-keypoint   kpxx
# application/vnd.dtg.local
# application/vnd.dtg.local.flash
# application/vnd.dtg.local.html
application/vnd.dvb.ait    ait
# application/vnd.dvb.dvbj
# application/vnd.dvb.esgcontainer
# application/vnd.dvb.ipdcdftnotifaccess
# application/vnd.dvb.ipdcesgaccess
# application/vnd.dvb.ipdcesgaccess2
# application/vnd.dvb.ipdcesgpdd
# application/vnd.dvb.ipdcroaming
#
 application/vnd.dvb.iptv.alfec-base
# application/vnd.dvb.iptv.alfec-enhancement
# application/vnd.dvb.notif-aggregate-root+xml
# application/vnd.dvb.notif-container+xml
# application/vnd.dvb.notif-generic+xml
# application/vnd.dvb.notif-ia-msglist+xml
# application/vnd.dvb.notif-ia-registration-request+xml
# application/vnd.dvb.notif-ia-registration-response+xml
# application/vnd.dvb.notif-init+xml
# application/vnd.dvb.pfr
application/vnd.dvb.service   svc
# application/vnd.dxr
application/vnd.dynageo    geo
# application/vnd.dzr
# application/vnd.easykaraoke.cdgdownload
# application/vnd.ecdis-update
application/vnd.ecowin.chart   mag
# application/vnd.ecowin.filerequest
# application/vnd.ecowin.fileupdate
# application/vnd.ecowin.series
# application/vnd.ecowin.seriesrequest
# application/vnd.ecowin.seriesupdate
# application/vnd.emclient.accessrequest+xml
application/vnd.enliven    nml
# application/vnd.enphase.envoy
# application/vnd.eprints.data+xml
application/vnd.epson.esf   esf
application/vnd.epson.msf   msf
application/vnd.epson.quickanime  qam
application/vnd.epson.salt   slt
application/vnd.epson.ssf   ssf
```

```
#
 application/vnd.ericsson.quickcall
application/vnd.eszigno3+xml   es3 et3
# application/vnd.etsi.aoc+xml
# application/vnd.etsi.asic-e+zip
# application/vnd.etsi.asic-s+zip
# application/vnd.etsi.cug+xml
# application/vnd.etsi.iptvcommand+xml
# application/vnd.etsi.iptvdiscovery+xml
# application/vnd.etsi.iptvprofile+xml
# application/vnd.etsi.iptvsad-bc+xml
# application/vnd.etsi.iptvsad-cod+xml
# application/vnd.etsi.iptvsad-npvr+xml
# application/vnd.etsi.iptvservice+xml
# application/vnd.etsi.iptvsync+xml
# application/vnd.etsi.iptvueprofile+xml
# application/vnd.etsi.mcid+xml
# application/vnd.etsi.mheg5
# application/vnd.etsi.overload-control-policy-dataset+xml
# application/vnd.etsi.pstn+xml
# application/vnd.etsi.sci+xml
# application/vnd.etsi.simservs+xml
# application/vnd.etsi.timestamp-token
# application/vnd.etsi.tsl+xml
# application/vnd.etsi.tsl.der
#
 application/vnd.eudora.data
application/vnd.ezpix-album   ez2
application/vnd.ezpix-package   ez3
# application/vnd.f-secure.mobile
# application/vnd.fastcopy-disk-image
application/vnd.fdf    fdf
application/vnd.fdsn.mseed   mseed
application/vnd.fdsn.seed   seed dataless
# application/vnd.ffsns
# application/vnd.filmit.zfc
# application/vnd.fints
# application/vnd.firemonkeys.cloudcell
application/vnd.flographit   gph
application/vnd.fluxtime.clip   ftc
# application/vnd.font-fontforge-sfd
application/vnd.framemaker   fm frame maker book
application/vnd.frogans.fnc   fnc
application/vnd.frogans.ltf   ltf
application/vnd.fsc.weblaunch   fsc
application/vnd.fujitsu.oasys   oas
application/vnd.fujitsu.oasys2   oa2
application/vnd.fujitsu.oasys3   oa3
```

application/vnd.fujitsu.oasysgp fg5
application/vnd.fujitsu.oasysprs bh2
application/vnd.fujixerox.art-ex
application/vnd.fujixerox.art4
application/vnd.fujixerox.ddd ddd
application/vnd.fujixerox.docuworks xdw
application/vnd.fujixerox.docuworks.binder xbd
#
application/vnd.fujixerox.docuworks.container
application/vnd.fujixerox.hbpl
application/vnd.fut-misnet
application/vnd.fuzzysheet fzs
application/vnd.genomatix.tuxedo txd
application/vnd.geo+json
application/vnd.geocube+xml
application/vnd.geogebra.file ggb
application/vnd.geogebra.tool ggt
application/vnd.geometry-explorer gex gre
application/vnd.geonext gxt
application/vnd.geoplan g2w
application/vnd.geospace g3w
application/vnd.gerber
application/vnd.globalplatform.card-content-mgt
application/vnd.globalplatform.card-content-mgt-response
application/vnd.gmx gmx
application/vnd.google-earth.kml+xml kml
application/vnd.google-earth.kmz kmz
application/vnd.gov.sk.e-form+xml
application/vnd.gov.sk.e-form+zip
application/vnd.gov.sk.xmldatacontainer+xml
application/vnd.grafeq gqf gqs
application/vnd.gridmp
application/vnd.groove-account gac
application/vnd.groove-help ghf
application/vnd.groove-identity-message gim
application/vnd.groove-injector grv
application/vnd.groove-tool-message gtm
application/vnd.groove-tool-template tpl
application/vnd.groove-vcard vcg
#
application/vnd.hal+json
application/vnd.hal+xml hal
application/vnd.handheld-entertainment+xml zmm
application/vnd.hbci hbci
application/vnd.hcl-bireports
application/vnd.hdt
application/vnd.heroku+json
application/vnd.hhe.lesson-player les

application/vnd.hp-hpgl hpgl
application/vnd.hp-hpid hpid
application/vnd.hp-hps hps
application/vnd.hp-jlyt jlt
application/vnd.hp-pcl pcl
application/vnd.hp-pclxl pclxl
application/vnd.httphone
application/vnd.hydrostatix.sof-data sfd-hdstx
application/vnd.hyperdrive+json
application/vnd.hzn-3d-crossword
application/vnd.ibm.afplinedata
application/vnd.ibm.electronic-media
application/vnd.ibm.minipay mpy
application/vnd.ibm.modcap afp listafp list3820
application/vnd.ibm.rights-management irm
application/vnd.ibm.secure-container sc
application/vnd.iccprofile icc
icm
application/vnd.ieee.1905
application/vnd.igloader igl
application/vnd.immervision-ivp ivp
application/vnd.immervision-ivu ivu
application/vnd.ims.imsccv1p1
application/vnd.ims.imsccv1p2
application/vnd.ims.imsccv1p3
application/vnd.ims.lis.v2.result+json
application/vnd.ims.lti.v2.toolconsumerprofile+json
application/vnd.ims.lti.v2.toolproxy+json
application/vnd.ims.lti.v2.toolproxy.id+json
application/vnd.ims.lti.v2.toolsettings+json
application/vnd.ims.lti.v2.toolsettings.simple+json
application/vnd.informedcontrol.rms+xml
application/vnd.informix-visionary
application/vnd.infotech.project
application/vnd.infotech.project+xml
application/vnd.innopath.wamp.notification
application/vnd.insors.igm igm
application/vnd.intercon.formnet xpw xpx
application/vnd.intergeo i2g
application/vnd.intertrust.digibox
application/vnd.intertrust.nncp
application/vnd.intu.qbo qbo
application/vnd.intu.qfx qfx
#
application/vnd.iptc.g2.catalogitem+xml
application/vnd.iptc.g2.conceptitem+xml
application/vnd.iptc.g2.knowledgeitem+xml
application/vnd.iptc.g2.newsitem+xml

application/vnd.iptc.g2.newsmessage+xml
application/vnd.iptc.g2.packageitem+xml
application/vnd.iptc.g2.planningitem+xml
application/vnd.ipunplugged.rcprofile rcprofile
application/vnd.irepository.package+xml irp
application/vnd.is-xpr xpr
application/vnd.isac.fcs fcs
application/vnd.jam jam
application/vnd.japannet-directory-service
application/vnd.japannet-jpnstore-wakeup
application/vnd.japannet-payment-wakeup
application/vnd.japannet-registration
application/vnd.japannet-registration-wakeup
application/vnd.japannet-setstore-wakeup
application/vnd.japannet-verification
application/vnd.japannet-verification-wakeup
application/vnd.jcp.javame.midlet-rms rms
application/vnd.jisp jisp
application/vnd.joost.joda-archive joda
application/vnd.jsk.isdn-ngn
application/vnd.kahootz ktz
ktr
application/vnd.kde.karbon karbon
application/vnd.kde.kchart chrt
application/vnd.kde.kformula kfo
application/vnd.kde.kivio flw
application/vnd.kde.kontour kon
application/vnd.kde.kpresenter kpr kpt
application/vnd.kde.kspread ksp
application/vnd.kde.kword kwd kwt
application/vnd.kenameaapp htke
application/vnd.kidspiration kia
application/vnd.kinar kne knp
application/vnd.koan skp skd skt skm
application/vnd.kodak-descriptor sse
application/vnd.las.las+xml lasxml
application/vnd.liberty-request+xml
application/vnd.llamagraphics.life-balance.desktop lbd
application/vnd.llamagraphics.life-balance.exchange+xml lbe
application/vnd.lotus-1-2-3 123
application/vnd.lotus-approach apr
application/vnd.lotus-freelance pre
application/vnd.lotus-notes nsf
application/vnd.lotus-organizer org
application/vnd.lotus-screencam scm
application/vnd.lotus-wordpro lwp
application/vnd.macports.portpkg portpkg
application/vnd.mapbox-vector-tile

```
# application/vnd.marlin.drm.actiontoken+xml
#
 application/vnd.marlin.drm.conftoken+xml
# application/vnd.marlin.drm.license+xml
# application/vnd.marlin.drm.mdcf
# application/vnd.mason+json
# application/vnd.maxmind.maxmind-db
application/vnd.mcd    mcd
application/vnd.medcalcdata   mc1
application/vnd.mediastation.cdkey  cdkey
# application/vnd.meridian-slingshot
application/vnd.mfer    mwf
application/vnd.mfmp    mfm
# application/vnd.micro+json
application/vnd.micrografx.flo   flo
application/vnd.micrografx.igx   igx
# application/vnd.microsoft.portable-executable
# application/vnd.miele+json
application/vnd.mif    mif
# application/vnd.minisoft-hp3000-save
# application/vnd.mitsubishi.misty-guard.trustweb
application/vnd.mobius.daf   daf
application/vnd.mobius.dis   dis
application/vnd.mobius.mbk   mbk
application/vnd.mobius.mqy   mqy
application/vnd.mobius.msl   msl
application/vnd.mobius.plc   plc
application/vnd.mobius.txf   txf
application/vnd.mophun.application  mpn
application/vnd.mophun.certificate  mpc
#
 application/vnd.motorola.flexsuite
# application/vnd.motorola.flexsuite.adsi
# application/vnd.motorola.flexsuite.fis
# application/vnd.motorola.flexsuite.gotap
# application/vnd.motorola.flexsuite.kmr
# application/vnd.motorola.flexsuite.ttc
# application/vnd.motorola.flexsuite.wem
# application/vnd.motorola.iprm
application/vnd.mozilla.xul+xml   xul
# application/vnd.ms-3mfdocument
application/vnd.ms-artgalry   cil
# application/vnd.ms-asf
application/vnd.ms-cab-compressed  cab
# application/vnd.ms-color.iccprofile
application/vnd.ms-excel   xls xlm xla xlc xlt xlw
application/vnd.ms-excel.addin.macroenabled.12  xlam
application/vnd.ms-excel.sheet.binary.macroenabled.12 xlsb
```

application/vnd.ms-excel.sheet.macroenabled.12 xlsm
application/vnd.ms-excel.template.macroenabled.12 xltm
application/vnd.ms-fontobject eot
application/vnd.ms-htmlhelp chm
application/vnd.ms-ims ims
application/vnd.ms-lrm lrm
application/vnd.ms-office.activex+xml
application/vnd.ms-officetheme thmx
#
application/vnd.ms-opentype
application/vnd.ms-package.obfuscated-opentype
application/vnd.ms-pki.seccat cat
application/vnd.ms-pki.stl stl
application/vnd.ms-playready.initiator+xml
application/vnd.ms-powerpoint ppt pps pot
application/vnd.ms-powerpoint.addin.macroenabled.12 ppam
application/vnd.ms-powerpoint.presentation.macroenabled.12 pptm
application/vnd.ms-powerpoint.slide.macroenabled.12 sldm
application/vnd.ms-powerpoint.slideshow.macroenabled.12 ppsm
application/vnd.ms-powerpoint.template.macroenabled.12 potm
application/vnd.ms-printdevicecapabilities+xml
application/vnd.ms-printing.printticket+xml
application/vnd.ms-printschematicket+xml
application/vnd.ms-project mpp mpt
application/vnd.ms-tnef
application/vnd.ms-windows.devicepairing
application/vnd.ms-windows.nwprinting.oob
application/vnd.ms-windows.printerpairing
application/vnd.ms-windows.wsd.oob
application/vnd.ms-wmdrm.lic-chlg-req
application/vnd.ms-wmdrm.lic-resp
#
application/vnd.ms-wmdrm.meter-chlg-req
application/vnd.ms-wmdrm.meter-resp
application/vnd.ms-word.document.macroenabled.12 docm
application/vnd.ms-word.template.macroenabled.12 dotm
application/vnd.ms-works wps wks wcm wdb
application/vnd.ms-wpl wpl
application/vnd.ms-xpsdocument xps
application/vnd.msa-disk-image
application/vnd.mseq mseq
application/vnd.msign
application/vnd.multiad.creator
application/vnd.multiad.creator.cif
application/vnd.music-niff
application/vnd.musician mus
application/vnd.muvee.style msty
application/vnd.mynfc taglet

application/vnd.ncd.control
application/vnd.ncd.reference
application/vnd.nervana
application/vnd.netfpx
application/vnd.neurolanguage.nlu nlu
application/vnd.nintendo.nitro.rom
application/vnd.nintendo.snes.rom
application/vnd.nitf ntf nitf
application/vnd.noblenet-directory nnd
application/vnd.noblenet-sealer nns
application/vnd.noblenet-web nnw
application/vnd.nokia.catalogs
#
 application/vnd.nokia.conml+wbxml
application/vnd.nokia.conml+xml
application/vnd.nokia.iptv.config+xml
application/vnd.nokia.isds-radio-presets
application/vnd.nokia.landmark+wbxml
application/vnd.nokia.landmark+xml
application/vnd.nokia.landmarkcollection+xml
application/vnd.nokia.n-gage.ac+xml
application/vnd.nokia.n-gage.data ngdat
application/vnd.nokia.n-gage.symbian.install n-gage
application/vnd.nokia.ncd
application/vnd.nokia.pcd+wbxml
application/vnd.nokia.pcd+xml
application/vnd.nokia.radio-preset rpst
application/vnd.nokia.radio-presets rpss
application/vnd.novadigm.edm edm
application/vnd.novadigm.edx edx
application/vnd.novadigm.ext ext
application/vnd.ntt-local.content-share
application/vnd.ntt-local.file-transfer
application/vnd.ntt-local.ogw_remote-access
application/vnd.ntt-local.sip-ta_remote
application/vnd.ntt-local.sip-ta_tcp_stream
application/vnd.oasis.opendocument.chart odc
application/vnd.oasis.opendocument.chart-template otc
application/vnd.oasis.opendocument.database odb
application/vnd.oasis.opendocument.formula odf
application/vnd.oasis.opendocument.formula-template odft
application/vnd.oasis.opendocument.graphics odg
application/vnd.oasis.opendocument.graphics-template otg
application/vnd.oasis.opendocument.image odi
application/vnd.oasis.opendocument.image-template oti
application/vnd.oasis.opendocument.presentation odp
application/vnd.oasis.opendocument.presentation-template otp
application/vnd.oasis.opendocument.spreadsheet ods

application/vnd.oasis.opendocument.spreadsheet-template ots
application/vnd.oasis.opendocument.text odt
application/vnd.oasis.opendocument.text-master odm
application/vnd.oasis.opendocument.text-template ott
application/vnd.oasis.opendocument.text-web oth
#
application/vnd.obn
application/vnd.oftn.l10n+json
application/vnd.oipf.contentaccessdownload+xml
application/vnd.oipf.contentaccessstreaming+xml
application/vnd.oipf.cspg-hexbinary
application/vnd.oipf.dae.svg+xml
#
application/vnd.oipf.dae.xhtml+xml
application/vnd.oipf.mippvcontrolmessage+xml
application/vnd.oipf.pae.gem
application/vnd.oipf.spdiscovery+xml
application/vnd.oipf.spdlist+xml
application/vnd.oipf.ueprofile+xml
application/vnd.oipf.userprofile+xml
application/vnd.olpc-sugar xo
application/vnd.oma-scws-config
application/vnd.oma-scws-http-request
application/vnd.oma-scws-http-response
application/vnd.oma.bcast.associated-procedure-parameter+xml
application/vnd.oma.bcast.drm-trigger+xml
application/vnd.oma.bcast.imd+xml
application/vnd.oma.bcast.ltkm
application/vnd.oma.bcast.notification+xml
application/vnd.oma.bcast.provisioningtrigger
application/vnd.oma.bcast.sgboot
application/vnd.oma.bcast.sgdd+xml
application/vnd.oma.bcast.sgdu
application/vnd.oma.bcast.simple-symbol-container
application/vnd.oma.bcast.smartcard-trigger+xml
application/vnd.oma.bcast.sprov+xml
application/vnd.oma.bcast.stkm
application/vnd.oma.cab-address-book+xml
#
application/vnd.oma.cab-feature-handler+xml
application/vnd.oma.cab-pcc+xml
application/vnd.oma.cab-subs-invite+xml
application/vnd.oma.cab-user-prefs+xml
application/vnd.oma.dcd
application/vnd.oma.dcdc
application/vnd.oma.dd2+xml dd2
application/vnd.oma.drm.risd+xml
application/vnd.oma.group-usage-list+xml

application/vnd.oma.lwm2m+json
application/vnd.oma.lwm2m+tlv
application/vnd.oma.pal+xml
application/vnd.oma.poc.detailed-progress-report+xml
application/vnd.oma.poc.final-report+xml
application/vnd.oma.poc.groups+xml
application/vnd.oma.poc.invocation-descriptor+xml
application/vnd.oma.poc.optimized-progress-report+xml
application/vnd.oma.push
application/vnd.oma.scidm.messages+xml
application/vnd.oma.xcap-directory+xml
application/vnd.omads-email+xml
application/vnd.omads-file+xml
application/vnd.omads-folder+xml
application/vnd.omaloc-supl-init
application/vnd.onepager
application/vnd.openblox.game+xml
#
 application/vnd.openblox.game-binary
application/vnd.openeye.oeb
application/vnd.openofficeorg.extension oxt
application/vnd.openxmlformats-officedocument.custom-properties+xml
application/vnd.openxmlformats-officedocument.customxmlproperties+xml
application/vnd.openxmlformats-officedocument.drawing+xml
application/vnd.openxmlformats-officedocument.drawingml.chart+xml
application/vnd.openxmlformats-officedocument.drawingml.chartshapes+xml
application/vnd.openxmlformats-officedocument.drawingml.diagramcolors+xml
application/vnd.openxmlformats-officedocument.drawingml.diagramdata+xml
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application/vnd.openxmlformats-officedocument.drawingml.diagramstyle+xml
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# application/vnd.oracle.resource+json
# application/vnd.orange.indata
# application/vnd.osa.netdeploy
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# application/vnd.osgi.bundle
application/vnd.osgi.dp    dp
application/vnd.osgi.subsystem   esa
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# application/vnd.oxli.countgraph
# application/vnd.pagerduty+json
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# application/vnd.panoply
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# application/vnd.pcos
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application/vnd.pmi.widget   wg
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# application/vnd.powerbuilder6-s
# application/vnd.powerbuilder7
# application/vnd.powerbuilder7-s
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# application/vnd.powerbuilder75-s
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application/vnd.publishare-delta-tree  qps
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# application/vnd.radisys.msml-audit+xml
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# application/vnd.radisys.msml-conf+xml
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# application/vnd.radisys.msml-dialog-speech+xml
# application/vnd.radisys.msml-dialog-transform+xml
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# application/vnd.rapid
# application/vnd.rar
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application/vnd.recordare.musicxml  mxl
application/vnd.recordare.musicxml+xml  musicxml
#
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application/vnd.rig.cryptonote   cryptonote
application/vnd.rim.cod    cod
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# application/vnd.sealed.tiff
# application/vnd.sealed.xls
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application/vnd.sema    sema
application/vnd.semd    semd
application/vnd.semf    semf
application/vnd.shana.informed.formdata  ifm
```

application/vnd.shana.informed.formtemplate itp
application/vnd.shana.informed.interchange iif
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application/vnd.simtech-mindmapper twd
twds
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application/vnd.stardivision.draw sda
application/vnd.stardivision.impress sdd
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application/vnd.stepmania.stepchart sm
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application/vnd.sun.xml.math sxm
application/vnd.sun.xml.writer sxw
application/vnd.sun.xml.writer.global sxg
application/vnd.sun.xml.writer.template stw
application/vnd.sus-calendar sus
susp
application/vnd.svd svd
application/vnd.swiftview-ics
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application/vnd.syncml.dm+wbxml bdm
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```
# application/vnd.syncml.dmtnds+wbxml
# application/vnd.syncml.dmtnds+xml
# application/vnd.syncml.ds.notification
application/vnd.tao.intent-module-archive tao
application/vnd.tcpdump.pcap   pcap cap dmp
# application/vnd.tmd.mediaflex.api+xml
# application/vnd.tml
application/vnd.tmobile-livetv   tmo
application/vnd.trid.tpt   tpt
application/vnd.triscape.mxs   mxs
application/vnd.trueapp    tra
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 application/vnd.truedoc
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application/vnd.uiq.theme   utz
application/vnd.umajin    umj
application/vnd.unity    unityweb
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# application/vnd.uplanet.bearer-choice-wbxml
# application/vnd.uplanet.cacheop
# application/vnd.uplanet.cacheop-wbxml
# application/vnd.uplanet.channel
# application/vnd.uplanet.channel-wbxml
# application/vnd.uplanet.list
# application/vnd.uplanet.list-wbxml
# application/vnd.uplanet.listcmd
# application/vnd.uplanet.listcmd-wbxml
# application/vnd.uplanet.signal
# application/vnd.uri-map
# application/vnd.valve.source.material
application/vnd.vcx    vcx
# application/vnd.vd-study
# application/vnd.vectorworks
# application/vnd.vel+json
#
 application/vnd.verimatrix.vcas
# application/vnd.vidsoft.vidconference
application/vnd.visio    vsd vst vss vsw
application/vnd.visionary   vis
# application/vnd.vividence.scriptfile
application/vnd.vsf    vsf
# application/vnd.wap.sic
# application/vnd.wap.slc
application/vnd.wap.wbxml   wbxml
```

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application/vnd.wfa.p2p
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application/vnd.xmpie.cpkg
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application/vnd.xmpie.plan
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application/vnd.yamaha.hv-script hvs
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application/voicexml+xml vxml
application/vq-rtcpxr
application/watcherinfo+xml
application/whoispp-query
application/whoispp-response

application/widget wgt
application/winhlp hlp
application/wita
application/wordperfect5.1
application/wsdl+xml wsdl
application/wspolicy+xml wspolicy
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application/x-abiword abw
application/x-ace-compressed ace
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application/x-authorware-seg aas
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audio/mp4a-latm
audio/mpa
audio/mpa-robust
audio/mpeg mpga mp2 mp2a mp3 m2a m3a
audio/mpeg4-generic
audio/musepack
audio/ogg oga ogg spx
audio/opus
audio/parityfec
audio/pcma
audio/pcma-wb
audio/pcmu
audio/pcmu-wb
audio/prs.sid

```
# audio/qcelp
# audio/raptorfec
# audio/red
# audio/rtp-enc-aescm128
# audio/rtp-midi
# audio/rtploopback
# audio/rtx
audio/s3m     s3m
audio/silk     sil
#
 audio/smv
# audio/smv-qcp
# audio/smv0
# audio/sp-midi
# audio/speex
# audio/t140c
# audio/t38
# audio/telephone-event
# audio/tone
# audio/uemclip
# audio/ulpfec
# audio/vdvi
# audio/vmr-wb
# audio/vnd.3gpp.iufp
# audio/vnd.4sb
# audio/vnd.audiokoz
# audio/vnd.celp
# audio/vnd.cisco.nse
# audio/vnd.cmles.radio-events
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# audio/vnd.cns.inf1
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# audio/vnd.dolby.mps
# audio/vnd.dolby.pl2
# audio/vnd.dolby.pl2x
# audio/vnd.dolby.pl2z
# audio/vnd.dolby.pulse.1
audio/vnd.dra     dra
audio/vnd.dts     dts
audio/vnd.dts.hd    dtshd
# audio/vnd.dvb.file
# audio/vnd.everad.plj
# audio/vnd.hns.audio
```

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audio/vnd.sealedmedia.softseal.mpeg
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audio/vorbis-config
audio/webm weba
audio/x-aac aac
audio/x-aiff aif aiff aifc
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audio/x-ms-wma wma
audio/x-pn-realaudio ram ra
audio/x-pn-realaudio-plugin rmp
audio/x-tta
audio/x-wav wav
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chemical/x-cmdf cmdf
chemical/x-cml cml
chemical/x-csml csml
chemical/x-pdb
chemical/x-xyz xyz
image/bmp bmp
image/cgm cgm
image/dicom-rle
image/emf
image/example
image/fits
image/g3fax g3
image/gif gif
image/ief ief
image/jls
image/jp2

image/jpeg jpeg jpg jpe
image/jpm
image/jpx
image/ktx ktx
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image/prs.btif btif
#
image/prs.pti
image/pwg-raster
image/sgi sgi
image/svg+xml svg svgz
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image/tiff tiff tif
image/tiff-fx
image/vnd.adobe.photoshop psd
image/vnd.airzip.accelerator.azv
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image/wmf
image/x-3ds 3ds

image/x-cmu-raster ras
image/x-cmx cmx
image/x-freehand fh
fhc fh4 fh5 fh7
image/x-icon ico
image/x-mrsid-image sid
image/x-pcx pcx
image/x-pict pic pct
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image/x-portable-pixmap ppm
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image/x-tga tga
image/x-xbitmap xbm
image/x-xpixmap xpm
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message/external-body
message/feedback-report
message/global
message/global-delivery-status
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message/global-headers
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message/imdn+xml
message/news
message/partial
message/rfc822 eml mime
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message/sip
message/sipfrag
message/tracking-status
message/vnd.si.simp
message/vnd.wfa.wsc
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model/iges igs iges
model/mesh msh mesh silo
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#
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model/vnd.gs-gdl

```
# model/vnd.gs.gdl
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# model/vnd.parasolid.transmit.text
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# multipart/x-mixed-replace
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# text/javascript
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# text/parityfec
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# text/rtp-enc-aescm128
# text/rtploopback
# text/rtx
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text/turtle	ttl
# text/ulpfec
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text/x-c     c cc cxx cpp h hh dic
text/x-fortran     f for f77 f90
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text/x-opml     opml
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# video/3gpp-tt
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# video/bt656
# video/celb
# video/dv
# video/encaprtp
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video/h263     h263
# video/h263-1998
# video/h263-2000
video/h264     h264
# video/h264-rcdo
# video/h264-svc
# video/h265
# video/iso.segment
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# video/jpeg2000
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# video/mp1s
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# video/mp2t
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# video/ulpfec
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video/x-ms-vob vob
video/x-ms-wm wm
video/x-ms-wmv wmv
video/x-ms-wmx wmx
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video/x-msvideo avi
video/x-sgi-movie movie
video/x-smv smv
x-conference/x-cooltalk ice

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jar/org/springframework/web/bind/MissingServletRequestParameterException.java
* /spring-web-5-2-24-release-sources-
jar/org/springframework/remoting/httpinvoker/HttpInvokerClientConfiguration.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/HttpMediaTypeNotAcceptableException.java
*
 /spring-web-5-2-24-release-sources-
jar/org/springframework/web/context/support/SpringBeanAutowiringSupport.java

* /spring-web-5-2-24-release-sources-jar/org/springframework/web/jsf/DelegatingPhaseListenerMulticaster.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/http/MediaTypeEditor.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/remoting/jaxws/JaxWsSoapFaultException.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/client/ResourceAccessException.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/bind/support/SimpleSessionStatus.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/bind/ServletRequestBindingException.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/jsf/DecoratingNavigationHandler.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/util/IntrospectorCleanupListener.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/context/ConfigurableWebEnvironment.java
*
 /spring-web-5-2-24-release-sources-jar/org/springframework/http/client/AbstractClientHttpResponse.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/bind/annotation/ValueConstants.java
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jar/org/springframework/http/codec/multipart/SynchronossPartHttpMessageReader.java
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jar/org/springframework/web/method/annotation/ModelAttributeMethodProcessor.java
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jar/org/springframework/web/method/support/CompositeUriComponentsContributor.java
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* /spring-web-5-2-24-release-sources-jar/org/springframework/web/method/HandlerTypePredicate.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/util/pattern/WildcardTheRestPathElement.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/util/pattern/CaptureVariablePathElement.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/bind/annotation/CookieValue.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/util/pattern/PathPattern.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/server/adapter/HttpWebHandlerAdapter.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/util/pattern/PatternParseException.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/http/MediaTypeFactory.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/cors/CorsConfiguration.java

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* /spring-web-5-2-24-release-sources-jar/org/springframework/web/client/DefaultResponseErrorHandler.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/util/UriComponents.java
* /spring-web-5-2-24-release-sources-
jar/org/springframework/web/util/pattern/SingleCharWildcardedPathElement.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/http/ResponseEntity.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/util/UriComponentsBuilder.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/http/server/reactive/JettyHeadersAdapter.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/util/UrlPathHelper.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/server/ResponseStatusException.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/http/server/PathContainer.java
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/spring-web-5-2-24-release-sources-jar/org/springframework/web/util/pattern/WildcardPathElement.java
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* /spring-web-5-2-24-release-sources-
jar/org/springframework/web/server/handler/ResponseStatusExceptionHandler.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/http/server/DefaultPathContainer.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/util/pattern/CaptureTheRestPathElement.java
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* /spring-web-5-2-24-release-sources-jar/org/springframework/web/server/session/WebSessionIdResolver.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/http/ReactiveHttpOutputMessage.java
* /spring-web-5-2-24-release-sources-
jar/org/springframework/web/context/support/ServletContextLiveBeansView.java
*
/spring-web-5-2-24-release-sources-jar/org/springframework/web/bind/support/WebBindingInitializer.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/bind/annotation/DeleteMapping.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/context/request/RequestContextHolder.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/bind/annotation/RequestAttribute.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/HttpRequestHandler.java

* /spring-web-5-2-24-release-sources-jar/org/springframework/web/context/annotation/SessionScope.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/context/request/WebRequestInterceptor.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/filter/CompositeFilter.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/remoting/httpinvoker/HttpInvokerRequestExecutor.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/multipart/MultipartRequest.java
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* /spring-web-5-2-24-release-sources-jar/org/springframework/http/client/ClientHttpRequestFactory.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/context/request/async/TimeoutDeferredResultProcessingInterceptor.java
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* /spring-web-5-2-24-release-sources-jar/org/springframework/web/bind/annotation/PutMapping.java
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* /spring-web-5-2-24-release-sources-jar/org/springframework/web/bind/annotation/GetMapping.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/server/session/WebSessionManager.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/cors/CorsConfigurationSource.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/server/WebExceptionHandler.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/http/client/ClientHttpRequestExecution.java
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* /spring-web-5-2-24-release-sources-jar/org/springframework/web/context/request/async/AsyncRequestTimeoutException.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/cors/reactive/CorsConfigurationSource.java
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* /spring-web-5-2-24-release-sources-jar/org/springframework/web/bind/annotation/SessionAttribute.java
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* /spring-web-5-2-24-release-sources-jar/org/springframework/http/client/ClientHttpRequest.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/http/converter/feed/AtomFeedHttpMessageConverter.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/jsf/FacesContextUtils.java
* /spring-web-5-2-24-release-sources-jar/org/springframework/web/method/support/HandlerMethodArgumentResolver.java
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* /spring-web-5-2-24-release-sources-jar/org/springframework/http/codec/ResourceHttpMessageWriter.java
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* /spring-web-5-2-24-release-sources-
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1.243 commons-pool 1.6

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1.244 libpkit 0.23.2

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1.246 coreutils 8.32-4+b1

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1.248 jboss-logging 3.4.1.Final

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1.249 flyway-spring5-test 6.4.0

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* /flyway-spring5-test-6-4-0-sources-1-jar/org/flywaydb/test/junit/FlywayTestExecutionListener.java
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 /flyway-spring5-test-6-4-0-sources-1-jar/org/flywaydb/test/junit5/annotation/FlywayTestExtension.java
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1.250 classgraph 4.8.69

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* /classgraph-4-8-69-sources-jar/nonapi/io/github/classgraph/scanspec/WhiteBlackList.java
* /classgraph-4-8-69-sources-jar/nonapi/io/github/classgraph/utils/LogNode.java
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* /classgraph-4-8-69-sources-jar/nonapi/io/github/classgraph/utils/VersionFinder.java
* /classgraph-4-8-69-sources-jar/nonapi/io/github/classgraph/classloaderhandler/EquinoxClassLoaderHandler.java

* /classgraph-4-8-69-sources-jar/io/github/classgraph/MethodTypeSignature.java
* /classgraph-4-8-69-sources-jar/nonapi/io/github/classgraph/scanspec/ScanSpec.java
* /classgraph-4-8-69-sources-jar/io/github/classgraph/ClasspathElement.java
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* /classgraph-4-8-69-sources-jar/io/github/classgraph/ClassGraph.java
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* /classgraph-4-8-69-sources-jar/io/github/classgraph/ModuleInfo.java
* /classgraph-4-8-69-sources-jar/nonapi/io/github/classgraph/classloaderhandler/URLClassLoaderHandler.java
* /classgraph-4-8-69-sources-
jar/nonapi/io/github/classgraph/classloaderhandler/TomcatWebappClassLoaderBaseHandler.java
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/*
* This file is part of ClassGraph.
*
* Author: Johno Crawford (johno@sulake.com)
*
* Hosted at: https://github.com/classgraph/classgraph
*
* --
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* /classgraph-4-8-69-sources-jar/nonapi/io/github/classgraph/concurrency/AutoCloseableExecutorService.java
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/*
* This file is part of ClassGraph.
*
* Author: R. Kempees
*
* With contributions from @cpierceworld (#414)
*
* Hosted at: https://github.com/classgraph/classgraph
*
* --
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* /classgraph-4-8-69-sources-jar/nonapi/io/github/classgraph/classloaderhandler/WebsphereLibertyClassLoaderHandler.java

1.251 libtasn 4.16.0-2

1.251.1 Available under license :

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Version 2.1, February 1999

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This option is useful when you wish to copy part of the code of

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the work with the complete corresponding
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properly with a modified version of the library, if
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c) Accompany the work with a written offer, valid for at least three years, to give the same user the materials specified in Subsection 6a, above, for a charge no more than the cost of performing this distribution.

d) If distribution of the work is made by offering access to copy from a designated place, offer equivalent access to copy the above specified materials from the same place.

e) Verify that the user has already received a copy of these

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* /spring-core-5-2-24-release-sources-jar/org/springframework/core/io/support/ResourceRegion.java
* /spring-core-5-2-24-release-sources-jar/org/springframework/core/ParameterNameDiscoverer.java
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* /spring-core-5-2-24-release-sources-jar/org/springframework/core/serializer/DefaultSerializer.java
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 /spring-core-5-2-24-release-sources-jar/org/springframework/util/IdGenerator.java
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jar/org/springframework/core/convert/support/FallbackObjectToStringConverter.java
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jar/org/springframework/core/convert/support/StringToCurrencyConverter.java
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* /spring-core-5-2-24-release-sources-jar/org/springframework/util/AlternativeJdkIdGenerator.java
* /spring-core-5-2-24-release-sources-jar/org/springframework/util/JdkIdGenerator.java
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jar/org/springframework/core/annotation/AnnotationConfigurationException.java
* /spring-core-5-2-24-release-sources-jar/org/springframework/core/convert/support/StringToCharsetConverter.java
*
 /spring-core-5-2-24-release-sources-jar/org/springframework/core/type/MethodMetadata.java
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jar/org/springframework/core/convert/converter/ConditionalGenericConverter.java
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jar/org/springframework/core/convert/support/StringToPropertiesConverter.java
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* /spring-core-5-2-24-release-sources-jar/org/springframework/core/convert/converter/ConverterRegistry.java
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* /spring-core-5-2-24-release-sources-
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* /spring-core-5-2-24-release-sources-jar/org/springframework/core/type/filter/AssignableTypeFilter.java
* /spring-core-5-2-24-release-sources-jar/org/springframework/util/backoff/BackOffExecution.java
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* /spring-core-5-2-24-release-sources-jar/org/springframework/util/concurrent/FailureCallback.java
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* /spring-core-5-2-24-release-sources-
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*
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jar/org/springframework/core/convert/support/NumberToCharacterConverter.java

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org.springframework.core.ReactiveAdapterRegistry$SpringCoreBlockHoundIntegration

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jar/org/springframework/core/convert/support/StringToCollectionConverter.java
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jar/org/springframework/core/convert/support/CollectionToCollectionConverter.java
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 /spring-core-5-2-24-release-sources-jar/org/springframework/core/env/SimpleCommandLinePropertySource.java
* /spring-core-5-2-24-release-sources-jar/org/springframework/core/env/EnumerablePropertySource.java
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* /spring-core-5-2-24-release-sources-jar/org/springframework/core/convert/support/MapToMapConverter.java
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* /spring-core-5-2-24-release-sources-
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* /spring-core-5-2-24-release-sources-jar/org/springframework/core/codec/AbstractSingleValueEncoder.java
* /spring-core-5-2-24-release-sources-jar/org/springframework/core/annotation/AnnotationFilter.java
* /spring-core-5-2-24-release-sources-jar/org/springframework/core/annotation/AnnotationTypeMappings.java
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* /spring-core-5-2-24-release-sources-jar/org/springframework/util/LinkedCaseInsensitiveMap.java
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* /spring-core-5-2-24-release-sources-jar/org/springframework/core/ResolvableType.java
* /spring-core-5-2-24-release-sources-jar/org/springframework/core/serializer/Serializer.java
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* /spring-core-5-2-24-release-sources-jar/org/springframework/core/io/support/PropertySourceFactory.java
* /spring-core-5-2-24-release-sources-jar/org/springframework/core/codec/Decoder.java
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* /spring-core-5-2-24-release-sources-jar/org/springframework/core/task/support/TaskExecutorAdapter.java
* /spring-core-5-2-24-release-sources-jar/org/springframework/core/convert/support/GenericConversionService.java
* /spring-core-5-2-24-release-sources-jar/org/springframework/util/MimeTypeUtils.java
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* /spring-core-5-2-24-release-sources-jar/org/springframework/util/xml/StaxEventXMLReader.java
* /spring-core-5-2-24-release-sources-jar/org/springframework/core/SimpleAliasRegistry.java
* /spring-core-5-2-24-release-sources-jar/org/springframework/core/annotation/MergedAnnotations.java
* /spring-core-5-2-24-release-sources-jar/org/springframework/util/Assert.java
* /spring-core-5-2-24-release-sources-jar/org/springframework/core/io/support/PropertiesLoaderSupport.java
* /spring-core-5-2-24-release-sources-
jar/org/springframework/core/convert/support/StringToCharacterConverter.java
* /spring-core-5-2-24-release-sources-jar/org/springframework/util/FileCopyUtils.java
* /spring-core-5-2-24-release-sources-jar/org/springframework/core/ReactiveTypeDescriptor.java
* /spring-core-5-2-24-release-sources-jar/org/springframework/util/SystemPropertyUtils.java
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 /spring-core-5-2-24-release-sources-
jar/org/springframework/core/convert/support/StringToEnumConverterFactory.java
* /spring-core-5-2-24-release-sources-jar/org/springframework/core/KotlinDetector.java
* /spring-core-5-2-24-release-sources-jar/org/springframework/core/io/support/PropertiesLoaderUtils.java
* /spring-core-5-2-24-release-sources-jar/org/springframework/core/task/TaskDecorator.java
* /spring-core-5-2-24-release-sources-jar/org/springframework/util/SimpleIdGenerator.java
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* /spring-core-5-2-24-release-sources-jar/org/springframework/core/annotation/TypeMappedAnnotation.java
* /spring-core-5-2-24-release-sources-jar/org/springframework/core/annotation/TypeMappedAnnotations.java
* /spring-core-5-2-24-release-sources-jar/org/springframework/core/MethodParameter.java
* /spring-core-5-2-24-release-sources-jar/org/springframework/core/log/LogAccessor.java
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* /spring-core-5-2-24-release-sources-jar/org/springframework/core/annotation/MergedAnnotationsCollection.java
* /spring-core-5-2-24-release-sources-jar/org/springframework/core/io/AbstractResource.java
* /spring-core-5-2-24-release-sources-jar/org/springframework/util/MultiValueMapAdapter.java

* /spring-core-5-2-24-release-sources-jar/org/springframework/core/io/support/PathMatchingResourcePatternResolver.java
* /spring-core-5-2-24-release-sources-jar/org/springframework/core/type/StandardAnnotationMetadata.java
* /spring-core-5-2-24-release-sources-jar/org/springframework/core/serializer/support/SerializingConverter.java
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 /spring-core-5-2-24-release-sources-jar/org/springframework/core/env/AbstractPropertyResolver.java
* /spring-core-5-2-24-release-sources-jar/org/springframework/core/env/PropertyResolver.java
* /spring-core-5-2-24-release-sources-jar/org/springframework/core/annotation/MergedAnnotation.java
* /spring-core-5-2-24-release-sources-jar/org/springframework/util/CommonsLogWriter.java
* /spring-core-5-2-24-release-sources-jar/org/springframework/core/annotation/SynthesizedMergedAnnotationInvocationHandler.java
* /spring-core-5-2-24-release-sources-jar/org/springframework/core/type/classreading/SimpleAnnotationMetadata.java
* /spring-core-5-2-24-release-sources-jar/org/springframework/core/io/buffer/LimitedDataBufferList.java
* /spring-core-5-2-24-release-sources-jar/org/springframework/core/type/classreading/MethodMetadataReadingVisitor.java
* /spring-core-5-2-24-release-sources-jar/org/springframework/core/io/FileUrlResource.java
* /spring-core-5-2-24-release-sources-jar/org/springframework/core/annotation/AnnotationUtils.java
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* /spring-core-5-2-24-release-sources-jar/org/springframework/core/ReactiveAdapterRegistry.java
* /spring-core-5-2-24-release-sources-jar/org/springframework/util/StringUtils.java
* /spring-core-5-2-24-release-sources-jar/org/springframework/util/ClassUtils.java
*
 /spring-core-5-2-24-release-sources-jar/org/springframework/util/PropertyPlaceholderHelper.java
* /spring-core-5-2-24-release-sources-jar/org/springframework/core/io/buffer/DefaultDataBuffer.java
* /spring-core-5-2-24-release-sources-jar/org/springframework/util/ReflectionUtils.java
* /spring-core-5-2-24-release-sources-
jar/org/springframework/core/type/classreading/SimpleMethodMetadataReadingVisitor.java
* /spring-core-5-2-24-release-sources-jar/org/springframework/core/io/InputStreamSource.java
* /spring-core-5-2-24-release-sources-jar/org/springframework/core/io/ClassPathResource.java
* /spring-core-5-2-24-release-sources-jar/org/springframework/core/log/LogFormatUtils.java
* /spring-core-5-2-24-release-sources-jar/org/springframework/util/ConcurrentReferenceHashMap.java
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* /spring-core-5-2-24-release-sources-jar/org/springframework/util/xml/AbstractXMLReader.java
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/spring-core-5-2-24-release-sources-jar/org/springframework/core/convert/ConversionFailedException.java
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* /spring-core-5-2-24-release-sources-
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* /spring-core-5-2-24-release-sources-jar/org/springframework/core/convert/support/IdToEntityConverter.java
* /spring-core-5-2-24-release-sources-jar/org/springframework/util/concurrent/ListenableFutureAdapter.java
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* /spring-core-5-2-24-release-sources-jar/org/springframework/core/convert/support/ObjectToObjectConverter.java
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* /spring-core-5-2-24-release-sources-jar/org/springframework/util/TypeUtils.java
* /spring-core-5-2-24-release-sources-jar/org/springframework/core/io/support/VfsPatternUtils.java
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* /spring-core-5-2-24-release-sources-jar/org/springframework/core/NestedExceptionUtils.java
* /spring-core-5-2-24-release-sources-jar/org/springframework/core/convert/support/DefaultConversionService.java
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* /spring-core-5-2-24-release-sources-jar/org/springframework/core/MethodClassKey.java
* /spring-core-5-2-24-release-sources-jar/org/springframework/core/convert/ConversionService.java
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* /spring-core-5-2-24-release-sources-jar/org/springframework/core/io/WritableResource.java
* /spring-core-5-2-24-release-sources-jar/org/springframework/core/type/ClassMetadata.java
* /spring-core-5-2-24-release-sources-jar/org/springframework/core/io/FileSystemResourceLoader.java
* /spring-core-5-2-24-release-sources-jar/org/springframework/util/StringValueResolver.java
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* /spring-core-5-2-24-release-sources-jar/org/springframework/core/DecoratingClassLoader.java
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* /spring-core-5-2-24-release-sources-jar/org/springframework/util/xml/StaxResult.java
* /spring-core-5-2-24-release-sources-jar/org/springframework/core/env/EnvironmentCapable.java
* /spring-core-5-2-24-release-sources-jar/org/springframework/core/type/filter/AspectJTypeFilter.java
* /spring-core-5-2-24-release-sources-jar/org/springframework/lang/NonNullApi.java
* /spring-core-5-2-24-release-sources-jar/org/springframework/util/CustomizableThreadCreator.java
* /spring-core-5-2-24-release-sources-jar/org/springframework/core/codec/EncodingException.java
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* /spring-core-5-2-24-release-sources-jar/org/springframework/util/SerializationUtils.java
* /spring-core-5-2-24-release-sources-jar/org/springframework/core/log/LogDelegateFactory.java
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* /spring-core-5-2-24-release-sources-jar/org/springframework/core/BridgeMethodResolver.java
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* /spring-core-5-2-24-release-sources-jar/org/springframework/core/codec/DataBufferDecoder.java
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* /spring-core-5-2-24-release-sources-jar/org/springframework/core/env/PropertyResolverExtensions.kt
* /spring-core-5-2-24-release-sources-jar/org/springframework/core/type/AnnotatedTypeMetadata.java
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* /spring-core-5-2-24-release-sources-
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* /spring-core-5-2-24-release-sources-jar/org/springframework/core/style/DefaultValueStyler.java
* /spring-core-5-2-24-release-sources-jar/org/springframework/core/DecoratingProxy.java
* /spring-core-5-2-24-release-sources-jar/org/springframework/core/codec/ByteArrayDecoder.java
* /spring-core-5-2-24-release-sources-jar/org/springframework/util/xml/AbstractStaxXMLReader.java

* /spring-core-5-2-24-release-sources-jar/org/springframework/core/convert/support/IntegerToEnumConverterFactory.java
* /spring-core-5-2-24-release-sources-jar/org/springframework/core/annotation/AnnotationAttributes.java
* /spring-core-5-2-24-release-sources-jar/org/springframework/core/convert/TypeDescriptor.java
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* /spring-core-5-2-24-release-sources-jar/org/springframework/core/annotation/IntrospectionFailureLogger.java
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* /spring-core-5-2-24-release-sources-jar/org/springframework/core/type/classreading/AnnotationReadingVisitorUtils.java
* /spring-core-5-2-24-release-sources-jar/org/springframework/core/io/support/ResourcePatternUtils.java
* /spring-core-5-2-24-release-sources-jar/org/springframework/core/annotation/MergedAnnotationPredicates.java
* /spring-core-5-2-24-release-sources-jar/org/springframework/core/type/classreading/RecursiveAnnotationArrayVisitor.java
* /spring-core-5-2-24-release-sources-jar/org/springframework/util/Base64Utils.java
* /spring-core-5-2-24-release-sources-jar/org/springframework/core/codec/ByteBufferEncoder.java
* /spring-core-5-2-24-release-sources-jar/org/springframework/util/DefaultPropertiesPersister.java
* /spring-core-5-2-24-release-sources-jar/org/springframework/core/annotation/MissingMergedAnnotation.java
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/spring-core-5-2-24-release-sources-jar/org/springframework/core/codec/AbstractDataBufferDecoder.java
* /spring-core-5-2-24-release-sources-jar/org/springframework/core/type/StandardMethodMetadata.java
* /spring-core-5-2-24-release-sources-jar/org/springframework/lang/NonNull.java
* /spring-core-5-2-24-release-sources-jar/org/springframework/core/PriorityOrdered.java
* /spring-core-5-2-24-release-sources-jar/org/springframework/core/annotation/RepeatableContainers.java
* /spring-core-5-2-24-release-sources-jar/org/springframework/core/convert/support/ConversionUtils.java
* /spring-core-5-2-24-release-sources-jar/org/springframework/core/codec/ByteArrayEncoder.java
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* /spring-core-5-2-24-release-sources-jar/org/springframework/core/env/AbstractEnvironment.java
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* /spring-core-5-2-24-release-sources-jar/org/springframework/util/PatternMatchUtils.java
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* /spring-core-5-2-24-release-sources-jar/org/springframework/util/SimpleRouteMatcher.java
* /spring-core-5-2-24-release-sources-jar/org/springframework/util/StopWatch.java
* /spring-core-5-2-24-release-sources-jar/org/springframework/core/Ordered.java
* /spring-core-5-2-24-release-sources-jar/org/springframework/core/annotation/MergedAnnotationSelectors.java
* /spring-core-5-2-24-release-sources-jar/org/springframework/core/codec/ByteBufferDecoder.java

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* /spring-jdbc-5-2-24-release-sources-
jar/org/springframework/jdbc/datasource/init/CompositeDatabasePopulator.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/datasource/lookup/DataSourceLookup.java
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jar/org/springframework/jdbc/datasource/init/ScriptStatementFailedException.java
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* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/core/SqlProvider.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/core/metadata/CallParameterMetaData.java
*
 /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/support/DatabaseMetaDataCallback.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/support/JdbcUtils.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/core/metadata/CallMetaDataContext.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/datasource/embedded/AbstractEmbeddedDatabaseConfigurer.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/datasource/SimpleDriverDataSource.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/datasource/SingleConnectionDataSource.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/datasource/embedded/DataSourceFactory.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/core/namedparam/SqlParameterSourceUtils.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/support/SQLErrorCodeSQLExceptionTranslator.java

* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/core/SingleColumnRowMapper.java
*
 /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/core/namedparam/ParsedSql.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/core/PreparedStatementCreatorFactory.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/support/SQLErrorCodesFactory.java
* /spring-jdbc-5-2-24-release-sources-
jar/org/springframework/jdbc/core/metadata/CallMetaDataProviderFactory.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/datasource/DriverManagerDataSource.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/core/StatementCreatorUtils.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/core/JdbcTemplate.java
* /spring-jdbc-5-2-24-release-sources-
jar/org/springframework/jdbc/datasource/lookup/AbstractRoutingDataSource.java
* /spring-jdbc-5-2-24-release-sources-
jar/org/springframework/jdbc/core/namedparam/NamedParameterJdbcTemplate.java
*
 /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/datasource/init/DatabasePopulatorUtils.java
* /spring-jdbc-5-2-24-release-sources-
jar/org/springframework/jdbc/datasource/DataSourceTransactionManager.java
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* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/support/incrementer/AbstractSequenceMaxValueIncrementer.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/support/MetaDataAccessException.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/support/xml/XmlBinaryStreamProvider.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/support/SqlValue.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/support/xml/XmlCharacterStreamProvider.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/SQLWarningException.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/core/InterruptibleBatchPreparedStatementSetter.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/support/xml/XmlResultProvider.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/datasource/embedded/SimpleDriverDataSourceFactory.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/object/GenericStoredProcedure.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/datasource/lookup/SingleDataSourceLookup.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/support/xml/SqlXmlFeatureNotImplementedException.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/datasource/lookup/JndiDataSourceLookup.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/datasource/lookup/DataSourceLookupFailureException.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/core/BatchPreparedStatementSetter.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/config/JdbcNamespaceHandler.java
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* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/core/namedparam/MapSqlParameterSourceExtensions.kt
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/**
* The classes in this package make JDBC easier to use and
* reduce the likelihood of common errors. In particular, they:
*
* Simplify error handling, avoiding the need for try/catch/finally
* blocks in application code.
* Present exceptions to application code in a generic hierarchy of
* unchecked exceptions, enabling applications to catch data access
* exceptions without being dependent on JDBC, and to ignore fatal
* exceptions there is no value in catching.
* Allow the implementation of error handling to be modified
* to target different RDBMSes without introducing proprietary
* dependencies into application code.
*
*
* <p>This package and related packages are discussed in Chapter 9 of
* Expert One-On-One J2EE Design and Development
* by Rod Johnson (Wrox, 2002).
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*/
/**
* Implement this interface when parameters need to be customized based
* on the connection. We might need to do this to make use of proprietary
* features, available only with a specific Connection type.
*
* @author Rod Johnson
* @author Thomas Risberg
* @see CallableStatementCreatorFactory#newCallableStatementCreator(ParameterMapper)
 * @see org.springframework.jdbc.object.StoredProcedure#execute(ParameterMapper)
*/
/**
  * Create a Map of input parameters, keyed by name.
  * @param con a JDBC connection. This is useful (and the purpose of this interface)
  * if we need to do something RDBMS-specific with a proprietary Connection
  * implementation class. This class conceals such proprietary details. However,
  * it is best to avoid using such proprietary RDBMS features if possible.
  * @return a Map of input parameters, keyed by name (never {@code null})
  * @throws SQLException if an SQLException is encountered setting
  * parameter values (that is, there's no need to catch SQLException)
  */
```

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* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/support/incrementer/H2SequenceMaxValueIncrementer.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/object/SqlCall.java
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 /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/support/AbstractFallbackSQLExceptionTranslator.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/datasource/AbstractDataSource.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/LobRetrievalFailureException.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/core/namedparam/NamedParameterBatchUpdateUtils.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/datasource/embedded/H2EmbeddedDatabaseConfigurer.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/datasource/lookup/MapDataSourceLookup.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/core/ResultSetSupportingSqlParameter.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/datasource/UserCredentialsDataSourceAdapter.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/datasource/lookup/IsolationLevelDataSourceRouter.java
*
 /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/core/StatementCallback.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/core/PreparedStatementCreator.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/datasource/embedded/EmbeddedDatabaseType.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/core/namedparam/EmptySqlParameterSource.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/datasource/embedded/EmbeddedDatabaseConfigurer.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/support/JdbcAccessor.java

* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/core/metadata/HanaCallMetaDataProvider.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/support/CustomSQLExceptionTranslatorRegistrar.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/support/incrementer/PostgresSequenceMaxValueIncrementer.java
*
/spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/core/support/AbstractSqlTypeValue.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/core/metadata/HsqlTableMetaDataProvider.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/BadSqlGrammarException.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/object/SqlQuery.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/core/support/AbstractInterruptibleBatchPreparedStatementSetter.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/support/incrementer/HsqlSequenceMaxValueIncrementer.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/CannotGetJdbcConnectionException.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/datasource/embedded/DerbyEmbeddedDatabaseConfigurer.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/UncategorizedSQLException.java
*
/spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/support/GeneratedKeyHolder.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/InvalidResultSetAccessException.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/object/StoredProcedure.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/support/incrementer/OracleSequenceMaxValueIncrementer.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/core/simple/SimpleJdbcInsertOperations.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/support/incrementer/SybaseMaxValueIncrementer.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/support/DatabaseStartupValidator.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/core/SqlReturnUpdateCount.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/datasource/WebSphereDataSourceAdapter.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/support/incrementer/AbstractDataFieldMaxValueIncrementer.java
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* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/core/metadata/TableParameterMetaData.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/support/incrementer/HanaSequenceMaxValueIncrementer.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/datasource/DataSourceUtils.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/core/support/JdbcDaoSupport.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/core/ArgumentPreparedStatementSetter.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/core/metadata/PostgresTableMetaDataProvider.java
*

/spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/support/incrementer/AbstractColumnMaxValueIncrementer.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/core/metadata/CallMetaDataProvider.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/core/SqlInOutParameter.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/config/SortedResourcesFactoryBean.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/core/simple/SimpleJdbcCallOperations.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/core/metadata/OracleTableMetaDataProvider.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/datasource/SimpleConnectionHandle.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/IncorrectResultSetColumnCountException.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/core/metadata/DerbyCallMetaDataProvider.java
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/spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/support/rowset/ResultSetWrappingSqlRowSetMetaData.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/support/incrementer/AbstractIdentityColumnMaxValueIncrementer.java
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* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/datasource/IsolationLevelDataSourceAdapter.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/object/SqlOperation.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/core/CallableStatementCallback.java
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* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/datasource/embedded/HsqlEmbeddedDatabaseConfigurer.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/core/SqlReturnResultSet.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/support/incrementer/MySQLMaxValueIncrementer.java
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* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/core/SqlParameter.java
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* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/datasource/embedded/EmbeddedDatabaseConfigurerFactory.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/core/SqlTypeValue.java
*
/spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/object/MappingSqlQueryWithParameters.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/support/incrementer/Db2MainframeMaxValueIncrementer.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/core/ArgumentTypePreparedStatementSetter.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/core/metadata/TableMetaDataProvider.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/core/ResultSetExtractor.java
* /spring-jdbc-5-2-24-release-sources-

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* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/core/RowCountCallbackHandler.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/core/PreparedStatementCallback.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/object/BatchSqlUpdate.java
* /spring-jdbc-5-2-24-release-sources-
jar/org/springframework/jdbc/JdbcUpdateAffectedIncorrectNumberOfRowsException.java
*
/spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/core/RowMapper.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/core/CallableStatementCreator.java
* /spring-jdbc-5-2-24-release-sources-
jar/org/springframework/jdbc/core/metadata/DerbyTableMetaDataProvider.java
* /spring-jdbc-5-2-24-release-sources-
jar/org/springframework/jdbc/datasource/embedded/EmbeddedDatabaseFactory.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/object/UpdatableSqlQuery.java
* /spring-jdbc-5-2-24-release-sources-
jar/org/springframework/jdbc/core/namedparam/NamedParameterJdbcDaoSupport.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/core/CallableStatementCreatorFactory.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/object/GenericSqlQuery.java
* /spring-jdbc-5-2-24-release-sources-
jar/org/springframework/jdbc/core/ParameterizedPreparedStatementSetter.java
*
/spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/core/metadata/Db2CallMetaDataProvider.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/core/SqlRowSetResultSetExtractor.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/datasource/ConnectionHandle.java
* /spring-jdbc-5-2-24-release-sources-
jar/org/springframework/jdbc/support/incrementer/DerbyMaxValueIncrementer.java
* /spring-jdbc-5-2-24-release-sources-
jar/org/springframework/jdbc/datasource/embedded/EmbeddedDatabaseBuilder.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/support/lob/TemporaryLobCreator.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/core/ConnectionCallback.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/core/SqlParameterValue.java
* /spring-jdbc-5-2-24-release-sources-
jar/org/springframework/jdbc/datasource/embedded/OutputStreamFactory.java
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/spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/object/SqlUpdate.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/core/ColumnMapRowMapper.java
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* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/core/namedparam/NamedParameterJdbcOperations.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/core/BeanPropertyRowMapper.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/core/metadata/GenericTableMetaDataProvider.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/core/metadata/TableMetaDataContext.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/core/JdbcOperations.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/core/namedparam/NamedParameterUtils.java
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* Strategy interface for translating between {@link SQLException SQLExceptions}
* and Spring's data access strategy-agnostic {@link DataAccessException}
* hierarchy.
*
* <p>Implementations can be generic (for example, using
* {@link java.sql.SQLException#getSQLState() SQLState} codes for JDBC) or
 wholly
* proprietary (for example, using Oracle error codes) for greater precision.

*
* @author Rod Johnson
* @author Juergen Hoeller
* @see org.springframework.dao.DataAccessException
*/

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* /spring-jdbc-5-2-24-release-sources-
jar/org/springframework/jdbc/support/CustomSQLExceptionTranslatorRegistry.java
*
 /spring-jdbc-5-2-24-release-sources-
jar/org/springframework/jdbc/core/namedparam/BeanPropertySqlParameterSource.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/object/SqlFunction.java
* /spring-jdbc-5-2-24-release-sources-
jar/org/springframework/jdbc/core/namedparam/MapSqlParameterSource.java
* /spring-jdbc-5-2-24-release-sources-
jar/org/springframework/jdbc/datasource/TransactionAwareDataSourceProxy.java
* /spring-jdbc-5-2-24-release-sources-
jar/org/springframework/jdbc/support/rowset/ResultSetWrappingSqlRowSet.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/support/rowset/SqlRowSet.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/core/simple/AbstractJdbcInsert.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/support/KeyHolder.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/support/SQLStateSQLExceptionTranslator.java
* /spring-jdbc-5-2-24-release-sources-
jar/org/springframework/jdbc/core/namedparam/AbstractSqlParameterSource.java
*

/spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/datasource/LazyConnectionDataSourceProxy.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/datasource/init/ResourceDatabasePopulator.java
* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/core/support/AbstractLobStreamingResultSetExtractor.java
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*/
/**
  * Close this LobCreator session and free its temporarily created BLOBs and CLOBs.
  * Will not need to do anything if using PreparedStatement's standard methods,
  * but might be necessary to free database resources if using proprietary means.
  * <p><b>NOTE</b>: Needs to be invoked after the involved
 PreparedStatements have
  * been executed or the affected O/R mapping sessions have been flushed.
  * Otherwise, the database resources for the temporary BLOBs might stay allocated.
  */
```

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jar/org/springframework/jdbc/support/incrementer/HsqlMaxValueIncrementer.java
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* /spring-jdbc-5-2-24-release-sources-jar/org/springframework/jdbc/support/incrementer/DB2SequenceMaxValueIncrementer.java
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jar/org/springframework/jdbc/support/CustomSQLErrorCodesTranslation.java
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1.267 statistics 2.1

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1.269 runc 1.1.8

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* /offheap-store-2-4-3-sources-jar/org/terracotta/offheapstore/storage/OffHeapBufferStorageEngine.java
* /offheap-store-2-4-3-sources-jar/org/terracotta/offheapstore/disk/storage/PersistentIntegerStorageEngine.java
* /offheap-store-2-4-3-sources-jar/org/terracotta/offheapstore/util/FindbugsSuppressWarnings.java
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/offheap-store-2-4-3-sources-jar/org/terracotta/offheapstore/storage/PortabilityBasedHalfStorageEngine.java
* /offheap-store-2-4-3-sources-jar/org/terracotta/offheapstore/storage/StringStorageEngine.java
* /offheap-store-2-4-3-sources-jar/org/terracotta/offheapstore/disk/storage/AATreeFileAllocator.java
* /offheap-store-2-4-3-sources-jar/org/terracotta/offheapstore/OffHeapHashMap.java
* /offheap-store-2-4-3-sources-jar/org/terracotta/offheapstore/storage/PortabilityBasedStorageEngine.java
* /offheap-store-2-4-3-sources-jar/org/terracotta/offheapstore/paging/OffHeapStorageArea.java
* /offheap-store-2-4-3-sources-jar/org/terracotta/offheapstore/util/ByteBufferUtils.java
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* /offheap-store-2-4-3-sources-jar/org/terracotta/offheapstore/storage/BooleanHalfStorageEngine.java
* /offheap-store-2-4-3-sources-
jar/org/terracotta/offheapstore/eviction/EvictionListeningWriteLockedOffHeapClockCache.java
* /offheap-store-2-4-3-sources-
jar/org/terracotta/offheapstore/disk/persistent/PersistentConcurrentOffHeapHashMap.java
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* /offheap-store-2-4-3-sources-jar/org/terracotta/offheapstore/util/DebuggingUtils.java
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* /offheap-store-2-4-3-sources-jar/org/terracotta/offheapstore/storage/listener/RuntimeStorageEngineListener.java
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* /offheap-store-2-4-3-sources-jar/org/terracotta/offheapstore/Metadata.java
* /offheap-store-2-4-3-sources-jar/org/terracotta/offheapstore/WriteLockedOffHeapClockCache.java
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* /offheap-store-2-4-3-sources-jar/org/terracotta/offheapstore/disk/storage/Region.java
* /offheap-store-2-4-3-sources-jar/org/terracotta/offheapstore/util/ByteBufferInputStream.java

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* /offheap-store-2-4-3-sources-jar/org/terracotta/offheapstore/buffersource/BufferSource.java
* /offheap-store-2-4-3-sources-jar/org/terracotta/offheapstore/util/NoOpLock.java
* /offheap-store-2-4-3-sources-jar/org/terracotta/offheapstore/storage/portability/WriteContext.java
* /offheap-store-2-4-3-sources-jar/org/terracotta/offheapstore/storage/portability/WriteBackPortability.java
* /offheap-store-2-4-3-sources-jar/org/terracotta/offheapstore/storage/portability/StringPortability.java
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* /offheap-store-2-4-3-sources-jar/org/terracotta/offheapstore/storage/allocator/IntegerBestFitAllocator.java
* /offheap-store-2-4-3-sources-jar/org/terracotta/offheapstore/util/MemoryUnit.java
* /offheap-store-2-4-3-sources-jar/org/terracotta/offheapstore/ReadWriteLockedOffHeapClockCache.java
* /offheap-store-2-4-3-sources-
jar/org/terracotta/offheapstore/disk/persistent/AbstractPersistentConcurrentOffHeapMap.java
* /offheap-store-2-4-3-sources-jar/org/terracotta/offheapstore/storage/allocator/Region.java
* /offheap-store-2-4-3-sources-jar/org/terracotta/offheapstore/concurrent/ConcurrentMapInternals.java
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Found in path(s):
* /offheap-store-2-4-3-sources-jar/META-INF/maven/org.terracotta/offheap-store/pom.xml

1.274 nio-multipart-parser 1.1.0

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jar/org/springframework/aop/aspectj/annotation/MetadataAwareAspectInstanceFactory.java
* /spring-aop-5-2-24-release-sources-jar/org/aopalliance/aop/Advice.java
*
 /spring-aop-5-2-24-release-sources-jar/org/aopalliance/intercept/ConstructorInterceptor.java
* /spring-aop-5-2-24-release-sources-jar/org/springframework/aop/target/ThreadLocalTargetSource.java
* /spring-aop-5-2-24-release-sources-
jar/org/springframework/aop/aspectj/annotation/SimpleMetadataAwareAspectInstanceFactory.java
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jar/org/springframework/aop/aspectj/annotation/SingletonMetadataAwareAspectInstanceFactory.java
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* /spring-aop-5-2-24-release-sources-jar/org/aopalliance/intercept/MethodInvocation.java
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* /spring-aop-5-2-24-release-sources-
jar/org/springframework/aop/config/AspectJAutoProxyBeanDefinitionParser.java
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* /spring-aop-5-2-24-release-sources-jar/org/springframework/aop/TargetClassAware.java
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jar/org/springframework/aop/aspectj/annotation/PrototypeAspectInstanceFactory.java
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jar/org/springframework/aop/config/ScopedProxyBeanDefinitionDecorator.java
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* /spring-aop-5-2-24-release-sources-jar/org/springframework/aop/support/DynamicMethodMatcherPointcut.java
* /spring-aop-5-2-24-release-sources-jar/org/springframework/aop/framework/adapter/ThrowsAdviceAdapter.java
* /spring-aop-5-2-24-release-sources-
jar/org/springframework/aop/config/SpringConfiguredBeanDefinitionParser.java
* /spring-aop-5-2-24-release-sources-
jar/org/springframework/aop/framework/adapter/UnknownAdviceTypeException.java
* /spring-aop-5-2-24-release-sources-
jar/org/springframework/aop/framework/adapter/AdvisorAdapterRegistrationManager.java
*
 /spring-aop-5-2-24-release-sources-jar/org/springframework/aop/interceptor/DebugInterceptor.java
* /spring-aop-5-2-24-release-sources-jar/org/springframework/aop/target/LazyInitTargetSource.java
* /spring-aop-5-2-24-release-sources-jar/org/springframework/aop/config/PointcutComponentDefinition.java
* /spring-aop-5-2-24-release-sources-jar/org/springframework/aop/PointcutAdvisor.java
* /spring-aop-5-2-24-release-sources-
jar/org/springframework/aop/target/dynamic/BeanFactoryRefreshableTargetSource.java
* /spring-aop-5-2-24-release-sources-jar/org/springframework/aop/framework/AopProxy.java
* /spring-aop-5-2-24-release-sources-jar/org/springframework/aop/support/JdkRegexpMethodPointcut.java
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* /spring-aop-5-2-24-release-sources-jar/org/springframework/aop/aspectj/AspectInstanceFactory.java
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* /spring-aop-5-2-24-release-sources-jar/org/springframework/aop/config/SimpleBeanFactoryAwareAspectInstanceFactory.java
* /spring-aop-5-2-24-release-sources-jar/org/springframework/aop/aspectj/annotation/AnnotationAwareAspectJAutoProxyCreator.java
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* /spring-aop-5-2-24-release-sources-jar/org/springframework/aop/interceptor/SimpleTraceInterceptor.java
* /spring-aop-5-2-24-release-sources-jar/org/springframework/aop/support/DefaultPointcutAdvisor.java
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* /spring-aop-5-2-24-release-sources-jar/org/springframework/aop/interceptor/ExposeInvocationInterceptor.java
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jar/org/springframework/aop/framework/autoproxy/AbstractAdvisorAutoProxyCreator.java

* /spring-aop-5-2-24-release-sources-jar/org/springframework/aop/aspectj/MethodInvocationProceedingJoinPoint.java
* /spring-aop-5-2-24-release-sources-jar/org/springframework/aop/aspectj/autoproxy/AspectJAwareAdvisorAutoProxyCreator.java
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* /spring-aop-5-2-24-release-sources-jar/org/springframework/aop/interceptor/SimpleAsyncUncaughtExceptionHandler.java
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* /spring-aop-5-2-24-release-sources-jar/org/springframework/aop/framework/adapter/AdvisorAdapterRegistry.java
* /spring-aop-5-2-24-release-sources-jar/org/springframework/aop/support/StaticMethodMatcherPointcutAdvisor.java
* /spring-aop-5-2-24-release-sources-jar/org/springframework/aop/target/AbstractPrototypeBasedTargetSource.java
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* /spring-aop-5-2-24-release-sources-jar/org/springframework/aop/TrueClassFilter.java
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* /spring-aop-5-2-24-release-sources-jar/org/springframework/aop/scope/ScopedProxyFactoryBean.java
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jar/org/springframework/aop/framework/autoproxy/ProxyCreationContext.java
* /spring-aop-5-2-24-release-sources-jar/org/springframework/aop/target/EmptyTargetSource.java
* /spring-aop-5-2-24-release-sources-jar/org/springframework/aop/MethodBeforeAdvice.java
* /spring-aop-5-2-24-release-sources-
jar/org/springframework/aop/framework/autoproxy/target/AbstractBeanFactoryBasedTargetSourceCreator.java
* /spring-aop-5-2-24-release-sources-
jar/org/springframework/aop/framework/autoproxy/DefaultAdvisorAutoProxyCreator.java
* /spring-aop-5-2-24-release-sources-jar/org/springframework/aop/framework/ProxyConfig.java
* /spring-aop-5-2-24-release-sources-jar/org/aopalliance/aop/AspectException.java
* /spring-aop-5-2-24-release-sources-jar/org/springframework/aop/aspectj/AspectJPrecedenceInformation.java
* /spring-aop-5-2-24-release-sources-jar/org/springframework/aop/IntroductionAwareMethodMatcher.java
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/spring-aop-5-2-24-release-sources-jar/org/springframework/aop/aspectj/RuntimeTestWalker.java
* /spring-aop-5-2-24-release-sources-jar/org/springframework/aop/support/AbstractRegexpMethodPointcut.java
* /spring-aop-5-2-24-release-sources-jar/org/springframework/aop/framework/AdvisorChainFactory.java
* /spring-aop-5-2-24-release-sources-
jar/org/springframework/aop/framework/adapter/ThrowsAdviceInterceptor.java
* /spring-aop-5-2-24-release-sources-jar/org/springframework/aop/aspectj/AspectJPointcutAdvisor.java
* /spring-aop-5-2-24-release-sources-jar/org/springframework/aop/TargetSource.java
* /spring-aop-5-2-24-release-sources-
jar/org/springframework/aop/target/AbstractBeanFactoryBasedTargetSource.java
* /spring-aop-5-2-24-release-sources-jar/org/springframework/aop/support/annotation/AnnotationClassFilter.java

* /spring-aop-5-2-24-release-sources-jar/org/springframework/aop/aspectj/annotation/AspectJProxyFactory.java
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 /spring-aop-5-2-24-release-sources-jar/org/springframework/aop/aspectj/SimpleAspectInstanceFactory.java
* /spring-aop-5-2-24-release-sources-jar/org/springframework/aop/interceptor/ExposeBeanNameAdvisors.java
* /spring-aop-5-2-24-release-sources-jar/org/springframework/aop/target/CommonsPool2TargetSource.java
* /spring-aop-5-2-24-release-sources-jar/org/springframework/aop/config/AdvisorComponentDefinition.java
* /spring-aop-5-2-24-release-sources-jar/org/springframework/aop/support/RegexpMethodPointcutAdvisor.java
* /spring-aop-5-2-24-release-sources-jar/org/springframework/aop/framework/DefaultAdvisorChainFactory.java
* /spring-aop-5-2-24-release-sources-jar/org/springframework/aop/support/DynamicMethodMatcher.java
* /spring-aop-5-2-24-release-sources-jar/org/springframework/aop/aspectj/AspectJExpressionPointcut.java
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jar/org/springframework/aop/framework/adapter/GlobalAdvisorAdapterRegistry.java
* /spring-aop-5-2-24-release-sources-jar/org/springframework/aop/framework/Advised.java
* /spring-aop-5-2-24-release-sources-
jar/org/springframework/aop/framework/adapter/AfterReturningAdviceInterceptor.java
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* /spring-aop-5-2-24-release-sources-
jar/org/springframework/aop/framework/InterceptorAndDynamicMethodMatcher.java
* /spring-aop-5-2-24-release-sources-jar/org/springframework/aop/framework/AopInfrastructureBean.java
* /spring-aop-5-2-24-release-sources-jar/org/springframework/aop/SpringProxy.java

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* /spring-aop-5-2-24-release-sources-jar/org/springframework/aop/aspectj/annotation/AspectMetadata.java
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 /spring-aop-5-2-24-release-sources-jar/org/springframework/aop/support/NameMatchMethodPointcut.java
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jar/org/springframework/aop/support/annotation/AnnotationMethodMatcher.java
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 /spring-aop-5-2-24-release-sources-jar/org/springframework/aop/ClassFilter.java
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jar/org/springframework/aop/support/annotation/AnnotationMatchingPointcut.java
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* /spring-aop-5-2-24-release-sources-
jar/org/springframework/aop/framework/autoproxy/AbstractAutoProxyCreator.java
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 /spring-aop-5-2-24-release-sources-
jar/org/springframework/aop/aspectj/annotation/AbstractAspectJAdvisorFactory.java
* /spring-aop-5-2-24-release-sources-jar/org/springframework/aop/framework/DefaultAopProxyFactory.java
* /spring-aop-5-2-24-release-sources-jar/org/springframework/aop/DynamicIntroductionAdvice.java

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jar/org/springframework/aop/framework/autoproxy/target/LazyInitTargetSourceCreator.java
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procfs provides functions to retrieve system, kernel and process
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1.280 jackson-dataformat-yaml 2.11.2

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1.282 management-model 5.7.3

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* /management-model-5-7-3-sources-jar/org/terracotta/management/model/call/ContextualCall.java
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* /management-model-5-7-3-sources-jar/org/terracotta/management/model/capabilities/descriptors/Descriptor.java
* /management-model-5-7-3-sources-jar/org/terracotta/management/model/stats/Statistic.java
* /management-model-5-7-3-sources-jar/org/terracotta/management/model/capabilities/context/CapabilityContext.java
* /management-model-5-7-3-sources-jar/org/terracotta/management/model/call/Parameter.java

* /management-model-5-7-3-sources-jar/org/terracotta/management/model/capabilities/descriptors/CallDescriptor.java
* /management-model-5-7-3-sources-jar/org/terracotta/management/model/stats/ContextualStatistics.java
* /management-model-5-7-3-sources-jar/org/terracotta/management/model/capabilities/descriptors/StatisticDescriptor.java
* /management-model-5-7-3-sources-jar/org/terracotta/management/model/capabilities/DefaultCapability.java
* /management-model-5-7-3-sources-jar/org/terracotta/management/model/context/ContextContainer.java
* /management-model-5-7-3-sources-jar/org/terracotta/management/model/context/Context.java
* /management-model-5-7-3-sources-jar/org/terracotta/management/model/capabilities/Capability.java
* /management-model-5-7-3-sources-jar/org/terracotta/management/model/message/ManagementCallMessage.java
* /management-model-5-7-3-sources-jar/org/terracotta/management/model/stats/StatisticRegistry.java
* /management-model-5-7-3-sources-jar/org/terracotta/management/model/message/DefaultMessage.java
* /management-model-5-7-3-sources-jar/org/terracotta/management/model/call/ContextualReturn.java
* /management-model-5-7-3-sources-jar/org/terracotta/management/model/message/Message.java
* /management-model-5-7-3-sources-jar/org/terracotta/management/model/cluster/ClientIdentifier.java
* /management-model-5-7-3-sources-jar/org/terracotta/management/model/capabilities/descriptors/Settings.java
* /management-model-5-7-3-sources-jar/org/terracotta/management/model/notification/ContextualNotification.java
* /management-model-5-7-3-sources-jar/org/terracotta/management/model/context/Contextual.java
* /management-model-5-7-3-sources-jar/org/terracotta/management/model/stats/StatisticType.java
* /management-model-5-7-3-sources-jar/org/terracotta/management/model/stats/DelegatingSample.java

1.283 swagger-annotations 2.1.9

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* /swagger-annotations-2-1-9-sources-jar/io/swagger/v3/oas/annotations/callbacks/Callback.java
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*
 /swagger-annotations-2-1-9-sources-jar/io/swagger/v3/oas/annotations/info/Info.java
* /swagger-annotations-2-1-9-sources-jar/io/swagger/v3/oas/annotations/security/SecurityRequirement.java
* /swagger-annotations-2-1-9-sources-jar/io/swagger/v3/oas/annotations/security/SecurityScheme.java
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* /swagger-annotations-2-1-9-sources-jar/io/swagger/v3/oas/annotations/security/OAuthScope.java
* /swagger-annotations-2-1-9-sources-jar/io/swagger/v3/oas/annotations/servers/ServerVariable.java
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* /swagger-annotations-2-1-9-sources-jar/io/swagger/v3/oas/annotations/tags/Tags.java
*
 /swagger-annotations-2-1-9-sources-jar/io/swagger/v3/oas/annotations/security/SecurityRequirements.java
* /swagger-annotations-2-1-9-sources-jar/io/swagger/v3/oas/annotations/links/Link.java
* /swagger-annotations-2-1-9-sources-jar/io/swagger/v3/oas/annotations/responses/ApiResponse.java
* /swagger-annotations-2-1-9-sources-jar/io/swagger/v3/oas/annotations/ExternalDocumentation.java
* /swagger-annotations-2-1-9-sources-jar/io/swagger/v3/oas/annotations/media/DiscriminatorMapping.java
* /swagger-annotations-2-1-9-sources-jar/io/swagger/v3/oas/annotations/responses/ApiResponses.java
* /swagger-annotations-2-1-9-sources-jar/io/swagger/v3/oas/annotations/parameters/RequestBody.java
* /swagger-annotations-2-1-9-sources-jar/io/swagger/v3/oas/annotations/links/LinkParameter.java
* /swagger-annotations-2-1-9-sources-jar/io/swagger/v3/oas/annotations/Hidden.java
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1.284 libxml2 2.9.4

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1.286 kerberos 1.17-6ubuntu4.4

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lib/gssapi/generic/gssapi_err_generic.et
lib/gssapi/mechglue/g_accept_sec_context.c
lib/gssapi/mechglue/g_acquire_cred.c
lib/gssapi/mechglue/g_canon_name.c
lib/gssapi/mechglue/g_compare_name.c
lib/gssapi/mechglue/g_context_time.c
lib/gssapi/mechglue/g_delete_sec_context.c
lib/gssapi/mechglue/g_dsp_name.c
lib/gssapi/mechglue/g_dsp_status.c
lib/gssapi/mechglue/g_dup_name.c

lib/gssapi/mechglue/g_exp_sec_context.c
lib/gssapi/mechglue/g_export_name.c
lib/gssapi/mechglue/g_glue.c
lib/gssapi/mechglue/g_imp_name.c
lib/gssapi/mechglue/g_imp_sec_context.c
lib/gssapi/mechglue/g_init_sec_context.c
lib/gssapi/mechglue/g_initialize.c
lib/gssapi/mechglue/g_inquire_context.c
lib/gssapi/mechglue/g_inquire_cred.c
lib/gssapi/mechglue/g_inquire_names.c
lib/gssapi/mechglue/g_process_context.c
lib/gssapi/mechglue/g_rel_buffer.c
lib/gssapi/mechglue/g_rel_cred.c
lib/gssapi/mechglue/g_rel_name.c
lib/gssapi/mechglue/g_rel_oid_set.c
lib/gssapi/mechglue/g_seal.c
lib/gssapi/mechglue/g_sign.c
lib/gssapi/mechglue/g_store_cred.c
lib/gssapi/mechglue/g_unseal.c
lib/gssapi/mechglue/g_userok.c
lib/gssapi/mechglue/g_utils.c
lib/gssapi/mechglue/g_verify.c
lib/gssapi/mechglue/gssd_pname_to_uid.c
lib/gssapi/mechglue/mglueP.h
lib/gssapi/mechglue/oid_ops.c
lib/gssapi/spnego/gssapiP_spnego.h
lib/gssapi/spnego/spnego_mech.c

and the initial implementation of incremental propagation, including
the following new or changed files:

include/iprop_hdr.h
kadmin/server/ipropd_svc.c
lib/kdb/iprop.x
lib/kdb/kdb_convert.c
lib/kdb/kdb_log.c
lib/kdb/kdb_log.h
lib/krb5/error_tables/kdb5_err.et
slave/kpropd_rpc.c
slave/kproplog.c

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1.290 goprotobuf 2.4.1

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1.291 cglib 3.3.0

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1.294 hibernate 5.4.20.Final

1.294.1 Available under license :

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header {
/*
* Hibernate, Relational Persistence for Idiomatic Java
*
* License: GNU Lesser General Public License (LGPL), version 2.1 or later.
* See the lgpl.txt file in the root directory or <http://www.gnu.org/licenses/lgpl-2.1.html>.
*/
package org.hibernate.graph.internal.parse;
}

```
/**
* Antlr grammar describing the Hibernate EntityGraph Language.
*/
class GeneratedGraphParser extends Parser;

options {
   // call the vocabulary (H)ibernate (E)ntity(G)raph (L)anguage
 exportVocab=HEGL;

   k = 2;

// buildAST = true;
 buildAST = false;
}


{
 // ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
 // semantic actions/callouts

 protected void startAttribute(Token attributeName) {
 }

 protected void startQualifiedAttribute(Token attributeName, Token qualifier) {
 }

 protected void finishAttribute() {
 }

 protected void startSubGraph(Token subType) {
 }

 protected void finishSubGraph()
 {
 }
}


graph
 : attributeNode (COMMA attributeNode)*
 ;

attributeNode
 : attributePath (subGraph)? { finishAttribute(); }
 ;

attributePath
```

```
 : path:NAME (DOT qualifier:NAME)? {
  if ( qualifier == null ) {
   startAttribute( path );
  }
  else {
   startQualifiedAttribute( path, qualifier );
  }
 }
 ;

subGraph
 : LPAREN (subtype:NAME COLON)? { startSubGraph( subtype ); } attributeNode (COMMA attributeNode )*
RPAREN {
  finishSubGraph();
 }
 ;



// **** LEXER ************************************************************************

/**
* Lexer for the Hibernate EntityGraph Language grammar
*/
class GraphLexer extends Lexer;

options {
   // call the vocabulary (H)ibernate (E)ntity(G)raph (L)anguage
 exportVocab=HEGL;

   k = 2;

   // Allow any char but \uffff (16 bit -1, ANTLR's EOF character)
   charVocabulary = '\u0000'..'\ufffe';

 caseSensitive = false;
 testLiterals = false;
}

COLON: ':';

COMMA: ',';

DOT: '.';

LPAREN: '(';

RPAREN: ')';
```

```
WHITESPACE
 :  (  ' '
  |
   '\t'
  |  '\r' '\n' { newline(); }
  |  '\n'     { newline(); }
  |  '\r'     { newline(); }
  )
  {$setType(Token.SKIP);} //ignore this token
 ;


/**
* In this grammar, basically any string since we (atm) have no keywords
*/
NAME
 : NAME_START ( NAME_CONTINUATION )*
 ;

protected
NAME_START
   :   '_'
   |   '$'
   |   'a'..'z'
   // HHH-558 : Allow unicode chars in identifiers
   //|   '\u0080'..'\ufffe'
   ;

protected
NAME_CONTINUATION
   :   NAME_START
   |   '0'..'9'
   ;
```

Found in path(s):
* /hibernate-core-5-4-20-final-sources-jar/graph.g
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```
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 -->
```

Found in path(s):
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/jpa/orm_2_2.xsd

* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/jpa/persistence_2_2.xsd
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* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/hibernate-configuration-3.0.dtd
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/hibernate-mapping-3.0.dtd
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*/
/*
* Written by Doug Lea with assistance from members of JCP JSR-166
* Expert Group and released to the public domain, as explained at
* http://creativecommons.org/licenses/publicdomain
*
* Modified for https://jira.jboss.org/jira/browse/ISPN-299
* Includes ideas described in http://portal.acm.org/citation.cfm?id=1547428
*
*/
/**
* A hash table supporting full concurrency of retrievals and
* adjustable expected concurrency for updates. This class obeys the
* same functional specification as {@link java.util.Hashtable}, and
* includes versions of methods corresponding to each method of
* <tt>Hashtable</tt>. However, even though all operations are
* thread-safe, retrieval
 operations do <em>not</em> entail locking,
* and there is <em>not</em> any support for locking the entire table
* in a way that prevents all access.  This class is fully
* interoperable with <tt>Hashtable</tt> in programs that rely on its
* thread safety but not on its synchronization details.
* <p/>
* <p> Retrieval operations (including <tt>get</tt>) generally do not
* block, so may overlap with update operations (including
* <tt>put</tt> and <tt>remove</tt>). Retrievals reflect the results
* of the most recently <em>completed</em> update operations holding
* upon their onset.  For aggregate operations such as <tt>putAll</tt>
* and <tt>clear</tt>, concurrent retrievals may reflect insertion or
* removal of only some entries.  Similarly, Iterators and
```

* Enumerations return elements reflecting the state of the hash table
* at some point at or since the creation of the iterator/enumeration.
* They do not throw {@link java.util.ConcurrentModificationException}.
*
 However, iterators are designed to be used by only one thread at a time.
*
* The allowed concurrency among update operations is guided by
* the optional <tt>concurrencyLevel</tt> constructor argument
* (default <tt>16</tt>), which is used as a hint for internal sizing. The
* table is internally partitioned to try to permit the indicated
* number of concurrent updates without contention. Because placement
* in hash tables is essentially random, the actual concurrency will
* vary. Ideally, you should choose a value to accommodate as many
* threads as will ever concurrently modify the table. Using a
* significantly higher value than you need can waste space and time,
* and a significantly lower value can lead to thread contention. But
* overestimates and underestimates within an order of magnitude do
* not usually have much noticeable impact. A value of one is
* appropriate when it is known that only one thread will modify and
* all others will only read. Also, resizing
 this or any other kind of
* hash table is a relatively slow operation, so, when possible, it is
* a good idea to provide estimates of expected table sizes in
* constructors.
*
* This class and its views and iterators implement all of the
* optional methods of the {@link Map} and {@link Iterator}
* interfaces.
*
* This class is copied from Infinispan, and was originally written
* by Doug Lea with assistance from members of JCP JSR-166 Expert Group and
* released to the public domain, as explained at
* http://creativecommons.org/licenses/publicdomain
*
*
* Like {@link java.util.Hashtable} but unlike {@link HashMap}, this class
* does not allow <tt>null</tt> to be used as a key or value.
*
* @param <K> the type of keys maintained by this map
* @param <V> the type of mapped values
*
* @author Doug Lea
*/

Found in path(s):
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/internal/util/collections/BoundedConcurrentHashMap.java
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*/
/**
  * Used to pass along the CDI BeanManager, if any, to be used.
  *
  * According to JPA, strictly, the BeanManager should be passed in
  * at boot-time and be ready for use at that time.  However not all
  * environments can do this (WildFly e.g.).  To accommodate such
  * environments, Hibernate provides 2 options:
  *
  *     * a proprietary CDI extension SPI (that we have proposed to
  *      the CDI spec group as a standard option) that can be used
  *      to provide delayed BeanManager access.  To use this solution,
  *      the reference passed as the BeanManager during bootstrap
  *      should be typed as {@link ExtendedBeanManager}
  *     * delayed access to the BeanManager
 reference.  Here, Hibernate
  *      will not access the reference passed as the BeanManager during
  *      bootstrap until it is first needed.  Note however that this has
  *      the effect of delaying any deployment problems until after
  *      bootstrapping.
  *
  * This setting is used to configure Hibernate ORM's access to
  * the BeanManager (either directly or via {@link ExtendedBeanManager}).
  */

Found in path(s):
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/cfg/AvailableSettings.java
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*/
/**
  * Subclass used to simply instantiation of singular attributes representing an entity's
  * version.
  */

Found in path(s):
* /hibernate-core-5-4-20-final-sources-
jar/org/hibernate/metamodel/model/domain/internal/SingularAttributeImpl.java
```

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*/
//  "proprietary" methods is better (this class is "proprietary" too).
```

Found in path(s):
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/graph/EntityGraphs.java
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```
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*/
/**
* JTA platform implementation intended for use with WebSphere Application Server (WAS).
* <p/>
* WAS, unlike every other app server on the planet, does not allow direct access to the JTS TransactionManager.
* Instead, for common transaction-related tasks users must utilize a proprietary API known as
ExtendedJTATransaction.
* <p/>
* Even more unfortunate, the exact TransactionManagerLookup to use inside of WAS is highly dependent upon<ul>
*     <li>WAS version</li>
*     <li>the WAS container in which Hibernate will be utilized</li>
* </ul>
* <p/>
* This class is reported to work on WAS version 6 in any of the standard J2EE/Java EE component containers.
*
* @author Gavin
 King
* @author <a href="mailto:jesper@udby.com>Jesper Udby</a>
* @author Steve Ebersole
*/
```

Found in path(s):
* /hibernate-core-5-4-20-final-sources-
jar/org/hibernate/engine/transaction/jta/platform/internal/WebSphereExtendedJtaPlatform.java
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```
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*
```

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*/

Found in path(s):
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/graph/spi/GraphImplementor.java
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/resource/beans/spi/ManagedBeanRegistry.java
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/cache/spi/QueryResultsCache.java
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/stat/NaturalIdCacheStatistics.java
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/hql/internal/ast/tree/CollectionPathNode.java
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/type/internal/TypeConfigurationRegistry.java
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/metamodel/model/domain/IdentifiableDomainType.java
*
 /hibernate-core-5-4-20-final-sources-
jar/org/hibernate/metamodel/model/domain/internal/EmbeddableTypeImpl.java
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/cache/cfg/internal/AbstractDomainDataCachingConfig.java
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/cache/spi/support/CollectionTransactionAccess.java
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/cache/spi/support/NaturalIdTransactionalAccess.java
* /hibernate-core-5-4-20-final-sources-
jar/org/hibernate/metamodel/model/convert/internal/JpaAttributeConverterImpl.java
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/stat/internal/DeprecatedNaturalIdCacheStatisticsImpl.java
* /hibernate-core-5-4-20-final-sources-
jar/org/hibernate/boot/model/convert/internal/AbstractConverterDescriptor.java
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/graph/spi/GraphHelper.java
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/cache/spi/support/DomainDataRegionImpl.java
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/boot/xsd/MappingXsdSupport.java
*
 /hibernate-core-5-4-20-final-sources-jar/org/hibernate/boot/xsd/XsdDescriptor.java
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/cache/spi/support/RegionFactoryTemplate.java
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/cache/spi/support/TimestampsRegionTemplate.java
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/cache/spi/access/CachedDomainDataAccess.java
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/cache/cfg/spi/NaturalIdDataCachingConfig.java
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/jpa/event/spi/CallbackBuilder.java
* /hibernate-core-5-4-20-final-sources-
jar/org/hibernate/metamodel/model/convert/internal/OrdinalEnumValueConverter.java
* /hibernate-core-5-4-20-final-sources-
jar/org/hibernate/metamodel/model/domain/internal/AbstractPluralAttribute.java
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/cache/spi/support/QueryResultsRegionTemplate.java
*
 /hibernate-core-5-4-20-final-sources-jar/org/hibernate/internal/build/AllowSysOut.java
* /hibernate-core-5-4-20-final-sources-
jar/org/hibernate/resource/beans/container/internal/CdiBeanContainerExtendedAccessImpl.java
* /hibernate-core-5-4-20-final-sources-
jar/org/hibernate/resource/beans/container/internal/JpaCompliantLifecycleStrategy.java
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/stat/SecondLevelCacheStatistics.java
* /hibernate-core-5-4-20-final-sources-
jar/org/hibernate/resource/beans/container/internal/NoSuchBeanException.java
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/graph/AttributeNode.java

* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/cache/spi/CacheImplementor.java
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/metamodel/model/domain/CollectionDomainType.java
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/cache/spi/support/NaturalIdReadOnlyAccess.java
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/graph/internal/parse/GraphParser.java
*
 /hibernate-core-5-4-20-final-sources-
jar/org/hibernate/boot/model/convert/spi/JpaAttributeConverterCreationContext.java
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/cache/spi/support/AbstractReadWriteAccess.java
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/graph/internal/RootGraphImpl.java
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/jpa/event/internal/EntityCallback.java
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/cache/spi/DirectAccessRegion.java
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/stat/CacheableDataStatistics.java
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/metamodel/model/domain/ManagedDomainType.java
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/metamodel/model/domain/spi/MapPersistentAttribute.java
* /hibernate-core-5-4-20-final-sources-
jar/org/hibernate/boot/registry/classloading/internal/AggregatedServiceLoader.java
* /hibernate-core-5-4-20-final-sources-
jar/org/hibernate/metamodel/model/domain/MappedSuperclassDomainType.java
*
 /hibernate-core-5-4-20-final-sources-jar/org/hibernate/cache/spi/QuerySpacesHelper.java
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/jpa/event/spi/Callback.java
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/type/StandardBasicTypeTemplate.java
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/cache/spi/SecondLevelCacheLogger.java
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/jpa/event/internal/EmptyCallbackBuilder.java
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/boot/AttributeConverterInfo.java
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/graph/spi/AppliedGraph.java
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/metamodel/model/convert/package-info.java
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/cache/spi/support/EntityNonStrictReadWriteAccess.java
* /hibernate-core-5-4-20-final-sources-
jar/org/hibernate/resource/beans/container/internal/NotYetReadyException.java
*
 /hibernate-core-5-4-20-final-sources-jar/org/hibernate/resource/beans/spi/ProvidedInstanceManagedBeanImpl.java
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/cache/spi/TimestampsCache.java
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/cache/internal/TimestampsCacheEnabledImpl.java
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/cache/cfg/package-info.java
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/cache/spi/AbstractCacheTransactionSynchronization.java
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/metamodel/model/domain/EmbeddedDomainType.java
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/cache/cfg/spi/DomainDataRegionConfig.java
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/cache/spi/support/DomainDataRegionTemplate.java
* /hibernate-core-5-4-20-final-sources-
jar/org/hibernate/bytecode/enhance/spi/interceptor/EnhancementAsProxyLazinessInterceptor.java
*
 /hibernate-core-5-4-20-final-sources-jar/org/hibernate/internal/util/collections/Stack.java
* /hibernate-core-5-4-20-final-sources-
jar/org/hibernate/resource/beans/container/internal/ContainerManagedLifecycleStrategy.java
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/resource/beans/container/internal/NamedBeanQualifier.java
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/graph/internal/AttributeNodeImpl.java
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/cache/internal/DisabledCaching.java

* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/id/uuid/LocalObjectUuidHelper.java
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/resource/beans/container/spi/AbstractCdiBeanContainer.java
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/metamodel/model/convert/spi/BasicValueConverter.java
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/jpa/event/internal/CallbacksFactory.java
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/jpa/event/spi/CallbackType.java
*
 /hibernate-core-5-4-20-final-sources-jar/org/hibernate/metamodel/model/domain/spi/EntityTypeDescriptor.java
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/metamodel/model/domain/spi/SingularPersistentAttribute.java
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/graph/package-info.java
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/graph/RootGraph.java
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/boot/model/convert/spi/ConverterAutoApplyHandler.java
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/cache/cfg/spi/DomainDataRegionBuildingContext.java
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/cache/spi/support/CollectionReadWriteAccess.java
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/engine/spi/EffectiveEntityGraph.java
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/cache/spi/CacheTransactionSynchronization.java
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/metamodel/model/domain/DomainType.java
*
 /hibernate-core-5-4-20-final-sources-jar/org/hibernate/bytecode/enhance/spi/interceptor/AbstractInterceptor.java
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/metamodel/model/domain/spi/ManagedTypeDescriptor.java
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/metamodel/model/domain/spi/PluralPersistentAttribute.java
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/cache/spi/access/NaturalIdDataAccess.java
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/cache/spi/RegionFactory.java
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/cache/spi/ExtendedStatisticsSupport.java
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/cache/internal/StandardTimestampsCacheFactory.java
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/metamodel/model/domain/internal/AbstractType.java
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/boot/model/convert/internal/AutoApplicableConverterDescriptorBypassedImpl.java
*
 /hibernate-core-5-4-20-final-sources-jar/org/hibernate/graph/CannotBecomeEntityGraphException.java
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/graph/internal/parse/SubGraphGenerator.java
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Found in path(s):
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/internal/util/collections/ConcurrentReferenceHashMap.java
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/*
* Hibernate, Relational Persistence for Idiomatic Java
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Found in path(s):
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/sql/ForUpdateFragment.java
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/loader/plan/build/spi/ExpandingQuerySpace.java
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/tool/schema/internal/exec/ScriptTargetOutputToWriter.java
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/ejb/HibernateEntityManager.java
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* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/query/criteria/internal/expression/ListIndexExpression.java
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/cfg/PropertyInferredData.java
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* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/boot/package-info.java
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* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/hql/spi/id/global/IdTableInfoImpl.java
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* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/loader/plan/spi/CompositeQuerySpace.java
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* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/tuple/IdentifierProperty.java
* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/dialect/Oracle12cDialect.java
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* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/bytecode/enhance/spi/EnhancementException.java
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* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/result/NoMoreReturnsException.java
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* /hibernate-core-5-4-20-final-sources-jar/org/hibernate/boot/model/Caching.java
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(CA). These were automatically extracted from Mozilla's root certificates
file (certdata.txt). This file can be found in the mozilla source tree:
https://hg.mozilla.org/mozilla-central/file/tip/security/nss/lib/ckfw/builtins/certdata.txt
It contains the certificates in PEM format and therefore
can be directly used with curl / libcurl / php_curl, or with
an Apache+mod_ssl webserver for SSL client authentication.
Just configure this file as the SSLCACertificateFile.#

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A. HISTORY OF THE SOFTWARE
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Python was created in the early 1990s by Guido van Rossum at Stichting Mathematisch Centrum (CWI, see http://www.cwi.nl) in the Netherlands as a successor of a language called ABC. Guido remains Python's principal author, although it includes many contributions from others.

In 1995, Guido continued his work on Python at the Corporation for National Research Initiatives (CNRI, see http://www.cnri.reston.va.us) in Reston, Virginia where he released several versions of the software.

In May 2000, Guido and the Python core development team moved to BeOpen.com to form the BeOpen PythonLabs team. In October of the same year, the PythonLabs team moved to Digital Creations (now Zope Corporation, see http://www.zope.com). In 2001, the Python Software Foundation (PSF, see http://www.python.org/psf/) was formed, a non-profit organization created specifically to own Python-related Intellectual Property. Zope Corporation is a sponsoring member of the PSF.

All Python releases are Open Source (see http://www.opensource.org for the Open Source Definition). Historically, most, but not all, Python releases have also been GPL-compatible; the table below summarizes the various releases.

Release	Derived from	Year	Owner	GPL-compatible? (1)
0.9.0 thru 1.2		1991-1995	CWI	yes
1.3 thru 1.5.2	1.2	1995-1999	CNRI	yes
1.6	1.5.2	2000	CNRI	no
2.0	1.6	2000	BeOpen.com	no
1.6.1	1.6	2001	CNRI	yes (2)
2.1	2.0+1.6.1	2001	PSF	no
2.0.1	2.0+1.6.1	2001	PSF	yes
2.1.1	2.1+2.0.1	2001	PSF	yes
2.2	2.1.1	2001	PSF	yes
2.1.2	2.1.1	2002	PSF	yes
2.1.3	2.1.2	2002	PSF	yes
2.2.1	2.2	2002	PSF	yes
2.2.2	2.2.1	2002	PSF	yes
2.2.3	2.2.2	2003	PSF	yes
2.3	2.2.2	2002-2003	PSF	yes
2.3.1	2.3	2002-2003	PSF	yes
2.3.2	2.3.1	2002-2003	PSF	yes
2.3.3	2.3.2	2002-2003	PSF	yes

2.3.4	2.3.3	2004	PSF	yes
2.3.5	2.3.4	2005	PSF	yes
2.4	2.3	2004	PSF	yes
2.4.1	2.4	2005	PSF	yes
2.4.2	2.4.1	2005	PSF	yes
2.4.3	2.4.2	2006	PSF	yes
2.4.4	2.4.3	2006	PSF	yes
2.5	2.4	2006	PSF	yes
2.5.1	2.5	2007	PSF	yes
2.5.2	2.5.1	2008	PSF	yes
2.5.3	2.5.2	2008	PSF	yes
2.6	2.5	2008	PSF	yes
2.6.1	2.6	2008	PSF	yes
2.6.2	2.6.1	2009	PSF	yes
2.6.3	2.6.2	2009	PSF	yes
2.6.4	2.6.3	2009	PSF	yes
2.6.5	2.6.4	2010	PSF	yes
3.0	2.6	2008	PSF	yes
3.0.1	3.0	2009	PSF	yes
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Thanks to the many outside volunteers who have worked under Guido's direction to make these releases possible.

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A. HISTORY OF THE SOFTWARE

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Python was created in the early 1990s by Guido van Rossum at Stichting Mathematisch Centrum (CWI, see http://www.cwi.nl) in the Netherlands as a successor of a language called ABC. Guido remains Python's principal author, although it includes many contributions from others.

In 1995, Guido continued his work on Python at the Corporation for National Research Initiatives (CNRI, see http://www.cnri.reston.va.us) in Reston, Virginia where he released several versions of the software.

In May 2000, Guido and the Python core development team moved to BeOpen.com to form the BeOpen PythonLabs team. In October of the same year, the PythonLabs team moved to Digital Creations, which became Zope Corporation. In 2001, the Python Software Foundation (PSF, see https://www.python.org/psf/) was formed, a non-profit organization created specifically to own Python-related Intellectual Property. Zope Corporation was a sponsoring member of the PSF.

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Release	Derived from	Year	Owner	GPL-compatible? (1)
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1.3 thru 1.5.2	1.2	1995-1999	CNRI	yes
1.6	1.5.2	2000	CNRI	no
2.0	1.6	2000	BeOpen.com	no
1.6.1	1.6	2001	CNRI	yes (2)
2.1	2.0+1.6.1	2001	PSF	no
2.0.1	2.0+1.6.1	2001	PSF	yes
2.1.1	2.1+2.0.1	2001	PSF	yes

2.1.2	2.1.1	2002	PSF	yes
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*
/spring-context-5-2-24-release-sources-jar/org/springframework/scheduling/annotation/AsyncConfigurerSupport.java
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* /spring-context-5-2-24-release-sources-jar/org/springframework/validation/annotation/Validated.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/scheduling/config/ContextLifecycleScheduledTaskRegistrar.java
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*/
/**
* Abstract the invocation of a cache operation.
*
* <p>Does not provide a way to transmit checked exceptions but
* provide a special exception that should be used to wrap any
* exception that was thrown by the underlying invocation.
* Callers are expected to handle this issue type specifically.
*
 * @author Stephane Nicoll
* @since 4.1
*/
```

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* /spring-context-5-2-24-release-sources-jar/org/springframework/format/datetime/joda/DateTimeParser.java

* /spring-context-5-2-24-release-sources-jar/org/springframework/format/datetime/joda/LocalTimeParser.java
*
/spring-context-5-2-24-release-sources-jar/org/springframework/context/i18n/LocaleContext.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/format/datetime/joda/ReadableInstantPrinter.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/format/datetime/joda/LocalDateTimeParser.java
* /spring-context-5-2-24-release-sources-
jar/org/springframework/context/support/MessageSourceResourceBundle.java
* /spring-context-5-2-24-release-sources-
jar/org/springframework/scheduling/concurrent/CustomizableThreadFactory.java
* /spring-context-5-2-24-release-sources-
jar/org/springframework/validation/beanvalidation/OptionalValidatorFactoryBean.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/context/annotation/FilterType.java
* /spring-context-5-2-24-release-sources-
jar/org/springframework/format/datetime/joda/MillisecondInstantPrinter.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/context/annotation/Description.java
*
/spring-context-5-2-24-release-sources-jar/org/springframework/context/i18n/TimeZoneAwareLocaleContext.java
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* /spring-context-5-2-24-release-sources-jar/org/springframework/scripting/groovy/GroovyObjectCustomizer.java
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/spring-context-5-2-24-release-sources-
jar/org/springframework/context/config/PropertyOverrideBeanDefinitionParser.java
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jar/org/springframework/context/support/GenericXmlApplicationContext.java
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jar/org/springframework/instrument/classloading/weblogic/WebLogicLoadTimeWeaver.java
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jar/org/springframework/format/support/FormatterPropertyEditorAdapter.java
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jar/org/springframework/scheduling/annotation/SchedulingConfiguration.java
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* /spring-context-5-2-24-release-sources-jar/org/springframework/remoting/rmi/RmiClientInterceptorUtils.java
*
/spring-context-5-2-24-release-sources-jar/org/springframework/context/annotation/ScopeMetadataResolver.java
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jar/org/springframework/format/datetime/standard/TemporalAccessorPrinter.java
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jar/org/springframework/context/config/AbstractPropertyLoadingBeanDefinitionParser.java
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jar/org/springframework/scheduling/config/ScheduledTasksBeanDefinitionParser.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/scheduling/annotation/Schedules.java
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*/
/**
* {@link FactoryBean} that obtains a WebSphere {@link javax.management.MBeanServer}
* reference through WebSphere's proprietary {@code AdminServiceFactory} API,
* available on WebSphere 5.1 and higher.
*
* <p>Exposes the {@code MBeanServer} for bean references.
*
* <p>This {@code FactoryBean} is
 a direct alternative to {@link MBeanServerFactoryBean},
* which uses standard JMX 1.2 API to access the platform's {@link MBeanServer}.
*
* <p>See the javadocs for WebSphere's
* <a
href="https://www.ibm.com/support/knowledgecenter/SSEQTJ_9.0.0/com.ibm.websphere.javadoc.doc/web/apidocs
/com/ibm/websphere/management/AdminServiceFactory.html">{@code AdminServiceFactory}</a>
* and
* <a
href="https://www.ibm.com/support/knowledgecenter/SSEQTJ_9.0.0/com.ibm.websphere.javadoc.doc/web/apidocs
/com/ibm/websphere/management/MBeanFactory.html">{@code MBeanFactory}</a>.
*
* @author Juergen Hoeller
* @author Rob Harrop
* @since 2.0.3
* @see javax.management.MBeanServer
* @see MBeanServerFactoryBean
*/

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* /spring-context-5-2-24-release-sources-jar/org/springframework/jmx/export/annotation/ManagedOperation.java
*
 /spring-context-5-2-24-release-sources-jar/org/springframework/jmx/export/annotation/ManagedMetric.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/validation/beanvalidation/SpringConstraintValidatorFactory.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/format/datetime/joda/DurationFormatter.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/context/event/EventListenerFactory.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/format/number/PercentStyleFormatter.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/context/PayloadApplicationEvent.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/context/annotation/ImportResource.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/format/datetime/joda/MonthDayFormatter.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/context/annotation/Role.java
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 /spring-context-5-2-24-release-sources-jar/org/springframework/remoting/RemoteTimeoutException.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/context/annotation/ComponentScans.java
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* /spring-context-5-2-24-release-sources-jar/org/springframework/cache/annotation/CacheConfig.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/scheduling/support/CronTrigger.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/scheduling/config/AnnotationDrivenBeanDefinitionParser.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/scripting/support/StandardScriptEvalException.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/jmx/export/annotation/ManagedOperationParameters.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/scripting/ScriptEvaluator.java
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 /spring-context-5-2-24-release-sources-jar/org/springframework/jmx/export/annotation/ManagedResource.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/format/number/money/CurrencyUnitFormatter.java
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* /spring-context-5-2-24-release-sources-jar/org/springframework/context/support/LiveBeansViewMBean.java
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jar/org/springframework/remoting/support/RemoteInvocationTraceInterceptor.java
* /spring-context-5-2-24-release-sources-
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* /spring-context-5-2-24-release-sources-jar/org/springframework/context/weaving/LoadTimeWeaverAware.java
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jar/org/springframework/jmx/export/annotation/AnnotationMBeanExporter.java
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* /spring-context-5-2-24-release-sources-jar/org/springframework/jndi/JndiLookupFailureException.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/remoting/soap/SoapFaultException.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/remoting/RemoteConnectFailureException.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/ui/context/ThemeSource.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/validation/BindingResultUtils.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/context/Phased.java
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* /spring-context-5-2-24-release-sources-
jar/org/springframework/scheduling/support/DelegatingErrorHandlingRunnable.java
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* /spring-context-5-2-24-release-sources-jar/org/springframework/format/Formatter.java
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/spring-context-5-2-24-release-sources-
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* /spring-context-5-2-24-release-sources-jar/org/springframework/jmx/MBeanServerNotFoundException.java
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* /spring-context-5-2-24-release-sources-jar/org/springframework/ui/context/support/SimpleTheme.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/jmx/export/MBeanExporterListener.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/remoting/rmi/RmiInvocationHandler.java
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* /spring-context-5-2-24-release-sources-jar/org/springframework/instrument/classloading/LoadTimeWeaver.java
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* /spring-context-5-2-24-release-sources-jar/org/springframework/scripting/ScriptSource.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/ui/context/Theme.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/format/number/AbstractNumberFormatter.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/remoting/rmi/RmiClientInterceptor.java
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* /spring-context-5-2-24-release-sources-jar/org/springframework/cache/annotation/CachePut.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/context/annotation/ConfigurationClassUtils.java
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 /spring-context-5-2-24-release-sources-jar/org/springframework/context/annotation/Lazy.java
* /spring-context-5-2-24-release-sources-
jar/org/springframework/context/index/CandidateComponentsIndexLoader.java
* /spring-context-5-2-24-release-sources-
jar/org/springframework/cache/config/AnnotationDrivenCacheBeanDefinitionParser.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/context/support/AbstractApplicationContext.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/validation/support/BindingAwareModelMap.java
* /spring-context-5-2-24-release-sources-
jar/org/springframework/context/annotation/CommonAnnotationBeanPostProcessor.java
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* /spring-context-5-2-24-release-sources-jar/org/springframework/context/event/SourceFilteringListener.java
* /spring-context-5-2-24-release-sources-
jar/org/springframework/validation/beanvalidation/LocalValidatorFactoryBean.java
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*/
/**
* Indicates that a component is only eligible for registration when all
* {@linkplain #value specified conditions} match.
*
* <p>A <em>condition</em> is any state that can be determined programmatically
* before the bean definition is due to be registered (see {@link Condition} for details).
*
*
 <p>The {@code @Conditional} annotation may be used in any of the following ways:
* <ul>
* <li>as a type-level annotation on any class directly or indirectly annotated with
* {@code @Component}, including {@link Configuration @Configuration} classes</li>
* <li>as a meta-annotation, for the purpose of composing custom stereotype
* annotations</li>
* <li>as a method-level annotation on any {@link Bean @Bean} method</li>
* </ul>
*
* <p>If a {@code @Configuration} class is marked with {@code @Conditional},
* all of the {@code @Bean} methods, {@link Import @Import} annotations, and
* {@link ComponentScan @ComponentScan} annotations associated with that
* class will be subject to the conditions.
*
* <p><strong>NOTE</strong>: Inheritance of {@code @Conditional} annotations
* is not supported; any conditions from superclasses or from overridden
* methods will not be considered. In order to enforce these semantics,
* {@code @Conditional} itself is not declared as
* {@link java.lang.annotation.Inherited
 @Inherited}; furthermore, any
* custom <em>composed annotation</em> that is meta-annotated with
* {@code @Conditional} must not be declared as {@code @Inherited}.
*
* @author Phillip Webb
* @author Sam Brannen
* @since 4.0
```

* @see Condition
*/

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* /spring-context-5-2-24-release-sources-
jar/org/springframework/context/support/AbstractResourceBasedMessageSource.java
*
 /spring-context-5-2-24-release-sources-jar/org/springframework/cache/concurrent/ConcurrentMapCache.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/context/annotation/AutoProxyRegistrar.java
* /spring-context-5-2-24-release-sources-
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* /spring-context-5-2-24-release-sources-jar/org/springframework/context/annotation/ConfigurationClassParser.java
* /spring-context-5-2-24-release-sources-
jar/org/springframework/context/expression/StandardBeanExpressionResolver.java
* /spring-context-5-2-24-release-sources-
jar/org/springframework/context/annotation/AnnotationConfigApplicationContext.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/context/index/CandidateComponentsIndex.java
* /spring-context-5-2-24-release-sources-
jar/org/springframework/scheduling/concurrent/DefaultManagedTaskScheduler.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/validation/AbstractBindingResult.java
*
 /spring-context-5-2-24-release-sources-jar/org/springframework/scripting/groovy/GroovyScriptFactory.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/context/annotation/Configuration.java
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* /spring-context-5-2-24-release-sources-jar/org/springframework/cache/interceptor/CacheAspectSupport.java
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* /spring-context-5-2-24-release-sources-jar/org/springframework/validation/beanvalidation/MethodValidationPostProcessor.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/cache/support/AbstractValueAdaptingCache.java
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* /spring-context-5-2-24-release-sources-jar/org/springframework/scheduling/concurrent/ThreadPoolTaskExecutor.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/context/support/PostProcessorRegistrationDelegate.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/validation/BindException.java
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* /spring-context-5-2-24-release-sources-jar/org/springframework/jmx/export/assembler/MethodExclusionMBeanInfoAssembler.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/cache/config/CacheNamespaceHandler.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/format/datetime/joda/DateTimeFormatterFactory.java
*
 /spring-context-5-2-24-release-sources-jar/org/springframework/format/datetime/joda/JodaTimeContext.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/cache/interceptor/CacheErrorHandler.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/remoting/rmi/RmiProxyFactoryBean.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/scheduling/support/MethodInvokingRunnable.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/context/support/AbstractRefreshableConfigApplicationContext.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/jmx/export/naming/MetadataNamingStrategy.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/context/support/ApplicationListenerDetector.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/stereotype/Controller.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/context/expression/AnnotatedElementKey.java
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 /spring-context-5-2-24-release-sources-jar/org/springframework/scripting/support/StaticScriptSource.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/cache/interceptor/CacheInterceptor.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/stereotype/Indexed.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/format/datetime/standard/Jsr310DateTimeFormatAnnotationFormatterFactory.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/jmx/access/MBeanProxyFactoryBean.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/scheduling/config/IntervalTask.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/context/weaving/LoadTimeWeaverAwareProcessor.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/instrument/classloading/SimpleLoadTimeWeaver.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/format/number/money/MonetaryAmountFormatter.java
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* /spring-context-5-2-24-release-sources-jar/org/springframework/jmx/export/metadata/ManagedResource.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/scheduling/config/FixedDelayTask.java
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* /spring-context-5-2-24-release-sources-jar/org/springframework/format/datetime/DateTimeFormatAnnotationFormatterFactory.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/jndi/JndiAccessor.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/scheduling/annotation/AsyncConfigurer.java

* /spring-context-5-2-24-release-sources-jar/org/springframework/scheduling/config/FixedRateTask.java
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* /spring-context-5-2-24-release-sources-jar/org/springframework/jmx/export/naming/ObjectNamingStrategy.java
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* /spring-context-5-2-24-release-sources-jar/org/springframework/format/number/NumberStyleFormatter.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/scripting/bsh/BshScriptEvaluator.java
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* /spring-context-5-2-24-release-sources-
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* /spring-context-5-2-24-release-sources-jar/org/springframework/jmx/export/metadata/ManagedMetric.java
* /spring-context-5-2-24-release-sources-
jar/org/springframework/format/support/FormattingConversionServiceFactoryBean.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/jmx/support/NotificationListenerHolder.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/stereotype/Repository.java
* /spring-context-5-2-24-release-sources-
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* /spring-context-5-2-24-release-sources-
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* /spring-context-5-2-24-release-sources-
jar/org/springframework/instrument/classloading/tomcat/TomcatLoadTimeWeaver.java
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/spring-context-5-2-24-release-sources-jar/org/springframework/context/EnvironmentAware.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/context/support/EmbeddedValueResolutionSupport.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/instrument/classloading/websphere/WebSphereLoadTimeWeaver.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/remoting/support/RemoteExporter.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/format/datetime/DateFormatterRegistrar.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/context/expression/EnvironmentAccessor.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/cache/support/SimpleValueWrapper.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/jmx/support/MetricType.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/context/support/DelegatingMessageSource.java
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/spring-context-5-2-24-release-sources-jar/org/springframework/jmx/export/assembler/AbstractMBeanInfoAssembler.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/format/datetime/standard/DateTimeContext.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/jmx/access/ConnectorDelegate.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/context/i18n/SimpleTimeZoneAwareLocaleContext.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/jndi/JndiObjectTargetSource.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/scheduling/config/ScheduledTaskHolder.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/context/support/AbstractXmlApplicationContext.java
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* /spring-context-5-2-24-release-sources-jar/org/springframework/context/MessageSourceResolvable.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/context/expression/MapAccessor.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/jmx/export/metadata/ManagedNotification.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/context/expression/BeanFactoryAccessor.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/scheduling/concurrent/ReschedulingRunnable.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/scheduling/config/Task.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/ui/ExtendedModelMap.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/instrument/classloading/glassfish/GlassFishLoadTimeWeaver.java
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/spring-context-5-2-24-release-sources-jar/org/springframework/format/datetime/standard/DateTimeFormatterFactoryBean.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/context/i18n/SimpleLocaleContext.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/format/number/CurrencyStyleFormatter.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/ejb/access/SimpleRemoteSlsbInvokerInterceptor.java
* /spring-context-5-2-24-release-sources-

jar/org/springframework/ejb/access/AbstractRemoteSlsbInvokerInterceptor.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/scripting/ScriptFactory.java
* /spring-context-5-2-24-release-sources-
jar/org/springframework/validation/beanvalidation/CustomValidatorBean.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/scheduling/config/ScheduledTask.java
* /spring-context-5-2-24-release-sources-
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/spring-context-5-2-24-release-sources-jar/org/springframework/cache/interceptor/SimpleCacheErrorHandler.java
* /spring-context-5-2-24-release-sources-
jar/org/springframework/format/datetime/joda/DateTimeFormatterFactoryBean.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/stereotype/Component.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/ejb/access/LocalSlsbInvokerInterceptor.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/jndi/TypeMismatchNamingException.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/cache/support/NullValue.java
* /spring-context-5-2-24-release-sources-
jar/org/springframework/cache/concurrent/ConcurrentMapCacheFactoryBean.java
* /spring-context-5-2-24-release-sources-
jar/org/springframework/context/annotation/AspectJAutoProxyRegistrar.java
* /spring-context-5-2-24-release-sources-
jar/org/springframework/context/config/MBeanExportBeanDefinitionParser.java
*
/spring-context-5-2-24-release-sources-jar/org/springframework/validation/DefaultMessageCodesResolver.java
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* /spring-context-5-2-24-release-sources-
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* /spring-context-5-2-24-release-sources-jar/org/springframework/context/support/StaticApplicationContext.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/cache/interceptor/CacheOperationSource.java
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* /spring-context-5-2-24-release-sources-
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* /spring-context-5-2-24-release-sources-jar/org/springframework/context/support/StaticMessageSource.java
* /spring-context-5-2-24-release-sources-
jar/org/springframework/instrument/classloading/ShadowingClassLoader.java
* /spring-context-5-2-24-release-sources-
jar/org/springframework/instrument/classloading/jboss/JBossLoadTimeWeaver.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/scheduling/support/TaskUtils.java
* /spring-context-5-2-24-release-sources-
jar/org/springframework/context/event/ApplicationListenerMethodAdapter.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/context/support/AbstractMessageSource.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/context/support/BeanDefinitionDsl.kt
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* /spring-context-5-2-24-release-sources-jar/org/springframework/cache/Cache.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/validation/ObjectError.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/context/SmartLifecycle.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/context/event/EventExpressionEvaluator.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/context/ResourceLoaderAware.java
* /spring-context-5-2-24-release-sources-
jar/org/springframework/instrument/classloading/InstrumentationLoadTimeWeaver.java
* /spring-context-5-2-24-release-sources-
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* /spring-context-5-2-24-release-sources-
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* /spring-context-5-2-24-release-sources-
jar/org/springframework/jmx/support/MBeanServerConnectionFactoryBean.java
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* /spring-context-5-2-24-release-sources-
jar/org/springframework/context/config/PropertyPlaceholderBeanDefinitionParser.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/jmx/support/ConnectorServerFactoryBean.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/ui/ModelMap.java
* /spring-context-5-2-24-release-sources-
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* /spring-context-5-2-24-release-sources-
jar/org/springframework/context/annotation/ImportBeanDefinitionRegistrar.java
* /spring-context-5-2-24-release-sources-
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* /spring-context-5-2-24-release-sources-jar/org/springframework/jndi/support/SimpleJndiBeanFactory.java
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* /spring-context-5-2-24-release-sources-jar/org/springframework/context/annotation/ConfigurationClass.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/cache/annotation/CacheAnnotationParser.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/context/annotation/ParserStrategyUtils.java
* /spring-context-5-2-24-release-sources-

jar/org/springframework/context/support/ResourceBundleMessageSource.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/scheduling/annotation/Async.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/cache/interceptor/AbstractCacheInvoker.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/jmx/access/MBeanClientInterceptor.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/cache/CacheManager.java
*
/spring-context-5-2-24-release-sources-jar/org/springframework/context/event/EventListener.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/context/support/GenericApplicationContext.java
* /spring-context-5-2-24-release-sources-
jar/org/springframework/context/annotation/ClassPathBeanDefinitionScanner.java
* /spring-context-5-2-24-release-sources-
jar/org/springframework/context/event/EventListenerMethodProcessor.java
* /spring-context-5-2-24-release-sources-
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* /spring-context-5-2-24-release-sources-jar/org/springframework/scheduling/annotation/Scheduled.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/jmx/support/MBeanServerFactoryBean.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/format/datetime/standard/InstantFormatter.java
* /spring-context-5-2-24-release-sources-
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/spring-context-5-2-24-release-sources-
jar/org/springframework/jmx/export/annotation/AnnotationJmxAttributeSource.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/context/ApplicationEvent.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/scripting/support/StandardScriptFactory.java
* /spring-context-5-2-24-release-sources-
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* /spring-context-5-2-24-release-sources-jar/org/springframework/context/MessageSource.java
* /spring-context-5-2-24-release-sources-
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* /spring-context-5-2-24-release-sources-jar/org/springframework/cache/support/AbstractCacheManager.java
* /spring-context-5-2-24-release-sources-
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* /spring-context-5-2-24-release-sources-
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/spring-context-5-2-24-release-sources-jar/org/springframework/context/event/ApplicationEventMulticaster.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/ui/Model.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/scheduling/config/ScheduledTaskRegistrar.java
* /spring-context-5-2-24-release-sources-
jar/org/springframework/context/support/ApplicationContextAwareProcessor.java
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 /spring-context-5-2-24-release-sources-jar/org/springframework/context/annotation/AnnotationConfigUtils.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/validation/SmartValidator.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/context/annotation/BeanAnnotationHelper.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/context/event/GenericApplicationListener.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/format/FormatterRegistry.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/instrument/classloading/ReflectiveLoadTimeWeaver.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/context/annotation/Scope.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/validation/DirectFieldBindingResult.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/remoting/rmi/RemoteInvocationSerializingExporter.java
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* /spring-context-5-2-24-release-sources-jar/org/springframework/remoting/rmi/JndiRmiServiceExporter.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/context/support/ContextTypeMatchClassLoader.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/cache/interceptor/CacheOperationInvocationContext.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/context/annotation/Profile.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/context/weaving/AspectJWeavingEnabler.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/jmx/export/MBeanExportOperations.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/scheduling/concurrent/ScheduledExecutorFactoryBean.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/validation/DefaultBindingErrorProcessor.java
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 /spring-context-5-2-24-release-sources-jar/org/springframework/scheduling/concurrent/DefaultManagedAwareThreadFactory.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/jmx/access/NotificationListenerRegistrar.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/jndi/JndiObjectLocator.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/remoting/support/SimpleHttpServerFactoryBean.java

* /spring-context-5-2-24-release-sources-jar/org/springframework/cache/interceptor/CacheExpressionRootObject.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/context/annotation/ComponentScanBeanDefinitionParser.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/remoting/support/RemoteInvocationResult.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/remoting/rmi/RmiInvocationWrapper.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/cache/interceptor/CacheOperation.java
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* /spring-context-5-2-24-release-sources-jar/org/springframework/scheduling/annotation/EnableScheduling.java
* /spring-context-5-2-24-release-sources-jar/org/springframework/context/Lifecycle.java
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1.299 spring-data-commons 2.3.3.RELEASE

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* /asm-5-0-4-sources-6-jar/org/objectweb/asm/optimizer/shrink-resize.properties
* /asm-5-0-4-sources-6-jar/org/objectweb/asm/optimizer/shrink-signatures.properties
*
/asm-5-0-4-sources-6-jar/org/objectweb/asm/optimizer/shrink.properties
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/**
    * Creates a new JSRInliner. <i>Subclasses must not use this
    * constructor</i>. Instead, they must use the
    * {@link #JSRInlinerAdapter(int, MethodVisitor, int, String, String, String, String[])}
    * version.
    *
    * @param mv
    *
   the <code>MethodVisitor</code> to send the resulting inlined
    *           method code to (use <code>null</code> for none).
    * @param access
    *           the method's access flags (see {@link Opcodes}). This
    *           parameter also indicates if the method is synthetic and/or
    *           deprecated.
    * @param name
    *           the method's name.
    * @param desc
    *           the method's descriptor (see {@link Type}).
    * @param signature
    *           the method's signature. May be <tt>null</tt>.
    * @param exceptions
```

```
    *           the internal names of the method's exception classes (see
    *           {@link Type#getInternalName() getInternalName}). May be
    *           <tt>null</tt>.
    * @throws IllegalStateException
    *           If a subclass calls this constructor.
    */
```

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*/
/**
    * Constructs a new {@link LocalVariableAnnotationNode}. <i>Subclasses must
    * not use this constructor</i>. Instead, they must use the
    * {@link #LocalVariableAnnotationNode(int, TypePath, LabelNode[], LabelNode[], int[], String)}
    * version.
    *
```

```
   * @param typeRef
   *          a reference to the annotated type. See {@link TypeReference}.
   * @param typePath
   *          the path to the annotated type argument, wildcard bound, array
   *          element type, or static inner type within 'typeRef'. May be
   *          <tt>null</tt> if the annotation targets 'typeRef' as a whole.
   * @param start
   *          the fist instructions corresponding to the continuous ranges
   *          that make the scope of this local variable (inclusive).
   * @param end
   *          the last instructions corresponding to the continuous ranges
   *          that make the scope of this local variable (exclusive). This
   *          array must have the same size as the 'start' array.
   * @param index
   *          the local variable's index in each range. This array must have
   *          the same size as the 'start' array.
   * @param desc
   *          the class descriptor of
 the annotation class.
   */
```

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/**
   * Constructs a new {@link ClassNode}. <i>Subclasses must not use this
   * constructor</i>. Instead, they must use the {@link #ClassNode(int)}
   * version.
   *
   * @throws IllegalStateException
   *             If a subclass calls this constructor.
    */
```

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/**
   * Creates a new {@link GeneratorAdapter}. <i>Subclasses must not use this
   * constructor</i>. Instead, they must use the
   * {@link #GeneratorAdapter(int, MethodVisitor, int, String, String)}
   * version.
   *
   * @param mv
   *            the
 method visitor to which this adapter delegates calls.
   * @param access
   *            the method's access flags (see {@link Opcodes}).
   * @param name
   *            the method's name.
   * @param desc
   *            the method's descriptor (see {@link Type Type}).
   * @throws IllegalStateException
   *             If a subclass calls this constructor.
   */
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* /asm-5-0-4-sources-6-jar/org/objectweb/asm/xml/SAXAnnotationAdapter.java
* /asm-5-0-4-sources-6-jar/org/objectweb/asm/xml/Processor.java
* /asm-5-0-4-sources-6-jar/org/objectweb/asm/xml/SAXFieldAdapter.java
*
/asm-5-0-4-sources-6-jar/org/objectweb/asm/xml/ASMContentHandler.java
* /asm-5-0-4-sources-6-jar/org/objectweb/asm/xml/SAXCodeAdapter.java
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/**
   * Creates a new {@link AnalyzerAdapter}. <i>Subclasses must not use this
   * constructor</i>. Instead, they must use the
   * {@link #AnalyzerAdapter(int, String, int, String, String, MethodVisitor)}
   * version.
   *
   * @param owner
   *
     the owner's class name.
   * @param access
   *          the method's access flags (see {@link Opcodes}).
   * @param name
   *          the method's name.
   * @param desc
   *          the method's descriptor (see {@link Type Type}).
   * @param mv
   *          the method visitor to which this adapter delegates calls. May
   *          be <tt>null</tt>.
   * @throws IllegalStateException
   *           If a subclass calls this constructor.
   */
```

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/**
    * Constructs a new {@link Textifier}. <i>Subclasses must not use this
    * constructor</i>. Instead, they must use the {@link #Textifier(int)}
    * version.
    *
    * @throws IllegalStateException
    *             If a subclass calls this constructor.
     */
```

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* /asm-5-0-4-sources-6-jar/org/objectweb/asm/AnnotationWriter.java
* /asm-5-0-4-sources-6-jar/org/objectweb/asm/tree/analysis/SimpleVerifier.java
*
 /asm-5-0-4-sources-6-jar/org/objectweb/asm/optimizer/NameMapping.java
* /asm-5-0-4-sources-6-jar/org/objectweb/asm/util/Printer.java
* /asm-5-0-4-sources-6-jar/org/objectweb/asm/optimizer/Shrinker.java
* /asm-5-0-4-sources-6-jar/org/objectweb/asm/commons/Method.java
* /asm-5-0-4-sources-6-jar/org/objectweb/asm/util/CheckAnnotationAdapter.java
* /asm-5-0-4-sources-6-jar/org/objectweb/asm/commons/RemappingSignatureAdapter.java
* /asm-5-0-4-sources-6-jar/org/objectweb/asm/commons/RemappingFieldAdapter.java
* /asm-5-0-4-sources-6-jar/org/objectweb/asm/ClassWriter.java
* /asm-5-0-4-sources-6-jar/org/objectweb/asm/Attribute.java
* /asm-5-0-4-sources-6-jar/org/objectweb/asm/tree/analysis/SourceInterpreter.java
* /asm-5-0-4-sources-6-jar/org/objectweb/asm/tree/MethodInsnNode.java
* /asm-5-0-4-sources-6-jar/org/objectweb/asm/MethodVisitor.java
* /asm-5-0-4-sources-6-jar/org/objectweb/asm/util/TraceFieldVisitor.java
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* /asm-5-0-4-sources-6-jar/org/objectweb/asm/tree/analysis/Interpreter.java
* /asm-5-0-4-sources-6-jar/org/objectweb/asm/tree/JumpInsnNode.java
* /asm-5-0-4-sources-6-jar/org/objectweb/asm/commons/TableSwitchGenerator.java

* /asm-5-0-4-sources-6-jar/org/objectweb/asm/tree/FieldNode.java
* /asm-5-0-4-sources-6-jar/org/objectweb/asm/tree/FieldInsnNode.java
* /asm-5-0-4-sources-6-jar/org/objectweb/asm/tree/LabelNode.java
* /asm-5-0-4-sources-6-jar/org/objectweb/asm/optimizer/ClassConstantsCollector.java
* /asm-5-0-4-sources-6-jar/org/objectweb/asm/util/CheckSignatureAdapter.java
* /asm-5-0-4-sources-6-jar/org/objectweb/asm/tree/analysis/BasicVerifier.java
*
/asm-5-0-4-sources-6-jar/org/objectweb/asm/commons/CodeSizeEvaluator.java
* /asm-5-0-4-sources-6-jar/org/objectweb/asm/commons/InstructionAdapter.java
* /asm-5-0-4-sources-6-jar/org/objectweb/asm/tree/IntInsnNode.java
* /asm-5-0-4-sources-6-jar/org/objectweb/asm/commons/RemappingClassAdapter.java
* /asm-5-0-4-sources-6-jar/org/objectweb/asm/tree/MultiANewArrayInsnNode.java
* /asm-5-0-4-sources-6-jar/org/objectweb/asm/ClassReader.java
* /asm-5-0-4-sources-6-jar/org/objectweb/asm/tree/VarInsnNode.java
* /asm-5-0-4-sources-6-jar/org/objectweb/asm/commons/RemappingMethodAdapter.java
* /asm-5-0-4-sources-6-jar/org/objectweb/asm/tree/analysis/Value.java
* /asm-5-0-4-sources-6-jar/org/objectweb/asm/commons/StaticInitMerger.java
* /asm-5-0-4-sources-6-jar/org/objectweb/asm/optimizer/AnnotationConstantsCollector.java
* /asm-5-0-4-sources-6-jar/org/objectweb/asm/AnnotationVisitor.java
* /asm-5-0-4-sources-6-jar/org/objectweb/asm/tree/InsnNode.java
*
/asm-5-0-4-sources-6-jar/org/objectweb/asm/signature/SignatureReader.java
* /asm-5-0-4-sources-6-jar/org/objectweb/asm/tree/LdcInsnNode.java
* /asm-5-0-4-sources-6-jar/org/objectweb/asm/tree/LookupSwitchInsnNode.java
* /asm-5-0-4-sources-6-jar/org/objectweb/asm/tree/LineNumberNode.java
* /asm-5-0-4-sources-6-jar/org/objectweb/asm/optimizer/JarOptimizer.java
* /asm-5-0-4-sources-6-jar/org/objectweb/asm/commons/LocalVariablesSorter.java
* /asm-5-0-4-sources-6-jar/org/objectweb/asm/util/TraceAnnotationVisitor.java
* /asm-5-0-4-sources-6-jar/org/objectweb/asm/optimizer/Constant.java
* /asm-5-0-4-sources-6-jar/org/objectweb/asm/tree/TypeAnnotationNode.java
* /asm-5-0-4-sources-6-jar/org/objectweb/asm/Handle.java
* /asm-5-0-4-sources-6-jar/org/objectweb/asm/tree/TryCatchBlockNode.java
* /asm-5-0-4-sources-6-jar/org/objectweb/asm/optimizer/ClassOptimizer.java
* /asm-5-0-4-sources-6-jar/org/objectweb/asm/util/ASMifier.java
* /asm-5-0-4-sources-6-jar/org/objectweb/asm/util/TraceClassVisitor.java
*
/asm-5-0-4-sources-6-jar/org/objectweb/asm/tree/TableSwitchInsnNode.java
* /asm-5-0-4-sources-6-jar/org/objectweb/asm/tree/analysis/Frame.java
* /asm-5-0-4-sources-6-jar/org/objectweb/asm/tree/InvokeDynamicInsnNode.java
* /asm-5-0-4-sources-6-jar/org/objectweb/asm/tree/analysis/AnalyzerException.java
* /asm-5-0-4-sources-6-jar/org/objectweb/asm/tree/analysis/Subroutine.java
* /asm-5-0-4-sources-6-jar/org/objectweb/asm/commons/SerialVersionUIDAdder.java
* /asm-5-0-4-sources-6-jar/org/objectweb/asm/tree/InnerClassNode.java
* /asm-5-0-4-sources-6-jar/org/objectweb/asm/tree/ParameterNode.java
* /asm-5-0-4-sources-6-jar/org/objectweb/asm/tree/LocalVariableNode.java
* /asm-5-0-4-sources-6-jar/org/objectweb/asm/tree/analysis/Analyzer.java
* /asm-5-0-4-sources-6-jar/org/objectweb/asm/tree/analysis/SmallSet.java
* /asm-5-0-4-sources-6-jar/org/objectweb/asm/commons/RemappingAnnotationAdapter.java

* /asm-5-0-4-sources-6-jar/org/objectweb/asm/tree/TypeInsnNode.java
*
 /asm-5-0-4-sources-6-jar/org/objectweb/asm/util/TraceSignatureVisitor.java
* /asm-5-0-4-sources-6-jar/org/objectweb/asm/tree/IincInsnNode.java
* /asm-5-0-4-sources-6-jar/org/objectweb/asm/optimizer/MethodOptimizer.java
* /asm-5-0-4-sources-6-jar/org/objectweb/asm/util/CheckFieldAdapter.java
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* /asm-5-0-4-sources-6-jar/org/objectweb/asm/util/CheckMethodAdapter.java
* /asm-5-0-4-sources-6-jar/org/objectweb/asm/commons/SimpleRemapper.java
* /asm-5-0-4-sources-6-jar/org/objectweb/asm/tree/AnnotationNode.java
* /asm-5-0-4-sources-6-jar/org/objectweb/asm/FieldVisitor.java
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* /asm-5-0-4-sources-6-jar/org/objectweb/asm/util/TraceMethodVisitor.java
* /asm-5-0-4-sources-6-jar/org/objectweb/asm/optimizer/MethodConstantsCollector.java
* /asm-5-0-4-sources-6-jar/org/objectweb/asm/Handler.java
* /asm-5-0-4-sources-6-jar/org/objectweb/asm/tree/MethodNode.java
* /asm-5-0-4-sources-6-jar/org/objectweb/asm/tree/InsnList.java
*
 /asm-5-0-4-sources-6-jar/org/objectweb/asm/optimizer/FieldConstantsCollector.java
* /asm-5-0-4-sources-6-jar/org/objectweb/asm/MethodWriter.java
* /asm-5-0-4-sources-6-jar/org/objectweb/asm/tree/analysis/BasicInterpreter.java
* /asm-5-0-4-sources-6-jar/org/objectweb/asm/signature/SignatureWriter.java
* /asm-5-0-4-sources-6-jar/org/objectweb/asm/commons/TryCatchBlockSorter.java
* /asm-5-0-4-sources-6-jar/org/objectweb/asm/Item.java
* /asm-5-0-4-sources-6-jar/org/objectweb/asm/Edge.java
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* /asm-5-0-4-sources-6-jar/org/objectweb/asm/tree/FrameNode.java
* /asm-5-0-4-sources-6-jar/org/objectweb/asm/optimizer/ConstantPool.java
* /asm-5-0-4-sources-6-jar/org/objectweb/asm/Opcodes.java
* /asm-5-0-4-sources-6-jar/org/objectweb/asm/util/CheckClassAdapter.java
* /asm-5-0-4-sources-6-jar/org/objectweb/asm/signature/SignatureVisitor.java

1.301 jansi-native 1.8

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* /jansi-1-18-sources-jar/org/fusesource/jansi/AnsiConsole.java
* /jansi-1-18-sources-jar/org/fusesource/jansi/AnsiOutputStream.java
* /jansi-1-18-sources-jar/org/fusesource/jansi/AnsiRenderer.java
* /jansi-1-18-sources-jar/org/fusesource/jansi/WindowsAnsiOutputStream.java
*
/jansi-1-18-sources-jar/org/fusesource/jansi/AnsiString.java
* /jansi-1-18-sources-jar/org/fusesource/jansi/HtmlAnsiOutputStream.java
* /jansi-1-18-sources-jar/org/fusesource/jansi/AnsiMain.java
* /jansi-1-18-sources-jar/org/fusesource/jansi/FilterPrintStream.java
* /jansi-1-18-sources-jar/org/fusesource/jansi/AnsiRenderWriter.java
* /jansi-1-18-sources-jar/org/fusesource/jansi/AnsiPrintStream.java
* /jansi-1-18-sources-jar/org/fusesource/jansi/WindowsAnsiPrintStream.java

1.303 heimdal 1.6rc2

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AES in libhcrypto

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rijndael-alg-fst.c

@version 3.0 (December 2000)

Optimised ANSI C code for the Rijndael cipher (now AES)

@author Vincent Rijmen <vincent.rijmen@esat.kuleuven.ac.be>
@author Antoon Bosselaers <antoon.bosselaers@esat.kuleuven.ac.be>
@author Paulo Barreto <paulo.barreto@terra.com.br>

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D3DES (V5.09) -

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Thanks to: Dan Hoey for his excellent Initial and Inverse permutation
code; Jim Gillogly & Phil Karn for the DES key schedule code; Dennis
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<signature of Ty Coon>, 1 April 1989
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In other cases, permission to use a particular library in non-free programs enables a greater number of people to use a large body of free software. For example, permission to use the GNU C Library in non-free programs enables many more people to use the whole GNU operating system, as well as its variant, the GNU/Linux operating system.

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"Source code" for a work means the preferred form of the work for making modifications to it. For a library, complete source code means all the source code for all modules it contains, plus any associated interface definition files, plus the scripts used to control compilation and installation of the library.

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These requirements apply to the modified work as a whole. If identifiable sections of that work are not derived from the Library, and can be reasonably considered independent and separate works in themselves, then this License, and its terms, do not apply to those sections when you distribute them as separate works. But when you distribute the same sections as part of a whole which is a work based on the Library, the distribution of the whole must be on the terms of this License, whose permissions for other licensees extend to the entire whole, and thus to each and every part regardless of who wrote it.

Thus, it is not the intent of this section to claim rights or contest your rights to work written entirely by you; rather, the intent is to exercise the right to control the distribution of derivative or collective works based on the Library.

In addition, mere aggregation of another work not based on the Library with the Library (or with a work based on the Library) on a volume of a storage or distribution medium does not bring the other work under the scope of this License.

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This option is useful when you wish to copy part of the code of the Library into a program that is not a library.

4. You may copy and distribute the Library (or a portion or derivative of it, under Section 2) in object code or executable form under the terms of Sections 1 and 2 above provided that you accompany it with the complete corresponding machine-readable source code, which must be distributed under the terms of Sections 1 and 2 above on a medium customarily used for software interchange.

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However, linking a "work that uses the Library" with the Library creates an executable that is a derivative of the Library (because it contains portions of the Library), rather than a "work that uses the library". The executable is therefore covered by this License. Section 6 states terms for distribution of such executables.

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Otherwise, if the work is a derivative of the Library, you may distribute the object code for the work under the terms of Section 6.
Any executables containing that work also fall under Section 6, whether or not they are linked directly with the Library itself.

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1.307 reactor-netty 0.9.11.RELEASE

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1.308 spring-security-web 5.4.11

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1.309 commons-dbcp 1.4

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1.310 protobuf 3.6.1.3-2ubuntu5.2

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  * MS Visual Studio error format option.
  * Detect unordered_map in stl_hash.m4.
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  * gzip/zlib I/O support.
Michael Poole <mdpoole@troilus.org>
  * Fixed warnings about generated constructors not explicitly initializing
    all fields (only present with certain compiler settings).
  * Added generation of field number constants.
Wink Saville <wink@google.com>
  * Fixed initialization ordering problem in logging code.
Will Pierce <willp@nuclei.com>
  * Small patch improving performance of in Python serialization.

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  * Added Swap(), SwapElements(), and RemoveLast() to Reflection interface.
Alexander Melnikov <alm@sibmail.ru>
  * HPUX support.
Oliver Jowett <oliver.jowett@gmail.com>
   * Detect whether zlib is new enough in configure script.
  * Fixes for Solaris 10 32/64-bit confusion.
Evan Jones <evanj@mit.edu>
  * Optimize Java serialization code when writing a small message to a stream.
  * Optimize Java serialization of strings so that UTF-8 encoding happens only
    once per string per serialization call.
  * Clean up some Java warnings.
  * Fix bug with permanent callbacks that delete themselves when run.
Michael Kucharski <m.kucharski@gmail.com>
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Kacper Kowalik <xarthisius.kk@gmail.com>
  * Fixed m4/acx_pthread.m4 problem for some Linux distributions.
William Orr <will@worrbase.com>
  * Fixed detection of sched_yield on Solaris.
  * Added atomicops for Solaris
Andrew Paprocki <andrew@ishiboo.com>
  * Fixed minor IBM xlC compiler build issues
  * Added atomicops for AIX (POWER)

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Manifest-Version: 1.0
Bnd-LastModified: 1563545580901
Build-Jdk: 1.8.0_202
Built-By: jenkins-slave
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 common to several Terracotta products
Bundle-License: http://www.apache.org/licenses/LICENSE-2.0.txt
Bundle-ManifestVersion: 2
Bundle-Name: Terracotta Management :: Sequence Generator
Bundle-SymbolicName: org.terracotta.management.sequence-generator
Bundle-Version: 5.7.3
Created-By: Apache Maven Bundle Plugin

Export-Package: org.terracotta.management.sequence;version="5.7.3",org.t
erracotta.management.sequence.perf;version="5.7.3"
Main-Class: org.terracotta.management.sequence.perf.PerfTest
Require-Capability: osgi.ee;filter:="(&(osgi.ee=JavaSE)(version=1.8))"
Tool: Bnd-2.4.1.201501161923

Found in path(s):
* /sequence-generator-5-7-3-jar/META-INF/MANIFEST.MF

1.312 swagger-ui 3.49.0

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1.313 libgpg-error 1.37-1

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1.314 activation-api 1.2.2

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jar/org/springframework/jca/cci/connection/TransactionAwareConnectionFactoryProxy.java
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* /spring-tx-5-2-24-release-sources-jar/org/springframework/jca/work/SimpleTaskWorkManager.java
* /spring-tx-5-2-24-release-sources-jar/org/springframework/dao/support/DataAccessUtils.java
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* /spring-tx-5-2-24-release-sources-jar/org/springframework/jca/endpoint/GenericMessageEndpointFactory.java

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* /spring-tx-5-2-24-release-sources-jar/org/springframework/transaction/support/DefaultTransactionDefinition.java
* /spring-tx-5-2-24-release-sources-jar/org/springframework/transaction/support/ResourceHolderSupport.java
* /spring-tx-5-2-24-release-sources-jar/org/springframework/jca/cci/RecordTypeNotSupportedException.java
* /spring-tx-5-2-24-release-sources-
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* /spring-tx-5-2-24-release-sources-jar/org/springframework/transaction/jta/JtaTransactionObject.java
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/spring-tx-5-2-24-release-sources-jar/org/springframework/transaction/interceptor/RollbackRuleAttribute.java
* /spring-tx-5-2-24-release-sources-jar/org/springframework/transaction/InvalidTimeoutException.java
* /spring-tx-5-2-24-release-sources-jar/org/springframework/jca/context/SpringContextResourceAdapter.java
* /spring-tx-5-2-24-release-sources-
jar/org/springframework/transaction/support/ResourceHolderSynchronization.java
* /spring-tx-5-2-24-release-sources-jar/org/springframework/jca/cci/core/support/CciDaoSupport.java
* /spring-tx-5-2-24-release-sources-
jar/org/springframework/transaction/interceptor/MatchAlwaysTransactionAttributeSource.java
* /spring-tx-5-2-24-release-sources-jar/org/springframework/jca/cci/connection/ConnectionHolder.java
* /spring-tx-5-2-24-release-sources-jar/org/springframework/jca/cci/object/SimpleRecordOperation.java
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/spring-tx-5-2-24-release-sources-jar/org/springframework/jca/cci/object/MappingCommAreaOperation.java
* /spring-tx-5-2-24-release-sources-jar/org/springframework/transaction/jta/JtaTransactionManager.java
* /spring-tx-5-2-24-release-sources-jar/org/springframework/jca/cci/core/RecordExtractor.java
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* /spring-tx-5-2-24-release-sources-jar/org/springframework/dao/NonTransientDataAccessResourceException.java
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* /spring-tx-5-2-24-release-sources-jar/org/springframework/jca/support/ResourceAdapterFactoryBean.java
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* /spring-tx-5-2-24-release-sources-jar/org/springframework/jca/cci/core/CciOperations.java
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* /spring-tx-5-2-24-release-sources-jar/org/springframework/jca/cci/connection/DelegatingConnectionFactory.java
* /spring-tx-5-2-24-release-sources-jar/org/springframework/jca/context/ResourceAdapterApplicationContext.java
* /spring-tx-5-2-24-release-sources-jar/org/springframework/jca/cci/core/support/CommAreaRecord.java
* /spring-tx-5-2-24-release-sources-jar/org/springframework/transaction/TransactionSystemException.java
* /spring-tx-5-2-24-release-sources-jar/org/springframework/dao/OptimisticLockingFailureException.java
* /spring-tx-5-2-24-release-sources-jar/org/springframework/jca/context/BootstrapContextAwareProcessor.java
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* /spring-tx-5-2-24-release-sources-jar/org/springframework/transaction/event/TransactionPhase.java
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 /spring-tx-5-2-24-release-sources-jar/org/springframework/transaction/annotation/Transactional.java
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* /spring-tx-5-2-24-release-sources-
jar/org/springframework/transaction/jta/WebSphereUowTransactionManager.java
* /spring-tx-5-2-24-release-sources-
jar/org/springframework/transaction/reactive/AbstractReactiveTransactionManager.java
* /spring-tx-5-2-24-release-sources-
jar/org/springframework/transaction/interceptor/RuleBasedTransactionAttribute.java
*
 /spring-tx-5-2-24-release-sources-
jar/org/springframework/transaction/support/AbstractPlatformTransactionManager.java
* /spring-tx-5-2-24-release-sources-jar/org/springframework/transaction/ReactiveTransactionManager.java
* /spring-tx-5-2-24-release-sources-jar/org/springframework/transaction/config/TxAdviceBeanDefinitionParser.java
* /spring-tx-5-2-24-release-sources-jar/org/springframework/transaction/interceptor/TransactionInterceptor.java
* /spring-tx-5-2-24-release-sources-jar/org/springframework/transaction/support/SimpleTransactionScope.java
* /spring-tx-5-2-24-release-sources-
jar/org/springframework/transaction/support/TransactionSynchronizationManager.java
* /spring-tx-5-2-24-release-sources-
jar/org/springframework/transaction/interceptor/TransactionAttributeSourcePointcut.java
* /spring-tx-5-2-24-release-sources-
jar/org/springframework/transaction/annotation/TransactionManagementConfigurer.java
* /spring-tx-5-2-24-release-sources-jar/org/springframework/transaction/interceptor/TransactionAspectSupport.java
*
 /spring-tx-5-2-24-release-sources-
jar/org/springframework/dao/support/PersistenceExceptionTranslationInterceptor.java
* /spring-tx-5-2-24-release-sources-jar/org/springframework/jca/work/WorkManagerTaskExecutor.java
* /spring-tx-5-2-24-release-sources-jar/org/springframework/transaction/reactive/TransactionalOperator.java
* /spring-tx-5-2-24-release-sources-jar/org/springframework/transaction/PlatformTransactionManager.java
* /spring-tx-5-2-24-release-sources-

jar/org/springframework/transaction/annotation/ProxyTransactionManagementConfiguration.java
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jar/org/springframework/transaction/annotation/EnableTransactionManagement.java
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* /spring-tx-5-2-24-release-sources-jar/org/springframework/transaction/interceptor/TransactionAttributeEditor.java
* /spring-tx-5-2-24-release-sources-
jar/org/springframework/transaction/interceptor/TransactionAttributeSource.java
*

/spring-tx-5-2-24-release-sources-
jar/org/springframework/transaction/interceptor/MethodMapTransactionAttributeSource.java
* /spring-tx-5-2-24-release-sources-
jar/org/springframework/transaction/interceptor/TransactionProxyFactoryBean.java
* /spring-tx-5-2-24-release-sources-
jar/org/springframework/transaction/reactive/TransactionSynchronizationManager.java
* /spring-tx-5-2-24-release-sources-
jar/org/springframework/transaction/config/JtaTransactionManagerFactoryBean.java
* /spring-tx-5-2-24-release-sources-
jar/org/springframework/transaction/annotation/JtaTransactionAnnotationParser.java
* /spring-tx-5-2-24-release-sources-jar/org/springframework/transaction/reactive/TransactionContext.java
* /spring-tx-5-2-24-release-sources-
jar/org/springframework/transaction/reactive/ReactiveResourceSynchronization.java
* /spring-tx-5-2-24-release-sources-
jar/org/springframework/transaction/annotation/SpringTransactionAnnotationParser.java
* /spring-tx-5-2-24-release-sources-jar/org/springframework/transaction/TransactionDefinition.java
*
/spring-tx-5-2-24-release-sources-jar/org/springframework/transaction/reactive/TransactionContextHolder.java
* /spring-tx-5-2-24-release-sources-
jar/org/springframework/transaction/annotation/AnnotationTransactionAttributeSource.java
* /spring-tx-5-2-24-release-sources-jar/org/springframework/transaction/support/AbstractTransactionStatus.java
* /spring-tx-5-2-24-release-sources-jar/org/springframework/transaction/support/TransactionOperations.java
* /spring-tx-5-2-24-release-sources-jar/org/springframework/transaction/support/WithoutTransactionOperations.java
* /spring-tx-5-2-24-release-sources-jar/org/springframework/transaction/TransactionManager.java
* /spring-tx-5-2-24-release-sources-
jar/org/springframework/transaction/event/ApplicationListenerMethodTransactionalAdapter.java
* /spring-tx-5-2-24-release-sources-jar/org/springframework/transaction/support/DefaultTransactionStatus.java
* /spring-tx-5-2-24-release-sources-jar/org/springframework/transaction/interceptor/TransactionAttribute.java
*
/spring-tx-5-2-24-release-sources-
jar/org/springframework/transaction/reactive/TransactionSynchronizationUtils.java
* /spring-tx-5-2-24-release-sources-jar/org/springframework/transaction/reactive/TransactionalOperatorImpl.java
* /spring-tx-5-2-24-release-sources-jar/org/springframework/transaction/reactive/TransactionSynchronization.java
* /spring-tx-5-2-24-release-sources-jar/org/springframework/transaction/TransactionStatus.java
* /spring-tx-5-2-24-release-sources-jar/org/springframework/transaction/annotation/Propagation.java
* /spring-tx-5-2-24-release-sources-
jar/org/springframework/transaction/interceptor/CompositeTransactionAttributeSource.java
* /spring-tx-5-2-24-release-sources-jar/org/springframework/transaction/ReactiveTransaction.java
* /spring-tx-5-2-24-release-sources-
jar/org/springframework/transaction/annotation/Ejb3TransactionAnnotationParser.java
* /spring-tx-5-2-24-release-sources-jar/org/springframework/transaction/StaticTransactionDefinition.java
*
/spring-tx-5-2-24-release-sources-jar/org/springframework/transaction/reactive/TransactionCallback.java
* /spring-tx-5-2-24-release-sources-
jar/org/springframework/transaction/annotation/AbstractTransactionManagementConfiguration.java
* /spring-tx-5-2-24-release-sources-jar/org/springframework/transaction/reactive/GenericReactiveTransaction.java
* /spring-tx-5-2-24-release-sources-
jar/org/springframework/transaction/annotation/TransactionAnnotationParser.java

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* /spring-tx-5-2-24-release-sources-jar/org/springframework/transaction/interceptor/DelegatingTransactionAttribute.java
* /spring-tx-5-2-24-release-sources-jar/org/springframework/dao/CannotSerializeTransactionException.java
*
/spring-tx-5-2-24-release-sources-jar/org/springframework/transaction/jta/ManagedTransactionAdapter.java
* /spring-tx-5-2-24-release-sources-jar/org/springframework/transaction/TransactionTimedOutException.java
* /spring-tx-5-2-24-release-sources-jar/org/springframework/transaction/interceptor/NoRollbackRuleAttribute.java
* /spring-tx-5-2-24-release-sources-jar/org/springframework/dao/QueryTimeoutException.java
* /spring-tx-5-2-24-release-sources-jar/org/springframework/dao/InvalidDataAccessApiUsageException.java
* /spring-tx-5-2-24-release-sources-jar/org/springframework/transaction/InvalidIsolationLevelException.java
* /spring-tx-5-2-24-release-sources-jar/org/springframework/dao/TransientDataAccessResourceException.java
* /spring-tx-5-2-24-release-sources-jar/org/springframework/dao/InvalidDataAccessResourceUsageException.java
* /spring-tx-5-2-24-release-sources-jar/org/springframework/dao/CannotAcquireLockException.java
* /spring-tx-5-2-24-release-sources-jar/org/springframework/transaction/CannotCreateTransactionException.java
*
/spring-tx-5-2-24-release-sources-jar/org/springframework/dao/CleanupFailureDataAccessException.java
* /spring-tx-5-2-24-release-sources-jar/org/springframework/dao/RecoverableDataAccessException.java
* /spring-tx-5-2-24-release-sources-jar/org/springframework/jca/cci/InvalidResultSetAccessException.java
* /spring-tx-5-2-24-release-sources-jar/org/springframework/transaction/TransactionUsageException.java
* /spring-tx-5-2-24-release-sources-jar/org/springframework/transaction/NestedTransactionNotSupportedException.java
* /spring-tx-5-2-24-release-sources-jar/org/springframework/transaction/NoTransactionException.java
* /spring-tx-5-2-24-release-sources-jar/org/springframework/jca/cci/connection/NotSupportedRecordFactory.java
* /spring-tx-5-2-24-release-sources-jar/org/springframework/dao/EmptyResultDataAccessException.java
* /spring-tx-5-2-24-release-sources-jar/org/springframework/dao/DuplicateKeyException.java
*

/spring-tx-5-2-24-release-sources-jar/org/springframework/transaction/interceptor/TransactionAttributeSourceEditor.java
* /spring-tx-5-2-24-release-sources-jar/org/springframework/dao/PessimisticLockingFailureException.java
* /spring-tx-5-2-24-release-sources-jar/org/springframework/dao/PermissionDeniedDataAccessException.java
* /spring-tx-5-2-24-release-sources-jar/org/springframework/transaction/TransactionSuspensionNotSupportedException.java
* /spring-tx-5-2-24-release-sources-jar/org/springframework/dao/DataIntegrityViolationException.java
* /spring-tx-5-2-24-release-sources-jar/org/springframework/transaction/support/DelegatingTransactionDefinition.java
* /spring-tx-5-2-24-release-sources-jar/org/springframework/transaction/support/TransactionSynchronizationAdapter.java
* /spring-tx-5-2-24-release-sources-jar/org/springframework/dao/DeadlockLoserDataAccessException.java
* /spring-tx-5-2-24-release-sources-jar/org/springframework/transaction/jta/UserTransactionAdapter.java
*
/spring-tx-5-2-24-release-sources-jar/org/springframework/transaction/jta/JtaAfterCompletionSynchronization.java
* /spring-tx-5-2-24-release-sources-jar/org/springframework/dao/TypeMismatchDataAccessException.java
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* /spring-tx-5-2-24-release-sources-jar/org/springframework/transaction/UnexpectedRollbackException.java
* /spring-tx-5-2-24-release-sources-jar/org/springframework/transaction/jta/TransactionFactory.java
* /spring-tx-5-2-24-release-sources-jar/org/springframework/transaction/support/ResourceTransactionManager.java
* /spring-tx-5-2-24-release-sources-jar/org/springframework/jca/work/DelegatingWork.java
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1.319 activation 1.2.2

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1.321 micrometer-core 1.5.4

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* /micrometer-core-1-5-4-sources-1-jar/io/micrometer/core/instrument/config/validate/ValidationException.java
* /micrometer-core-1-5-4-sources-1-jar/io/micrometer/core/instrument/binder/jetty/JettyClientTagsProvider.java
* /micrometer-core-1-5-4-sources-1-jar/io/micrometer/core/instrument/config/validate/Validated.java
* /micrometer-core-1-5-4-sources-1-
jar/io/micrometer/core/instrument/binder/http/DefaultHttpServletRequestTagsProvider.java
* /micrometer-core-1-5-4-sources-1-
jar/io/micrometer/core/instrument/binder/httpcomponents/MicrometerHttpClientInterceptor.java
* /micrometer-core-1-5-4-sources-1-
jar/io/micrometer/core/instrument/internal/CumulativeHistogramLongTaskTimer.java
* /micrometer-core-1-5-4-sources-1-jar/io/micrometer/core/instrument/step/StepValue.java
*
/micrometer-core-1-5-4-sources-1-jar/io/micrometer/core/instrument/config/validate/PropertyValidator.java
* /micrometer-core-1-5-4-sources-1-jar/io/micrometer/core/instrument/binder/jetty/JettySslHandshakeMetrics.java
* /micrometer-core-1-5-4-sources-1-jar/io/micrometer/core/instrument/binder/jetty/JettyClientMetrics.java
* /micrometer-core-1-5-4-sources-1-jar/io/micrometer/core/instrument/binder/jpa/HibernateQueryMetrics.java
* /micrometer-core-1-5-4-sources-1-
jar/io/micrometer/core/instrument/distribution/FixedBoundaryVictoriaMetricsHistogram.java
* /micrometer-core-1-5-4-sources-1-jar/io/micrometer/core/instrument/binder/http/package-info.java
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* /micrometer-core-1-5-4-sources-1-jar/io/micrometer/core/instrument/logging/LoggingRegistryConfig.java
* /micrometer-core-1-5-4-sources-1-jar/io/micrometer/core/instrument/push/PushRegistryConfig.java
* /micrometer-core-1-5-4-sources-1-jar/io/micrometer/core/instrument/MultiGauge.java
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 /micrometer-core-1-5-4-sources-1-jar/io/micrometer/core/instrument/push/PushMeterRegistry.java
* /micrometer-core-1-5-4-sources-1-jar/io/micrometer/core/ipc/http/OkHttpSender.java
* /micrometer-core-1-5-4-sources-1-jar/io/micrometer/core/ipc/http/HttpStatusClass.java
* /micrometer-core-1-5-4-sources-1-jar/io/micrometer/core/instrument/util/JsonUtils.java
* /micrometer-core-1-5-4-sources-1-jar/io/micrometer/core/ipc/http/HttpUrlConnectionSender.java
* /micrometer-core-1-5-4-sources-1-jar/io/micrometer/core/instrument/StrongReferenceGaugeFunction.java
* /micrometer-core-1-5-4-sources-1-jar/io/micrometer/core/ipc/http/HttpSender.java
* /micrometer-core-1-5-4-sources-1-jar/io/micrometer/core/ipc/http/ReactorNettySender.java

* /micrometer-core-1-5-4-sources-1-jar/io/micrometer/core/instrument/binder/kafka/KafkaConsumerMetrics.java
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* /micrometer-core-1-5-4-sources-1-
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* /micrometer-core-1-5-4-sources-1-jar/io/micrometer/core/instrument/composite/AbstractCompositeMeter.java
* /micrometer-core-1-5-4-sources-1-jar/io/micrometer/core/instrument/dropwizard/package-info.java
* /micrometer-core-1-5-4-sources-1-jar/io/micrometer/core/instrument/binder/jvm/DiskSpaceMetrics.java
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* /micrometer-core-1-5-4-sources-1-jar/io/micrometer/core/instrument/dropwizard/DropwizardClock.java
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* /micrometer-core-1-5-4-sources-1-
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* /micrometer-core-1-5-4-sources-1-jar/io/micrometer/core/instrument/dropwizard/DropwizardRate.java
* /micrometer-core-1-5-4-sources-1-jar/io/micrometer/core/instrument/noop/package-info.java
* /micrometer-core-1-5-4-sources-1-jar/io/micrometer/core/instrument/dropwizard/DropwizardGauge.java
* /micrometer-core-1-5-4-sources-1-jar/io/micrometer/core/instrument/config/MeterRegistryConfig.java

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* /micrometer-core-1-5-4-sources-1-jar/io/micrometer/core/instrument/composite/CompositeFunctionTimer.java
* /micrometer-core-1-5-4-sources-1-jar/io/micrometer/core/instrument/step/StepMeasurement.java
* /micrometer-core-1-5-4-sources-1-jar/io/micrometer/core/instrument/AbstractMeter.java
* /micrometer-core-1-5-4-sources-1-
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* /micrometer-core-1-5-4-sources-1-jar/io/micrometer/core/instrument/Counter.java
* /micrometer-core-1-5-4-sources-1-jar/io/micrometer/core/lang/NonNull.java
* /micrometer-core-1-5-4-sources-1-jar/io/micrometer/core/instrument/distribution/package-info.java
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* /micrometer-core-1-5-4-sources-1-jar/io/micrometer/core/instrument/simple/CountingMode.java
* /micrometer-core-1-5-4-sources-1-jar/io/micrometer/core/instrument/util/TimeUtils.java
* /micrometer-core-1-5-4-sources-1-jar/io/micrometer/core/lang/Nullable.java
* /micrometer-core-1-5-4-sources-1-jar/io/micrometer/core/annotation/Timed.java
* /micrometer-core-1-5-4-sources-1-jar/io/micrometer/core/instrument/noop/NoopGauge.java
* /micrometer-core-1-5-4-sources-1-jar/io/micrometer/core/instrument/search/RequiredSearch.java
* /micrometer-core-1-5-4-sources-1-jar/io/micrometer/core/instrument/binder/db/PostgreSQLDatabaseMetrics.java
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* /micrometer-core-1-5-4-sources-1-jar/io/micrometer/core/annotation/Incubating.java
* /micrometer-core-1-5-4-sources-1-jar/io/micrometer/core/instrument/config/package-info.java
* /micrometer-core-1-5-4-sources-1-jar/io/micrometer/core/instrument/distribution/pause/package-info.java
* /micrometer-core-1-5-4-sources-1-jar/io/micrometer/core/instrument/distribution/NoopHistogram.java
* /micrometer-core-1-5-4-sources-1-jar/io/micrometer/core/instrument/step/StepLong.java
* /micrometer-core-1-5-4-sources-1-jar/io/micrometer/core/instrument/search/Search.java
* /micrometer-core-1-5-4-sources-1-
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/micrometer-core-1-5-4-sources-1-jar/io/micrometer/core/instrument/util/IOUtils.java
* /micrometer-core-1-5-4-sources-1-jar/io/micrometer/core/instrument/binder/system/UptimeMetrics.java
* /micrometer-core-1-5-4-sources-1-jar/io/micrometer/core/instrument/util/MeterEquivalence.java
* /micrometer-core-1-5-4-sources-1-jar/io/micrometer/core/instrument/binder/jvm/JvmCompilationMetrics.java
* /micrometer-core-1-5-4-sources-1-jar/io/micrometer/core/instrument/Clock.java
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* /micrometer-core-1-5-4-sources-1-jar/io/micrometer/core/instrument/composite/CompositeCounter.java
* /micrometer-core-1-5-4-sources-1-jar/io/micrometer/core/instrument/util/AbstractPartition.java
* /micrometer-core-1-5-4-sources-1-jar/io/micrometer/core/instrument/dropwizard/DropwizardCounter.java
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* /micrometer-core-1-5-4-sources-1-jar/io/micrometer/core/instrument/binder/jvm/JvmGcMetrics.java
* /micrometer-core-1-5-4-sources-1-jar/io/micrometer/core/instrument/AbstractTimer.java
* /micrometer-core-1-5-4-sources-1-jar/io/micrometer/core/instrument/noop/NoopCounter.java
* /micrometer-core-1-5-4-sources-1-
jar/io/micrometer/core/instrument/binder/hystrix/MicrometerMetricsPublisherThreadPool.java
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* /micrometer-core-1-5-4-sources-1-jar/io/micrometer/core/instrument/distribution/DistributionStatisticConfig.java
*
/micrometer-core-1-5-4-sources-1-jar/io/micrometer/core/instrument/step/StepMeterRegistry.java
* /micrometer-core-1-5-4-sources-1-jar/io/micrometer/core/instrument/logging/package-info.java
* /micrometer-core-1-5-4-sources-1-jar/io/micrometer/core/instrument/internal/DefaultMeter.java
* /micrometer-core-1-5-4-sources-1-jar/io/micrometer/core/instrument/simple/SimpleConfig.java
* /micrometer-core-1-5-4-sources-1-jar/io/micrometer/core/instrument/noop/NoopTimeGauge.java
* /micrometer-core-1-5-4-sources-1-jar/io/micrometer/core/instrument/binder/logging/Log4j2Metrics.java
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 /micrometer-core-1-5-4-sources-1-jar/io/micrometer/core/instrument/binder/hystrix/HystrixMetricsBinder.java
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jar/io/micrometer/core/instrument/distribution/AbstractTimeWindowHistogram.java
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* /micrometer-core-1-5-4-sources-1-jar/io/micrometer/core/instrument/dropwizard/DropwizardMeterRegistry.java
* /micrometer-core-1-5-4-sources-1-jar/io/micrometer/core/instrument/LongTaskTimer.java
* /micrometer-core-1-5-4-sources-1-jar/io/micrometer/core/instrument/binder/cache/CacheMeterBinder.java
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* /spring-retry-1-2-5-release-sources-jar/org/springframework/classify/util/MethodInvokerUtils.java
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* /spring-retry-1-2-5-release-sources-jar/org/springframework/retry/annotation/AnnotationAwareRetryOperationsInterceptor.java
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* /spring-retry-1-2-5-release-sources-jar/org/springframework/retry/RetryListener.java
* /spring-retry-1-2-5-release-sources-jar/org/springframework/retry/RetryStatistics.java
* /spring-retry-1-2-5-release-sources-jar/org/springframework/retry/policy/AlwaysRetryPolicy.java
* /spring-retry-1-2-5-release-sources-jar/org/springframework/retry/backoff/NoBackOffPolicy.java
*
 /spring-retry-1-2-5-release-sources-jar/org/springframework/retry/ExhaustedRetryException.java
* /spring-retry-1-2-5-release-sources-jar/org/springframework/retry/policy/MapRetryContextCache.java
* /spring-retry-1-2-5-release-sources-jar/org/springframework/retry/backoff/Sleeper.java
* /spring-retry-1-2-5-release-sources-jar/org/springframework/retry/RecoveryCallback.java
* /spring-retry-1-2-5-release-sources-
jar/org/springframework/retry/policy/RetryCacheCapacityExceededException.java
* /spring-retry-1-2-5-release-sources-jar/org/springframework/retry/backoff/BackOffContext.java
* /spring-retry-1-2-5-release-sources-jar/org/springframework/retry/RetryCallback.java
* /spring-retry-1-2-5-release-sources-jar/org/springframework/retry/RetryContext.java
* /spring-retry-1-2-5-release-sources-jar/org/springframework/retry/listener/RetryListenerSupport.java
* /spring-retry-1-2-5-release-sources-jar/org/springframework/retry/support/DefaultRetryState.java
*
 /spring-retry-1-2-5-release-sources-jar/org/springframework/retry/backoff/BackOffPolicy.java
* /spring-retry-1-2-5-release-sources-jar/org/springframework/retry/RetryOperations.java
* /spring-retry-1-2-5-release-sources-jar/org/springframework/retry/RetryPolicy.java
* /spring-retry-1-2-5-release-sources-jar/org/springframework/retry/TerminatedRetryException.java
* /spring-retry-1-2-5-release-sources-jar/org/springframework/retry/backoff/ObjectWaitSleeper.java
* /spring-retry-1-2-5-release-sources-
jar/org/springframework/retry/interceptor/NewMethodArgumentsIdentifier.java
* /spring-retry-1-2-5-release-sources-jar/org/springframework/retry/backoff/SleepingBackOffPolicy.java
* /spring-retry-1-2-5-release-sources-jar/org/springframework/retry/policy/NeverRetryPolicy.java
* /spring-retry-1-2-5-release-sources-jar/org/springframework/retry/support/RetrySimulator.java
* /spring-retry-1-2-5-release-sources-jar/org/springframework/retry/RetryState.java
*
 /spring-retry-1-2-5-release-sources-jar/org/springframework/classify/BackToBackPatternClassifier.java
* /spring-retry-1-2-5-release-sources-jar/org/springframework/retry/policy/CompositeRetryPolicy.java
* /spring-retry-1-2-5-release-sources-jar/org/springframework/classify/ClassifierAdapter.java
* /spring-retry-1-2-5-release-sources-jar/org/springframework/classify/Classifier.java

* /spring-retry-1-2-5-release-sources-jar/org/springframework/retry/backoff/StatelessBackOffPolicy.java
* /spring-retry-1-2-5-release-sources-jar/org/springframework/retry/policy/RetryContextCache.java
* /spring-retry-1-2-5-release-sources-jar/org/springframework/classify/ClassifierSupport.java
* /spring-retry-1-2-5-release-sources-jar/org/springframework/classify/annotation/Classifier.java
* /spring-retry-1-2-5-release-sources-jar/org/springframework/retry/policy/ExceptionClassifierRetryPolicy.java
* /spring-retry-1-2-5-release-sources-jar/org/springframework/retry/support/RetrySimulation.java
* /spring-retry-1-2-5-release-sources-jar/org/springframework/retry/RetryException.java
*
/spring-retry-1-2-5-release-sources-jar/org/springframework/retry/support/RetrySynchronizationManager.java
* /spring-retry-1-2-5-release-sources-jar/org/springframework/classify/PatternMatcher.java
* /spring-retry-1-2-5-release-sources-jar/org/springframework/classify/PatternMatchingClassifier.java
* /spring-retry-1-2-5-release-sources-jar/org/springframework/retry/backoff/BackOffInterruptedException.java
* /spring-retry-1-2-5-release-sources-jar/org/springframework/retry/policy/TimeoutRetryPolicy.java
* /spring-retry-1-2-5-release-sources-
jar/org/springframework/retry/interceptor/MethodArgumentsKeyGenerator.java
* /spring-retry-1-2-5-release-sources-jar/org/springframework/retry/interceptor/MethodInvocationRecoverer.java
* /spring-retry-1-2-5-release-sources-
jar/org/springframework/retry/policy/SoftReferenceMapRetryContextCache.java

1.324 click 8.1.7

1.324.1 Available under license :

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.. _contrib:

==========
click-contrib
==========

As the number of users of Click grows, more and more major feature requests are made. To users it may seem reasonable to include those features with Click; however, many of them are experimental or aren't practical to support generically. Maintainers have to choose what is reasonable to maintain in Click core.

The click-contrib_ GitHub organization exists as a place to collect third-party packages that extend Click's features. It is also meant to ease the effort of searching for such extensions.

Please note that the quality and stability of those packages may be different than Click itself. While published under a common organization, they are still separate from Click and the Pallets maintainers.

.. _click-contrib: https://github.com/click-contrib/

Found in path(s):

* /pallets-click-8-1-7-0-g874ca2b-tar-gz/pallets-click-006ae84/docs/contrib.rst
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Including attribution to #612

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1.325 coreutils 8.30-3

1.325.1 Available under license :

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1.326 flyway-commandline 7.3.1

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1.327 postgresql-jdbc 42.2.14

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1.328 lombok 1.18.12

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1.330 libxcrypt 4.4.10-10ubuntu4

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Protocol Buffers for Go with Gadgets

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http://github.com/gogo/protobuf

Go support for Protocol Buffers - Google's data interchange format

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1.338 slf4j 1.7.30

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1.340 cache-api 1.1.1

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1.341 dash 0.5.11+git20200708+dd9ef66-5

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1.342 jakarta-transaction-api 1.3.3

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* A Base64 encoder/decoder.
*

* <p>
* This class is used to encode and decode data in Base64 format as described in RFC 1521.
*
* <p>
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* /snakeyaml-2-0-sources-jar/org/yaml/snakeyaml/LoaderOptions.java
* /snakeyaml-2-0-sources-jar/org/yaml/snakeyaml/tokens/CommentToken.java
* /snakeyaml-2-0-sources-jar/org/yaml/snakeyaml/extensions/compactnotation/PackageCompactConstructor.java
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 /snakeyaml-2-0-sources-jar/org/yaml/snakeyaml/inspector/TrustedPrefixesTagInspector.java
* /snakeyaml-2-0-sources-jar/org/yaml/snakeyaml/tokens/BlockEndToken.java
* /snakeyaml-2-0-sources-jar/org/yaml/snakeyaml/serializer/SerializerException.java
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* /snakeyaml-2-0-sources-jar/org/yaml/snakeyaml/error/YAMLException.java
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* /snakeyaml-2-0-sources-jar/org/yaml/snakeyaml/events/MappingEndEvent.java
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 /snakeyaml-2-0-sources-jar/org/yaml/snakeyaml/error/MissingEnvironmentVariableException.java
* /snakeyaml-2-0-sources-jar/org/yaml/snakeyaml/constructor/BaseConstructor.java

* /snakeyaml-2-0-sources-jar/org/yaml/snakeyaml/tokens/StreamEndToken.java
* /snakeyaml-2-0-sources-jar/org/yaml/snakeyaml/composer/Composer.java
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* /snakeyaml-2-0-sources-jar/org/yaml/snakeyaml/extensions/compactnotation/CompactConstructor.java
* /snakeyaml-2-0-sources-jar/org/yaml/snakeyaml/comments/CommentType.java
* /snakeyaml-2-0-sources-jar/org/yaml/snakeyaml/introspector/GenericProperty.java

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- javaee_web_services_1_3.xsd
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- web-app_3_0.xsd
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- javaee_web_services_client_1_2.xsd
- javaee_6.xsd
- javaee_web_services_1_3.xsd
- javaee_web_services_client_1_3.xsd
- jsp_2_2.xsd
- web-app_3_0.xsd
- web-common_3_0.xsd
- web-fragment_3_0.xsd
- javaee_7.xsd
- javaee_web_services_1_4.xsd
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- jsp_2_3.xsd
- web-app_3_1.xsd
- web-common_3_1.xsd
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- javaee_6.xsd
- javaee_web_services_1_3.xsd
- javaee_web_services_client_1_3.xsd
- jsp_2_2.xsd
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1.345 jul-to-slf4j 1.7.30

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1.346 txw2 2.3.3

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* /jandex-2-1-3-final-sources-jar/org/jboss/jandex/IndexWriter.java
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* /jandex-2-1-3-final-sources-jar/org/jboss/jandex/ClassType.java
* /jandex-2-1-3-final-sources-jar/org/jboss/jandex/IndexReaderV1.java
* /jandex-2-1-3-final-sources-jar/org/jboss/jandex/Result.java
*
 /jandex-2-1-3-final-sources-jar/org/jboss/jandex/Index.java
* /jandex-2-1-3-final-sources-jar/org/jboss/jandex/MethodParameterInfo.java
* /jandex-2-1-3-final-sources-jar/org/jboss/jandex/UnsupportedVersion.java
* /jandex-2-1-3-final-sources-jar/org/jboss/jandex/AnnotationValue.java
* /jandex-2-1-3-final-sources-jar/org/jboss/jandex/AnnotationTarget.java
* /jandex-2-1-3-final-sources-jar/org/jboss/jandex/PrimitiveType.java
* /jandex-2-1-3-final-sources-jar/org/jboss/jandex/Main.java
* /jandex-2-1-3-final-sources-jar/org/jboss/jandex/PackedDataInputStream.java
* /jandex-2-1-3-final-sources-jar/org/jboss/jandex/AnnotationInstance.java
* /jandex-2-1-3-final-sources-jar/org/jboss/jandex/IndexReader.java
* /jandex-2-1-3-final-sources-jar/org/jboss/jandex/Type.java
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```

Found in path(s):

```
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* /jandex-2-1-3-final-sources-jar/org/jboss/jandex/Utils.java
* /jandex-2-1-3-final-sources-jar/org/jboss/jandex/FieldInfoGenerator.java
*
 /jandex-2-1-3-final-sources-jar/org/jboss/jandex/MethodInfoGenerator.java
* /jandex-2-1-3-final-sources-jar/org/jboss/jandex/ThrowsTypeTarget.java
* /jandex-2-1-3-final-sources-jar/org/jboss/jandex/TypeParameterBoundTypeTarget.java
* /jandex-2-1-3-final-sources-jar/org/jboss/jandex/EmptyTypeTarget.java
* /jandex-2-1-3-final-sources-jar/org/jboss/jandex/PositionBasedTypeTarget.java
* /jandex-2-1-3-final-sources-jar/org/jboss/jandex/TypeTarget.java
* /jandex-2-1-3-final-sources-jar/org/jboss/jandex/AnnotationTargetFilterCollection.java
* /jandex-2-1-3-final-sources-jar/org/jboss/jandex/IndexWriterImpl.java
* /jandex-2-1-3-final-sources-jar/org/jboss/jandex/TypeParameterTypeTarget.java
* /jandex-2-1-3-final-sources-jar/org/jboss/jandex/VoidType.java
* /jandex-2-1-3-final-sources-jar/org/jboss/jandex/IndexReaderImpl.java
* /jandex-2-1-3-final-sources-jar/org/jboss/jandex/ArrayType.java
* /jandex-2-1-3-final-sources-jar/org/jboss/jandex/IndexWriterV2.java
* /jandex-2-1-3-final-sources-jar/org/jboss/jandex/ClassExtendsTypeTarget.java
*
 /jandex-2-1-3-final-sources-jar/org/jboss/jandex/MethodParameterTypeTarget.java
* /jandex-2-1-3-final-sources-jar/org/jboss/jandex/MethodInternal.java
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* /jandex-2-1-3-final-sources-jar/org/jboss/jandex/IndexReaderV2.java
```

1.348 jaxb-core 2.3.3

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procfs provides functions to retrieve system, kernel and process
metrics from the pseudo-filesystem proc.

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 /gson-2-8-6-sources-1-jar/com/google/gson/internal/Excluder.java
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 /javassist-3-24-0-ga-sources-5-jar/javassist/bytecode/annotation/ArrayMemberValue.java
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1.354 spring-webflux 5.2.24.RELEASE

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1.358 spring-security-config 5.4.11

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jar/org/springframework/beans/factory/support/SimpleInstantiationStrategy.java
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jar/org/springframework/beans/factory/annotation/AnnotationBeanWiringInfoResolver.java
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jar/org/springframework/beans/factory/support/SimpleSecurityContextProvider.java
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jar/org/springframework/beans/factory/annotation/RequiredAnnotationBeanPostProcessor.java
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* /spring-beans-5-2-24-release-sources-jar/org/springframework/beans/factory/config/BeanDefinition.java
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* /jakarta-validation-api-2-0-2-sources-3-jar/META-INF/maven/jakarta.validation/jakarta.validation-api/pom.xml
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Found in path(s):
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/Validator.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/metadata/CascadableDescriptor.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/ConstraintTarget.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/constraints/FutureOrPresent.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/constraints/Null.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/ConstraintValidatorContext.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/metadata/ExecutableDescriptor.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/groups/Default.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/MessageInterpolator.java
*
 /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/metadata/package-info.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/valueextraction/Unwrapping.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/valueextraction/ValueExtractor.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/constraintvalidation/ValidationTarget.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/metadata/MethodDescriptor.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/package-info.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/UnexpectedTypeException.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/metadata/BeanDescriptor.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/constraints/Digits.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/bootstrap/ProviderSpecificBootstrap.java
*
 /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/valueextraction/UnwrapByDefault.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/constraints/NegativeOrZero.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/ConstraintViolation.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/ConstraintDefinitionException.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/metadata/ValidateUnwrappedValue.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/constraintvalidation/SupportedValidationTarget.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/groups/package-info.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/spi/ValidationProvider.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/ElementKind.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/metadata/GroupConversionDescriptor.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/valueextraction/ExtractedValue.java
*
 /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/bootstrap/GenericBootstrap.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/metadata/MethodType.java

* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/valueextraction/ValueExtractorDeclarationException.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/metadata/ConstructorDescriptor.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/constraintvalidation/package-info.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/constraints/AssertTrue.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/Path.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/executable/package-info.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/valueextraction/package-info.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/constraints/PositiveOrZero.java
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 /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/valueextraction/ValueExtractorDefinitionException.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/BootstrapConfiguration.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/metadata/ElementDescriptor.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/metadata/ContainerElementTypeDescriptor.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/GroupDefinitionException.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/constraints/Min.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/groups/ConvertGroup.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/metadata/Scope.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/constraints/Max.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/ReportAsSingleViolation.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/metadata/ReturnValueDescriptor.java
*
 /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/ParameterNameProvider.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/constraints/Pattern.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/NoProviderFoundException.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/Validation.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/ValidatorContext.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/constraints/NotBlank.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/spi/package-info.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/Constraint.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/Valid.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/metadata/CrossParameterDescriptor.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/ClockProvider.java
*
 /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/Configuration.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/executable/ValidateOnExecution.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/constraints/Size.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/constraints/PastOrPresent.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/ConstraintViolationException.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/bootstrap/package-info.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/TraversableResolver.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/executable/ExecutableValidator.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/ValidationProviderResolver.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/ValidatorFactory.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/metadata/ContainerDescriptor.java
*

/jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/metadata/ConstraintDescriptor.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/metadata/ParameterDescriptor.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/constraints/NotNull.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/constraints/package-info.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/GroupSequence.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/constraints/Negative.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/ConstraintValidatorFactory.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/ValidationException.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/OverridesAttribute.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/spi/BootstrapState.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/constraints/Email.java
*
/jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/ConstraintDeclarationException.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/metadata/PropertyDescriptor.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/ConstraintValidator.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/executable/ExecutableType.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/constraints/AssertFalse.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/constraints/Future.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/constraints/DecimalMax.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/constraints/Positive.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/constraints/NotEmpty.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/spi/ConfigurationState.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/Payload.java
*
/jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/constraints/DecimalMin.java
* /jakarta-validation-api-2-0-2-sources-3-jar/javax/validation/constraints/Past.java

1.363 log4j-to-slf4j 2.13.3

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1.364 systemd 245.4-4ubuntu3.22

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gunicorn.logging_config

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util/unlink.py
---

backport frop python3 Lib/test/support.py

1.367 jakarta-mail 1.6.5

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* /springdoc-openapi-common-1-5-9-sources-jar/org/springdoc/core/OpenAPIService.java
```

* /springdoc-openapi-common-1-5-9-sources-jar/org/springdoc/core/SwaggerUiOAuthProperties.java
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* /springdoc-openapi-common-1-5-9-sources-jar/org/springdoc/core/OperationService.java
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* /springdoc-openapi-common-1-5-9-sources-jar/org/springdoc/core/MethodAttributes.java
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* /springdoc-openapi-common-1-5-9-sources-jar/org/springdoc/ui/AbstractSwaggerIndexTransformer.java
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* /springdoc-openapi-common-1-5-9-sources-jar/org/springdoc/core/converters/PolymorphicModelConverter.java
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* /springdoc-openapi-common-1-5-9-sources-jar/org/springdoc/core/fn/builders/externaldocumentation/Builder.java
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* /springdoc-openapi-common-1-5-9-sources-jar/org/springdoc/core/fn/builders/operation/Builder.java

1.370 jctools-core 3.0.0

1.370.1 Available under license :

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<scm>
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</scm>

<developers>
 <developer>
  <url>https://github.com/nitsanw</url>
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  <url>https://github.com/mjpt777</url>
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 <developer>
  <url>https://github.com/RichardWarburton</url>
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 <junit.version>4.12</junit.version>
 <guava-testlib.version>21.0</guava-testlib.version>
</properties>
</project>

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* /jctools-core-3-0-0-sources-jar/META-INF/maven/org.jctools/jctools-core/pom.xml
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* /jctools-core-3-0-0-sources-jar/org/jctools/queues/MessagePassingQueueUtil.java
* /jctools-core-3-0-0-sources-jar/org/jctools/util/UnsafeJvmInfo.java
* /jctools-core-3-0-0-sources-jar/org/jctools/queues/atomic/MpscAtomicArrayQueue.java
* /jctools-core-3-0-0-sources-jar/org/jctools/queues/atomic/MpscLinkedAtomicQueue.java
* /jctools-core-3-0-0-sources-jar/org/jctools/queues/atomic/MpmcAtomicArrayQueue.java
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* /jctools-core-3-0-0-sources-jar/org/jctools/queues/SpscArrayQueue.java
* /jctools-core-3-0-0-sources-jar/org/jctools/maps/ConcurrentAutoTable.java
* /jctools-core-3-0-0-sources-jar/org/jctools/maps/NonBlockingIdentityHashMap.java
* /jctools-core-3-0-0-sources-jar/org/jctools/queues/MpscGrowableArrayQueue.java
* /jctools-core-3-0-0-sources-jar/org/jctools/util/Pow2.java
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* /jctools-core-3-0-0-sources-jar/org/jctools/queues/BaseLinkedQueue.java
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1.371 spring-security-core 5.4.11

1.371.1 Available under license :

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1.372 spring-expression 5.2.24.RELEASE

1.372.1 Available under license :

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* /spring-expression-5-2-24-release-sources-jar/org/springframework/expression/spel/ast/VariableReference.java
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* /spring-expression-5-2-24-release-sources-jar/org/springframework/expression/spel/standard/SpelCompiler.java
* /spring-expression-5-2-24-release-sources-jar/org/springframework/expression/spel/ast/MethodReference.java
*
/spring-expression-5-2-24-release-sources-
jar/org/springframework/expression/spel/support/ReflectivePropertyAccessor.java
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* /spring-expression-5-2-24-release-sources-jar/org/springframework/expression/spel/ast/ValueRef.java
*
 /spring-expression-5-2-24-release-sources-jar/org/springframework/expression/spel/ast/QualifiedIdentifier.java
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jar/org/springframework/expression/spel/support/ReflectiveConstructorResolver.java
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 /spring-expression-5-2-24-release-sources-jar/org/springframework/expression/spel/ast/Elvis.java
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 /spring-expression-5-2-24-release-sources-jar/org/springframework/expression/spel/ast/OpOr.java
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jar/org/springframework/expression/spel/support/StandardTypeComparator.java
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jar/org/springframework/expression/spel/support/ReflectiveConstructorExecutor.java
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* /spring-expression-5-2-24-release-sources-jar/org/springframework/expression/spel/SpelNode.java
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* /spring-expression-5-2-24-release-sources-jar/org/springframework/expression/spel/support/ReflectiveMethodExecutor.java
* /spring-expression-5-2-24-release-sources-jar/org/springframework/expression/common/LiteralExpression.java
* /spring-expression-5-2-24-release-sources-jar/org/springframework/expression/ExpressionException.java
* /spring-expression-5-2-24-release-sources-jar/org/springframework/expression/common/CompositeStringExpression.java
* /spring-expression-5-2-24-release-sources-jar/org/springframework/expression/spel/support/DataBindingPropertyAccessor.java
* /spring-expression-5-2-24-release-sources-jar/org/springframework/expression/Operation.java

* /spring-expression-5-2-24-release-sources-jar/org/springframework/expression/spel/CodeFlow.java
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1.377 python-setuptools 58.1.0

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1.378 spring-jcl 5.2.24.RELEASE

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* /swagger-annotations-2-1-9-sources-jar/io/swagger/v3/oas/annotations/security/SecuritySchemes.java
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* /swagger-annotations-2-1-9-sources-jar/io/swagger/v3/oas/annotations/responses/ApiResponse.java
* /swagger-annotations-2-1-9-sources-jar/io/swagger/v3/oas/annotations/media/Encoding.java
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* /swagger-annotations-2-1-9-sources-jar/io/swagger/v3/oas/annotations/security/OAuthFlow.java
* /swagger-annotations-2-1-9-sources-jar/io/swagger/v3/oas/annotations/servers/Server.java
*
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* /swagger-annotations-2-1-9-sources-jar/io/swagger/v3/oas/annotations/callbacks/Callbacks.java
* /swagger-annotations-2-1-9-sources-jar/io/swagger/v3/oas/annotations/security/SecurityRequirements.java
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* /swagger-annotations-2-1-9-sources-jar/io/swagger/v3/oas/annotations/info/Info.java
* /swagger-annotations-2-1-9-sources-jar/io/swagger/v3/oas/annotations/Operation.java
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*
 /swagger-annotations-2-1-9-sources-jar/io/swagger/v3/oas/annotations/responses/ApiResponses.java
* /swagger-annotations-2-1-9-sources-jar/io/swagger/v3/oas/annotations/info/Contact.java
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* /swagger-annotations-2-1-9-sources-jar/io/swagger/v3/oas/annotations/extensions/Extensions.java
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1.380 aspect-j 1.9.6

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1.382 gnutls 3.4

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1.383 flyway-core 7.3.1

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* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/database/postgresql/PostgreSQLTable.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/configuration/package-info.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/license/VersionPrinter.java

* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/command/DbRepair.java
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* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/database/db2/DB2Connection.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/database/postgresql/PostgreSQLConnection.java
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* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/logging/apachecommons/package-info.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/database/derby/DerbyParser.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/api/output/ErrorOutput.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/scanner/classpath/JarUtils.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/api/android/ContextHolder.java
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* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/authentication/postgres/PgpassFileReader.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/database/sqlite/SQLiteDatabase.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/api/migration/Context.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/resolver/ResolvedMigrationImpl.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/logging/javautil/JavaUtilLog.java
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 /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/resolver/package-info.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/resource/s3/AwsS3Resource.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/util/CloseableIterator.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/exception/FlywayDbUpgradeRequiredException.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/database/h2/package-info.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/database/cockroachdb/package-info.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/database/mysql/MySQLParser.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/database/h2/H2DatabaseType.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/database/derby/DerbyDatabase.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/database/sybasease/package-info.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/api/configuration/Configuration.java
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 /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/util/AsciiTable.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/jdbc/ExecutionTemplateFactory.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/resolver/sql/package-info.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/util/SqlCallable.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/database/hsqldb/HSQLDBParser.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/database/postgresql/PostgreSQLDatabaseType.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/api/output/RepairOutput.java
* /flyway-core-7-3-1-sources-
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* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/database/db2/DB2Type.java

* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/api/resolver/package-info.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/sqlscript/SqlScriptMetadata.java
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* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/api/MigrationPattern.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/info/package-info.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/database/mysql/MySQLTable.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/database/saphana/SAPHANADatabase.java
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* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/resource/classpath/ClassPathResource.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/resource/classpath/package-info.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/scanner/package-info.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/api/FlywayException.java
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* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/api/output/RepairResult.java
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* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/logging/android/AndroidLogCreator.java
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* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/api/exception/FlywayValidateException.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/jdbc/StatementInterceptor.java
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 /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/database/redshift/RedshiftSchema.java
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* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/sqlscript/ParserSqlScript.java
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* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/api/callback/Statement.java
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* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/logging/LogCreatorFactory.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/api/migration/package-info.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/logging/slf4j/package-info.java
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* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/parser/ParserContext.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/api/logging/package-info.java
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* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/database/sqlserver/SQLServerSchema.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/database/derby/DerbyTable.java
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* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/database/oracle/package-info.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/database/sqlserver/SQLServerConnection.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/database/redshift/RedshiftParser.java
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* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/resource/gcs/package-info.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/parser/PositionTracker.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/jdbc/PlainExecutionTemplate.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/resolver/CompositeMigrationResolver.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/scanner/classpath/jboss/JBossVFSv2UrlResolver.java
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 /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/parser/Statement.java
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* /flyway-core-7-3-1-sources-
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* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/database/db2/DB2Parser.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/database/firebird/FirebirdTable.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/scanner/classpath/ResourceAndClassScanner.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/database/oracle/OracleConnection.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/database/DefaultExecutionStrategy.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/resource/LoadableResource.java
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 /flyway-core-7-3-1-sources-jar/org/flywaydb/core/api/MigrationType.java
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* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/util/ClassUtils.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/logging/apachecommons/ApacheCommonsLog.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/api/package-info.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/database/h2/H2Table.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/api/callback/package-info.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/license/FlywayTeamsUpgradeMessage.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/api/ErrorDetails.java

* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/database/firebird/FirebirdDatabase.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/database/db2/DB2DatabaseType.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/database/sqlserver/synapse/SynapseDatabase.java
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 /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/database/postgresql/PostgreSQLType.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/package-info.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/database/base/Function.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/resource/ResourceType.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/parser/TokenType.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/util/AbbreviationUtils.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/api/ErrorCode.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/database/hsqldb/HSQLDBTable.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/jdbc/JdbcConnectionFactory.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/database/base/Connection.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/database/sqlserver/SQLServerDatabaseType.java
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 /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/database/firebird/FirebirdConnection.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/api/callback/Event.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/api/executor/package-info.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/sqlscript/ParsedSqlStatement.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/database/sqlserver/SQLServerDatabase.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/sqlscript/Delimiter.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/database/base/TestContainersDatabaseType.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/util/ExceptionUtils.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/database/saphana/SAPHANAConnection.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/parser/RecordingReader.java
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 /flyway-core-7-3-1-sources-
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* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/util/IOUtils.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/util/UrlUtils.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/database/hsqldb/HSQLDBSchema.java
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* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/resource/android/AndroidResource.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/parser/PeekingReader.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/resolver/ChecksumCalculator.java
* /flyway-core-7-3-1-sources-
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 /flyway-core-7-3-1-sources-jar/org/flywaydb/core/api/output/InfoOutput.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/database/cockroachdb/CockroachDBParser.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/api/callback/Error.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/resource/Resource.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/resource/gcs/GCSResource.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/scanner/classpath/OsgiClassPathLocationScanner.java
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* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/database/postgresql/PostgreSQLSchema.java
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* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/util/StopWatch.java
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* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/database/sqlite/SQLiteSchema.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/api/executor/Context.java
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* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/command/DbClean.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/database/snowflake/SnowflakeSchema.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/resolver/java/package-info.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/database/h2/H2Connection.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/database/postgresql/package-info.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/package-info.java

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* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/logging/package-info.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/api/MigrationState.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/database/DatabaseExecutionStrategy.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/jdbc/DriverDataSource.java
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* /flyway-core-7-3-1-sources-
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* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/database/mysql/mariadb/MariaDBDatabaseType.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/configuration/ConfigurationValidator.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/license/Edition.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/database/cockroachdb/CockroachDBDatabase.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/license/package-info.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/database/sqlite/package-info.java
* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/callback/package-info.java
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/flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/database/firebird/FirebirdParser.java
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* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/database/h2/H2Schema.java
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* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/api/callback/Callback.java
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* /flyway-core-7-3-1-sources-jar/org/flywaydb/core/internal/parser/UnboundedReadAheadReader.java

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1.384 jakarta-persistence-api 2.2.3

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1.385 antlr 2.7.7

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1.386 kubernetes-client 1.8.11

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Protocol Buffers for Go with Gadgets

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1.387 jackson 2.11.2

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1.389 spring-web-mvc 5.2.24.RELEASE

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* /spring-webmvc-5-2-24-release-sources-jar/org/springframework/web/servlet/theme/ThemeChangeInterceptor.java
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*/
/**
* A contract for inspecting and potentially modifying request data values such
* as URL query parameters or form field values before they are rendered by a
* view or before a redirect.
*
* <p>Implementations may use this contract for example as part of a solution
* to provide data integrity, confidentiality,
 protection against cross-site
* request forgery (CSRF), and others or for other tasks such as automatically
* adding a hidden field to all forms and URLs.
*
```

```
* <p>View technologies that support this contract can obtain an instance to
* delegate to via {@link RequestContext#getRequestDataValueProcessor()}.
*
* @author Rossen Stoyanchev
* @since 3.1
*/
```

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* /spring-webmvc-5-2-24-release-sources-jar/org/springframework/web/servlet/config/FreeMarkerConfigurerBeanDefinitionParser.java
* /spring-webmvc-5-2-24-release-sources-jar/org/springframework/web/servlet/i18n/AcceptHeaderLocaleResolver.java
*
/spring-webmvc-5-2-24-release-sources-jar/org/springframework/web/servlet/mvc/method/annotation/RequestBodyAdvice.java
* /spring-webmvc-5-2-24-release-sources-jar/org/springframework/web/servlet/mvc/method/annotation/RequestMappingHandlerMapping.java
* /spring-webmvc-5-2-24-release-sources-jar/org/springframework/web/servlet/function/RequestPredicate.java
* /spring-webmvc-5-2-24-release-sources-jar/org/springframework/web/servlet/mvc/method/annotation/ReactiveTypeHandler.java
* /spring-webmvc-5-2-24-release-sources-jar/org/springframework/web/servlet/handler/AbstractHandlerExceptionResolver.java
* /spring-webmvc-5-2-24-release-sources-jar/org/springframework/web/servlet/resource/ResourceUrlProvider.java
* /spring-webmvc-5-2-24-release-sources-jar/org/springframework/web/servlet/handler/MatchableHandlerMapping.java
* /spring-webmvc-5-2-24-release-sources-jar/org/springframework/web/servlet/mvc/support/DefaultHandlerExceptionResolver.java
*
/spring-webmvc-5-2-24-release-sources-jar/org/springframework/web/servlet/handler/AbstractHandlerMethodMapping.java
* /spring-webmvc-5-2-24-release-sources-jar/org/springframework/web/servlet/function/PathResourceLookupFunction.java
* /spring-webmvc-5-2-24-release-sources-jar/org/springframework/web/servlet/mvc/method/annotation/MvcUriComponentsBuilder.java
* /spring-webmvc-5-2-24-release-sources-jar/org/springframework/web/servlet/mvc/method/RequestMappingInfoHandlerMapping.java
* /spring-webmvc-5-2-24-release-sources-jar/org/springframework/web/servlet/mvc/method/annotation/RequestBodyAdviceAdapter.java
* /spring-webmvc-5-2-24-release-sources-jar/org/springframework/web/servlet/FrameworkServlet.java
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* /spring-webmvc-5-2-24-release-sources-jar/org/springframework/web/servlet/view/ViewResolverComposite.java
* /spring-webmvc-5-2-24-release-sources-jar/org/springframework/web/servlet/mvc/Controller.java
* /spring-webmvc-5-2-24-release-sources-jar/org/springframework/web/servlet/mvc/method/annotation/StreamingResponseBody.java
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* /spring-webmvc-5-2-24-release-sources-jar/org/springframework/web/servlet/config/InterceptorsBeanDefinitionParser.java
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* /spring-webmvc-5-2-24-release-sources-jar/org/springframework/web/servlet/resource/ResourceTransformer.java
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* /spring-webmvc-5-2-24-release-sources-jar/org/springframework/web/servlet/function/DefaultRenderingResponseBuilder.java
* /spring-webmvc-5-2-24-release-sources-jar/org/springframework/web/servlet/function/ToStringVisitor.java
* /spring-webmvc-5-2-24-release-sources-jar/org/springframework/web/servlet/mvc/WebContentInterceptor.java
* /spring-webmvc-5-2-24-release-sources-jar/org/springframework/web/servlet/function/RenderingResponse.java
* /spring-webmvc-5-2-24-release-sources-jar/org/springframework/web/servlet/mvc/ServletWrappingController.java
* /spring-webmvc-5-2-24-release-sources-jar/org/springframework/web/servlet/DispatcherServlet.java
* /spring-webmvc-5-2-24-release-sources-jar/org/springframework/web/servlet/view/DefaultRequestToViewNameTranslator.java
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* /spring-webmvc-5-2-24-release-sources-jar/org/springframework/web/servlet/resource/ResourceUrlProviderExposingInterceptor.java
* /spring-webmvc-5-2-24-release-sources-jar/org/springframework/web/servlet/i18n/LocaleChangeInterceptor.java
* /spring-webmvc-5-2-24-release-sources-jar/org/springframework/web/servlet/resource/VersionResourceResolver.java
* /spring-webmvc-5-2-24-release-sources-jar/org/springframework/web/servlet/handler/AbstractUrlHandlerMapping.java
* /spring-webmvc-5-2-24-release-sources-jar/org/springframework/web/servlet/config/annotation/DelegatingWebMvcConfiguration.java
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* /spring-webmvc-5-2-24-release-sources-jar/org/springframework/web/servlet/mvc/method/annotation/SessionAttributeMethodArgumentResolver.java
* /spring-webmvc-5-2-24-release-sources-jar/org/springframework/web/servlet/resource/WebJarsResourceResolver.java
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* /spring-webmvc-5-2-24-release-sources-jar/org/springframework/web/servlet/view/UrlBasedViewResolver.java
* /spring-webmvc-5-2-24-release-sources-
jar/org/springframework/web/servlet/mvc/method/annotation/ServletInvocableHandlerMethod.java
* /spring-webmvc-5-2-24-release-sources-
jar/org/springframework/web/servlet/view/AbstractCachingViewResolver.java
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/spring-webmvc-5-2-24-release-sources-jar/org/springframework/web/servlet/config/MvcNamespaceUtils.java
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* /spring-webmvc-5-2-24-release-sources-
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jar/org/springframework/web/servlet/config/annotation/DefaultServletHandlerConfigurer.java

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/**
* XSLT-driven View that allows for response context to be rendered as the
* result of an XSLT transformation.
*
* <p>The XSLT Source object is supplied as a parameter in the model and then
* {@link #locateSource detected} during response rendering. Users can either specify
* a specific entry in the
 model via the {@link #setSourceKey sourceKey} property or
* have Spring locate the Source object. This class also provides basic conversion
* of objects into Source implementations. See {@link #getSourceTypes() here}
* for more details.
*
* <p>All model parameters are passed to the XSLT Transformer as parameters.
* In addition the user can configure {@link #setOutputProperties output properties}
* to be passed to the Transformer.
*
* @author Rob Harrop
* @author Juergen Hoeller
* @since 2.0
*/
```

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* /spring-webmvc-5-2-24-release-sources-jar/org/springframework/web/servlet/view/document/AbstractPdfStamperView.java
* /spring-webmvc-5-2-24-release-sources-jar/org/springframework/web/servlet/ViewResolver.java
* /spring-webmvc-5-2-24-release-sources-jar/org/springframework/web/servlet/mvc/method/annotation/MatrixVariableMethodArgumentResolver.java
* /spring-webmvc-5-2-24-release-sources-jar/org/springframework/web/servlet/tags/form/AbstractHtmlInputElementTag.java
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* /spring-webmvc-5-2-24-release-sources-jar/org/springframework/web/servlet/tags/form/SelectTag.java
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jar/org/springframework/web/servlet/config/GroovyMarkupConfigurerBeanDefinitionParser.java
* /spring-webmvc-5-2-24-release-sources-
jar/org/springframework/web/servlet/mvc/method/annotation/ResponseBodyAdvice.java
* /spring-webmvc-5-2-24-release-sources-
jar/org/springframework/web/servlet/mvc/method/annotation/MatrixVariableMapMethodArgumentResolver.java

1.390 apscheduler 3.10.1

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Java ClassMate library was originally written by Tatu Saloranta (tatu.saloranta@iki.fi)

Other developers who have contributed code are:

* Brian Langel

1.392 keyutils 1.6.1-2

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-- vile: txtmode file-encoding=utf-8

1.400 jakarta-annotation-api 1.3.5

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* https://github.com/eclipse-ee4j/common-annotations-api

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1.401 python-requests 2.22.0

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1.410 nio-stream-storage 1.1.3

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* /nio-stream-storage-1-1-3-sources-jar/org/synchronoss/cloud/nio/stream/storage/StreamStorageFactory.java
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jar/org/synchronoss/cloud/nio/stream/storage/DeferredFileStreamStorageFactory.java
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1.411 runc v1.0.0-rc9

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1.412 servlet-api 4.0.0

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* /servlet-api-4-0-0-sources-6-jar/org/xipki/http/servlet/ServletURI.java
* /servlet-api-4-0-0-sources-6-jar/org/xipki/http/servlet/ServletURIPool.java
* /servlet-api-4-0-0-sources-6-jar/org/xipki/http/servlet/HttpServlet.java
*
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* /servlet-api-4-0-0-sources-6-jar/org/xipki/http/servlet/TlsHelper.java
* /servlet-api-4-0-0-sources-6-jar/org/xipki/http/servlet/SimpleLruCache.java
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```

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*
/reactive-streams-1-0-3-sources-3-jar/org/reactivestreams/Subscription.java
* /reactive-streams-1-0-3-sources-3-jar/org/reactivestreams/Subscriber.java

1.414 kubernetes-apimachinery 1.8.11

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Protocol Buffers for Go with Gadgets

Go support for Protocol Buffers - Google's data interchange format

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1.416 jackson-databind 2.11.2

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Jackson JSON processor

Jackson is a high-performance, Free/Open Source JSON processing library.
It was originally written by Tatu Saloranta (tatu.saloranta@iki.fi), and has
been in development since 2007.
It is currently developed by a community of developers, as well as supported
commercially by FasterXML.com.

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Credits

A list of contributors may be found from CREDITS file, which is included
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from the source code management (SCM) system project uses.

1.417 junixsocket-common 2.3.2

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* junixsocket
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*/

Found in path(s):
* /junixsocket-common-2-3-2-sources-jar/org/newsclub/net/unix/AFUNIXSocket.java
* /junixsocket-common-2-3-2-sources-jar/org/newsclub/net/unix/Closeables.java
* /junixsocket-common-2-3-2-sources-jar/org/newsclub/net/unix/SuppressFBWarnings.java
* /junixsocket-common-2-3-2-sources-jar/org/newsclub/net/unix/NativeUnixSocket.java
*
 /junixsocket-common-2-3-2-sources-jar/org/newsclub/net/unix/AFUNIXSocketImpl.java
* /junixsocket-common-2-3-2-sources-jar/org/newsclub/net/unix/AFUNIXSocketCapability.java
* /junixsocket-common-2-3-2-sources-jar/org/newsclub/net/unix/AFUNIXSocketFactory.java
* /junixsocket-common-2-3-2-sources-jar/org/newsclub/net/unix/AFUNIXServerSocket.java
* /junixsocket-common-2-3-2-sources-jar/org/newsclub/net/unix/NativeLibraryLoader.java
* /junixsocket-common-2-3-2-sources-jar/org/newsclub/net/unix/AFUNIXSocketAddress.java
* /junixsocket-common-2-3-2-sources-jar/org/newsclub/net/unix/AFUNIXSocketCredentials.java

1.418 ehcache 3.8.1

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Found in path(s):
* /ehcache-3-8-1-sources-jar/org/ehcache/impl/internal/classes/commonslang/reflect/MethodUtils.java
* /ehcache-3-8-1-sources-jar/org/ehcache/impl/internal/classes/commonslang/ArrayUtils.java
*
 /ehcache-3-8-1-sources-jar/org/ehcache/impl/internal/classes/commonslang/ClassUtils.java
* /ehcache-3-8-1-sources-jar/org/ehcache/impl/internal/classes/commonslang/reflect/MemberUtils.java
* /ehcache-3-8-1-sources-jar/org/ehcache/impl/internal/classes/commonslang/reflect/ConstructorUtils.java
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*/
```

Found in path(s):

```
* /ehcache-3-8-1-sources-jar/org/ehcache/config/FluentConfigurationBuilder.java
* /ehcache-3-8-1-sources-jar/org/ehcache/core/spi/time/TimeSource.java
* /ehcache-3-8-1-sources-jar/org/ehcache/impl/copy/IdentityCopier.java
* /ehcache-3-8-1-sources-jar/org/ehcache/impl/persistence/DefaultLocalPersistenceService.java
*
 /ehcache-3-8-1-sources-jar/org/ehcache/impl/internal/events/FudgingInvocationScopedEventSink.java
* /ehcache-3-8-1-sources-jar/org/ehcache/core/spi/store/WrapperStore.java
* /ehcache-3-8-1-sources-jar/org/ehcache/impl/serialization/ByteArraySerializer.java
* /ehcache-3-8-1-sources-jar/org/ehcache/impl/internal/store/heap/Backend.java
* /ehcache-3-8-1-sources-jar/org/ehcache/config/builders/UserManagedCacheConfiguration.java
* /ehcache-3-8-1-sources-jar/org/ehcache/impl/config/loaderwriter/writebehind/package-info.java
* /ehcache-3-8-1-sources-jar/org/ehcache/xml/service/DefaultSerializerConfigurationParser.java
* /ehcache-3-8-1-sources-jar/org/ehcache/config/builders/CacheManagerBuilder.java
* /ehcache-3-8-1-sources-jar/org/ehcache/impl/internal/resilience/RobustLoaderWriterResilienceStrategy.java
* /ehcache-3-8-1-sources-jar/org/ehcache/event/EventType.java
* /ehcache-3-8-1-sources-jar/org/ehcache/UserManagedCache.java
* /ehcache-3-8-1-sources-jar/org/ehcache/impl/internal/classes/ClassInstanceConfiguration.java
*
 /ehcache-3-8-1-sources-jar/org/ehcache/impl/persistence/FileUtils.java
* /ehcache-3-8-1-sources-jar/org/ehcache/core/events/CacheEvents.java
* /ehcache-3-8-1-sources-jar/org/ehcache/impl/config/persistence/UserManagedPersistenceContext.java
* /ehcache-3-8-1-sources-jar/org/ehcache/core/spi/store/events/package-info.java
* /ehcache-3-8-1-sources-jar/org/ehcache/core/statistics/DelegatingOperationStatistic.java
* /ehcache-3-8-1-sources-jar/org/ehcache/jsr107/DefaultConfigurationResolver.java
* /ehcache-3-8-1-sources-jar/org/ehcache/core/CacheConfigurationChangeEvent.java
* /ehcache-3-8-1-sources-jar/org/ehcache/config/Eviction.java
* /ehcache-3-8-1-sources-jar/org/ehcache/core/spi/store/AbstractValueHolder.java
* /ehcache-3-8-1-sources-jar/org/ehcache/event/EventOrdering.java
* /ehcache-3-8-1-sources-jar/org/ehcache/impl/internal/sizeof/listeners/exceptions/VisitorListenerException.java
* /ehcache-3-8-1-sources-jar/org/ehcache/impl/internal/loaderwriter/writebehind/operations/SingleOperation.java
*
```

/ehcache-3-8-1-sources-jar/org/ehcache/jsr107/config/Jsr107Configuration.java
* /ehcache-3-8-1-sources-jar/org/ehcache/impl/internal/events/CacheEventDispatcherFactoryImpl.java
* /ehcache-3-8-1-sources-jar/org/ehcache/jsr107/config/ConfigurationElementState.java
* /ehcache-3-8-1-sources-jar/org/ehcache/expiry/Duration.java
* /ehcache-3-8-1-sources-jar/org/ehcache/StateTransitionException.java
* /ehcache-3-8-1-sources-jar/org/ehcache/core/spi/LifeCycledAdapter.java
* /ehcache-3-8-1-sources-jar/org/ehcache/config/builders/PooledExecutionServiceConfigurationBuilder.java
* /ehcache-3-8-1-sources-
jar/org/ehcache/impl/internal/events/CacheEventNotificationListenerServiceProviderFactory.java
* /ehcache-3-8-1-sources-jar/org/ehcache/impl/config/serializer/DefaultSerializationProviderConfiguration.java
* /ehcache-3-8-1-sources-jar/org/ehcache/impl/config/AbstractResourcePool.java
* /ehcache-3-8-1-sources-jar/org/ehcache/spi/resilience/StoreAccessException.java
*
/ehcache-3-8-1-sources-jar/org/ehcache/core/exceptions/ExceptionFactory.java
* /ehcache-3-8-1-sources-jar/org/ehcache/core/statistics/package-info.java
* /ehcache-3-8-1-sources-jar/org/ehcache/xml/model/CacheTemplate.java
* /ehcache-3-8-1-sources-jar/org/ehcache/core/spi/service/LocalPersistenceService.java
* /ehcache-3-8-1-sources-jar/org/ehcache/impl/internal/loaderwriter/writebehind/operations/WriteAllOperation.java
* /ehcache-3-8-1-sources-jar/org/ehcache/core/spi/time/TimeSourceService.java
* /ehcache-3-8-1-sources-jar/org/ehcache/core/statistics/BulkOps.java
* /ehcache-3-8-1-sources-jar/org/ehcache/impl/internal/events/ThreadLocalStoreEventDispatcher.java
* /ehcache-3-8-1-sources-jar/org/ehcache/impl/config/executor/PooledExecutionServiceConfiguration.java
* /ehcache-3-8-1-sources-jar/org/ehcache/impl/copy/ReadWriteCopier.java
* /ehcache-3-8-1-sources-jar/org/ehcache/spi/serialization/package-info.java
* /ehcache-3-8-1-sources-jar/org/ehcache/xml/model/SizeOfEngineLimits.java
*
/ehcache-3-8-1-sources-jar/org/ehcache/core/collections/ConcurrentWeakIdentityHashMap.java
* /ehcache-3-8-1-sources-jar/org/ehcache/impl/serialization/DoubleSerializer.java
* /ehcache-3-8-1-sources-jar/org/ehcache/core/spi/store/events/StoreEventSource.java
* /ehcache-3-8-1-sources-jar/org/ehcache/core/events/CacheEventListenerConfiguration.java
* /ehcache-3-8-1-sources-jar/org/ehcache/impl/internal/classes/ClassInstanceProvider.java
* /ehcache-3-8-1-sources-jar/org/ehcache/jsr107/Eh107CacheManager.java
* /ehcache-3-8-1-sources-jar/org/ehcache/CacheIterationException.java
* /ehcache-3-8-1-sources-jar/org/ehcache/core/statistics/TierOperationOutcomes.java
* /ehcache-3-8-1-sources-jar/org/ehcache/jsr107/Eh107IdentityCopier.java
* /ehcache-3-8-1-sources-jar/org/ehcache/jsr107/Eh107CacheStatisticsMXBean.java
* /ehcache-3-8-1-sources-jar/org/ehcache/event/EventFiring.java
* /ehcache-3-8-1-sources-jar/org/ehcache/core/CacheConfigurationProperty.java
* /ehcache-3-8-1-sources-jar/org/ehcache/impl/internal/events/StoreEvents.java
*
/ehcache-3-8-1-sources-
jar/org/ehcache/impl/config/loaderwriter/writebehind/WriteBehindProviderConfiguration.java
* /ehcache-3-8-1-sources-jar/org/ehcache/core/statistics/DefaultStatisticsService.java
* /ehcache-3-8-1-sources-jar/org/ehcache/core/store/StoreSupport.java
* /ehcache-3-8-1-sources-jar/org/ehcache/jsr107/Eh107CacheLoaderWriter.java
* /ehcache-3-8-1-sources-jar/org/ehcache/impl/internal/loaderwriter/writebehind/operations/BatchOperation.java
* /ehcache-3-8-1-sources-jar/org/ehcache/core/statistics/DefaultTierStatistics.java
* /ehcache-3-8-1-sources-jar/org/ehcache/jsr107/Eh107CacheLoaderWriterProvider.java

* /ehcache-3-8-1-sources-jar/org/ehcache/impl/persistence/DefaultDiskResourceService.java
* /ehcache-3-8-1-sources-jar/org/ehcache/core/config/DefaultConfiguration.java
* /ehcache-3-8-1-sources-jar/org/ehcache/core/spi/package-info.java
* /ehcache-3-8-1-sources-jar/org/ehcache/impl/internal/executor/OnDemandExecutionService.java
*
 /ehcache-3-8-1-sources-jar/org/ehcache/impl/internal/store/tiering/TieredStore.java
* /ehcache-3-8-1-sources-jar/org/ehcache/core/util/ClassLoading.java
* /ehcache-3-8-1-sources-jar/org/ehcache/config/CacheRuntimeConfiguration.java
* /ehcache-3-8-1-sources-jar/org/ehcache/impl/events/CacheEventDispatcherImpl.java
* /ehcache-3-8-1-sources-jar/org/ehcache/expiry/ExpiryPolicy.java
* /ehcache-3-8-1-sources-jar/org/ehcache/impl/internal/store/heap/holders/OnHeapValueHolder.java
* /ehcache-3-8-1-sources-jar/org/ehcache/xml/XmlConfiguration.java
* /ehcache-3-8-1-sources-jar/org/ehcache/core/statistics/DelegatedMappedOperationStatistics.java
* /ehcache-3-8-1-sources-jar/org/ehcache/impl/internal/sizeof/NoopSizeOfEngine.java
* /ehcache-3-8-1-sources-jar/org/ehcache/core/statistics/LowerCachingTierOperationsOutcome.java
* /ehcache-3-8-1-sources-jar/org/ehcache/core/Ehcache.java
* /ehcache-3-8-1-sources-jar/org/ehcache/impl/config/serializer/DefaultSerializerConfiguration.java
* /ehcache-3-8-1-sources-jar/org/ehcache/impl/internal/loaderwriter/writebehind/AbstractWriteBehind.java
*
 /ehcache-3-8-1-sources-jar/org/ehcache/impl/internal/events/AbstractStoreEventDispatcher.java
* /ehcache-3-8-1-sources-jar/org/ehcache/core/spi/store/heap/package-info.java
* /ehcache-3-8-1-sources-jar/org/ehcache/impl/store/HashUtils.java
* /ehcache-3-8-1-sources-jar/org/ehcache/core/config/store/StoreEventSourceConfiguration.java
* /ehcache-3-8-1-sources-jar/org/ehcache/xml/provider/DefaultCopyProviderConfigurationParser.java
* /ehcache-3-8-1-sources-jar/org/ehcache/impl/internal/events/DisabledCacheEventNotificationService.java
* /ehcache-3-8-1-sources-jar/org/ehcache/config/SizedResourcePool.java
* /ehcache-3-8-1-sources-jar/org/ehcache/impl/internal/events/StoreEventImpl.java
* /ehcache-3-8-1-sources-jar/org/ehcache/jsr107/config/Jsr107CacheConfiguration.java
* /ehcache-3-8-1-sources-jar/org/ehcache/spi/service/ServiceProvider.java
* /ehcache-3-8-1-sources-jar/org/ehcache/xml/provider/CacheEventDispatcherFactoryConfigurationParser.java
*
 /ehcache-3-8-1-sources-jar/org/ehcache/core/events/EventListenerWrapper.java
* /ehcache-3-8-1-sources-jar/org/ehcache/core/statistics/CachingTierOperationOutcomes.java
* /ehcache-3-8-1-sources-jar/org/ehcache/xml/DomUtil.java
* /ehcache-3-8-1-sources-jar/org/ehcache/core/config/store/StoreStatisticsConfiguration.java
* /ehcache-3-8-1-sources-jar/org/ehcache/core/SpecIterator.java
* /ehcache-3-8-1-sources-jar/org/ehcache/config/Configuration.java
* /ehcache-3-8-1-sources-jar/org/ehcache/impl/serialization/IntegerSerializer.java
* /ehcache-3-8-1-sources-jar/org/ehcache/expiry/package-info.java
* /ehcache-3-8-1-sources-jar/org/ehcache/core/statistics/SuppliedValueStatistic.java
* /ehcache-3-8-1-sources-jar/org/ehcache/spi/copy/Copier.java
* /ehcache-3-8-1-sources-jar/org/ehcache/config/ResourcePools.java
* /ehcache-3-8-1-sources-jar/org/ehcache/impl/internal/util/Pacer.java
* /ehcache-3-8-1-sources-jar/org/ehcache/impl/internal/store/disk/OffHeapDiskStore.java
*
 /ehcache-3-8-1-sources-jar/org/ehcache/config/EvictionAdvisor.java
* /ehcache-3-8-1-sources-jar/org/ehcache/core/PersistentUserManagedEhcache.java
* /ehcache-3-8-1-sources-jar/org/ehcache/Status.java

* /ehcache-3-8-1-sources-jar/org/ehcache/impl/internal/store/basic/NopStore.java
* /ehcache-3-8-1-sources-jar/org/ehcache/impl/internal/TimeSourceConfiguration.java
* /ehcache-3-8-1-sources-jar/org/ehcache/xml/ServiceCreationConfigurationParser.java
* /ehcache-3-8-1-sources-jar/org/ehcache/impl/config/event/DefaultEventSourceConfiguration.java
* /ehcache-3-8-1-sources-jar/org/ehcache/PersistentUserManagedCache.java
* /ehcache-3-8-1-sources-jar/org/ehcache/impl/internal/store/heap/holders/OnHeapKey.java
* /ehcache-3-8-1-sources-jar/org/ehcache/jsr107/Eh107CompleteConfiguration.java
* /ehcache-3-8-1-sources-jar/org/ehcache/spi/service/PluralService.java
* /ehcache-3-8-1-sources-jar/org/ehcache/config/builders/UserManagedCacheBuilder.java
* /ehcache-3-8-1-sources-jar/org/ehcache/jsr107/Eh107Configuration.java
*
/ehcache-3-8-1-sources-jar/org/ehcache/config/Builder.java
* /ehcache-3-8-1-sources-jar/org/ehcache/impl/config/copy/DefaultCopierConfiguration.java
* /ehcache-3-8-1-sources-jar/org/ehcache/xml/ResourceConfigurationParser.java
* /ehcache-3-8-1-sources-jar/org/ehcache/core/HumanReadable.java
* /ehcache-3-8-1-sources-jar/org/ehcache/impl/internal/store/tiering/TieredStoreProviderFactory.java
* /ehcache-3-8-1-sources-jar/org/ehcache/xml/BaseConfigParser.java
* /ehcache-3-8-1-sources-jar/org/ehcache/impl/internal/spi/serialization/DefaultSerializationProvider.java
* /ehcache-3-8-1-sources-jar/org/ehcache/core/spi/store/heap/LimitExceededException.java
* /ehcache-3-8-1-sources-jar/org/ehcache/impl/config/store/heap/DefaultSizeOfEngineConfiguration.java
* /ehcache-3-8-1-sources-jar/org/ehcache/impl/internal/store/offheap/LazyOffHeapValueHolder.java
* /ehcache-3-8-1-sources-jar/org/ehcache/config/units/MemoryUnit.java
* /ehcache-3-8-1-sources-jar/org/ehcache/impl/internal/events/FireableStoreEventHolder.java
*
/ehcache-3-8-1-sources-jar/org/ehcache/xml/CacheManagerServiceConfigurationParser.java
* /ehcache-3-8-1-sources-
jar/org/ehcache/impl/internal/loaderwriter/writebehind/BatchingLocalHeapWriteBehindQueue.java
* /ehcache-3-8-1-sources-jar/org/ehcache/xml/JaxbHelper.java
* /ehcache-3-8-1-sources-jar/org/ehcache/impl/internal/store/loaderwriter/LocalWriteBehindLoaderWriterStore.java
* /ehcache-3-8-1-sources-jar/org/ehcache/core/statistics/CacheOperationOutcomes.java
* /ehcache-3-8-1-sources-jar/org/ehcache/core/util/CollectionUtil.java
* /ehcache-3-8-1-sources-jar/org/ehcache/core/spi/service/FileBasedPersistenceContext.java
* /ehcache-3-8-1-sources-jar/org/ehcache/core/statistics/CacheStatistics.java
* /ehcache-3-8-1-sources-jar/org/ehcache/core/statistics/Jsr107LatencyMonitor.java
* /ehcache-3-8-1-sources-jar/org/ehcache/impl/internal/util/ThreadFactoryUtil.java
* /ehcache-3-8-1-sources-jar/org/ehcache/core/spi/store/ConfigurationChangeSupport.java
*
/ehcache-3-8-1-sources-jar/org/ehcache/config/builders/ResourcePoolsBuilder.java
* /ehcache-3-8-1-sources-jar/org/ehcache/core/spi/time/package-info.java
* /ehcache-3-8-1-sources-jar/org/ehcache/xml/exceptions/XmlConfigurationException.java
* /ehcache-3-8-1-sources-jar/org/ehcache/impl/internal/store/heap/KeyCopyBackend.java
* /ehcache-3-8-1-sources-jar/org/ehcache/impl/internal/store/disk/factories/EhcachePersistentSegmentFactory.java
* /ehcache-3-8-1-sources-jar/org/ehcache/jsr107/internal/WrappedCacheLoaderWriter.java
* /ehcache-3-8-1-sources-jar/org/ehcache/core/spi/store/tiering/HigherCachingTier.java
* /ehcache-3-8-1-sources-jar/org/ehcache/core/spi/time/SystemTimeSource.java
* /ehcache-3-8-1-sources-jar/org/ehcache/core/spi/store/tiering/package-info.java
* /ehcache-3-8-1-sources-jar/org/ehcache/jsr107/internal/Jsr107ServiceConfigurationParser.java
* /ehcache-3-8-1-sources-jar/org/ehcache/impl/config/store/heap/DefaultSizeOfEngineProviderConfiguration.java

*
 /ehcache-3-8-1-sources-jar/org/ehcache/impl/internal/store/offheap/OffHeapStoreUtils.java
* /ehcache-3-8-1-sources-jar/org/ehcache/spi/loaderwriter/CacheLoaderWriterConfiguration.java
* /ehcache-3-8-1-sources-jar/org/ehcache/spi/copy/CopyProvider.java
* /ehcache-3-8-1-sources-jar/org/ehcache/core/osgi/OsgiServiceLoader.java
* /ehcache-3-8-1-sources-jar/org/ehcache/core/spi/store/events/StoreEvent.java
* /ehcache-3-8-1-sources-jar/org/ehcache/impl/internal/store/loaderwriter/LoaderWriterValueHolder.java
* /ehcache-3-8-1-sources-jar/org/ehcache/jsr107/config/package-info.java
* /ehcache-3-8-1-sources-jar/org/ehcache/impl/internal/spi/event/DefaultCacheEventListenerProvider.java
* /ehcache-3-8-1-sources-jar/org/ehcache/impl/internal/store/heap/OnHeapStoreProviderFactory.java
* /ehcache-3-8-1-sources-jar/org/ehcache/core/spi/service/DiskResourceService.java
* /ehcache-3-8-1-sources-jar/org/ehcache/jsr107/ConfigurationMerger.java
* /ehcache-3-8-1-sources-jar/org/ehcache/impl/internal/executor/OutOfBandScheduledExecutor.java
*
 /ehcache-3-8-1-sources-jar/org/ehcache/jsr107/Eh107MXBean.java
* /ehcache-3-8-1-sources-jar/org/ehcache/impl/internal/store/disk/OffHeapDiskStoreProviderFactory.java
* /ehcache-3-8-1-sources-jar/org/ehcache/impl/config/store/disk/OffHeapDiskStoreConfiguration.java
* /ehcache-3-8-1-sources-jar/org/ehcache/config/FluentCacheConfigurationBuilder.java
* /ehcache-3-8-1-sources-jar/org/ehcache/xml/provider/OffHeapDiskStoreProviderConfigurationParser.java
* /ehcache-3-8-1-sources-jar/org/ehcache/CacheManager.java
* /ehcache-3-8-1-sources-jar/org/ehcache/spi/service/ServiceDependencies.java
* /ehcache-3-8-1-sources-jar/org/ehcache/core/statistics/OperationObserver.java
* /ehcache-3-8-1-sources-jar/org/ehcache/impl/internal/store/offheap/EhcacheConcurrentOffHeapClockCache.java
* /ehcache-3-8-1-sources-jar/org/ehcache/spi/serialization/UnsupportedTypeException.java
* /ehcache-3-8-1-sources-jar/org/ehcache/jsr107/Eh107ReverseConfiguration.java
* /ehcache-3-8-1-sources-jar/org/ehcache/impl/internal/store/heap/OnHeapStrategy.java
*
 /ehcache-3-8-1-sources-
jar/org/ehcache/impl/config/loaderwriter/DefaultCacheLoaderWriterProviderConfiguration.java
* /ehcache-3-8-1-sources-
jar/org/ehcache/impl/internal/store/disk/EhcachePersistentConcurrentOffHeapClockCache.java
* /ehcache-3-8-1-sources-jar/org/ehcache/CachePersistenceException.java
* /ehcache-3-8-1-sources-jar/org/ehcache/core/config/store/package-info.java
* /ehcache-3-8-1-sources-jar/org/ehcache/impl/internal/loaderwriter/writebehind/WriteBehindProviderFactory.java
* /ehcache-3-8-1-sources-jar/org/ehcache/impl/internal/store/offheap/BinaryOffHeapValueHolder.java
* /ehcache-3-8-1-sources-jar/org/ehcache/xml/service/DefaultCacheEventListenerConfigurationParser.java
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* /ehcache-3-8-1-sources-jar/org/ehcache/core/statistics/DelegatingOperationObserver.java
* /ehcache-3-8-1-sources-jar/org/ehcache/xml/service/DefaultWriteBehindConfigurationParser.java
* /ehcache-3-8-1-sources-jar/org/ehcache/xml/CoreCacheConfigurationParser.java
* /ehcache-3-8-1-sources-jar/org/ehcache/impl/config/loaderwriter/package-info.java
* /ehcache-3-8-1-sources-jar/org/ehcache/impl/internal/resilience/AbstractResilienceStrategy.java
* /ehcache-3-8-1-sources-jar/org/ehcache/core/statistics/StatsUtils.java
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* /ehcache-3-8-1-sources-jar/org/ehcache/core/statistics/DefaultCacheStatistics.java
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* /ehcache-3-8-1-sources-jar/org/ehcache/impl/internal/store/offheap/OffHeapStore.java
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* /ehcache-3-8-1-sources-jar/org/ehcache/event/package-info.java
* /ehcache-3-8-1-sources-jar/org/ehcache/jsr107/internal/Jsr107CacheLoaderWriter.java
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* /ehcache-3-8-1-sources-jar/org/ehcache/core/osgi/SafeOsgi.java
* /ehcache-3-8-1-sources-jar/org/ehcache/event/CacheEvent.java
* /ehcache-3-8-1-sources-jar/org/ehcache/spi/serialization/SerializerException.java
* /ehcache-3-8-1-sources-jar/org/ehcache/impl/internal/store/loaderwriter/LocalLoaderWriterStore.java
* /ehcache-3-8-1-sources-jar/org/ehcache/core/statistics/LatencyHistogramConfiguration.java
* /ehcache-3-8-1-sources-jar/org/ehcache/impl/config/event/DefaultCacheEventDispatcherConfiguration.java
* /ehcache-3-8-1-sources-jar/org/ehcache/core/spi/service/package-info.java
* /ehcache-3-8-1-sources-jar/org/ehcache/jsr107/Eh107CacheEntryEvent.java
* /ehcache-3-8-1-sources-jar/org/ehcache/impl/internal/spi/event/DefaultCacheEventListenerProviderFactory.java
* /ehcache-3-8-1-sources-jar/org/ehcache/expiry/Expiry.java
* /ehcache-3-8-1-sources-jar/org/ehcache/impl/internal/spi/copy/DefaultCopyProvider.java
*
/ehcache-3-8-1-sources-jar/org/ehcache/jsr107/CacheResources.java
* /ehcache-3-8-1-sources-jar/org/ehcache/spi/loaderwriter/WriteBehindConfiguration.java
* /ehcache-3-8-1-sources-jar/org/ehcache/impl/internal/store/disk/DiskWriteThreadPool.java
* /ehcache-3-8-1-sources-jar/org/ehcache/core/EhcacheRuntimeConfiguration.java
* /ehcache-3-8-1-sources-jar/org/ehcache/impl/config/event/DefaultCacheEventListenerConfiguration.java
* /ehcache-3-8-1-sources-jar/org/ehcache/core/spi/store/heap/SizeOfEngineProvider.java
* /ehcache-3-8-1-sources-jar/org/ehcache/core/statistics/StoreOperationOutcomes.java
* /ehcache-3-8-1-sources-jar/org/ehcache/impl/internal/sizeof/DefaultSizeOfEngineProviderFactory.java
* /ehcache-3-8-1-sources-jar/org/ehcache/core/statistics/DefaultStatisticsServiceFactory.java
* /ehcache-3-8-1-sources-jar/org/ehcache/xml/provider/WriteBehindProviderConfigurationParser.java
* /ehcache-3-8-1-sources-jar/org/ehcache/core/spi/service/CacheManagerProviderService.java
*
/ehcache-3-8-1-sources-jar/org/ehcache/xml/service/OffHeapDiskStoreConfigurationParser.java
* /ehcache-3-8-1-sources-jar/org/ehcache/impl/internal/loaderwriter/writebehind/operations/WriteOperation.java
* /ehcache-3-8-1-sources-jar/org/ehcache/core/EhcacheManager.java
* /ehcache-3-8-1-sources-jar/org/ehcache/xml/CoreServiceCreationConfigurationParser.java
* /ehcache-3-8-1-sources-jar/org/ehcache/ValueSupplier.java
* /ehcache-3-8-1-sources-jar/org/ehcache/impl/config/SizedResourcePoolImpl.java
* /ehcache-3-8-1-sources-jar/org/ehcache/impl/internal/store/tiering/CompoundCachingTierProviderFactory.java
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Found in path(s):
* /ehcache-3-8-1-sources-jar/ehcache-multi.xsd
* /ehcache-3-8-1-sources-jar/ehcache-core.xsd
* /ehcache-3-8-1-sources-jar/ehcache-107-ext.xsd
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Found in path(s):
* /ehcache-3-8-1-sources-jar/META-INF/maven/org.ehcache.modules/ehcache-impl/pom.xml
* /ehcache-3-8-1-sources-jar/META-INF/maven/org.ehcache.modules/ehcache-api/pom.xml
* /ehcache-3-8-1-sources-jar/META-INF/maven/org.ehcache.modules/ehcache-xml/pom.xml
* /ehcache-3-8-1-sources-jar/META-INF/maven/org.ehcache.modules/ehcache-107/pom.xml
* /ehcache-3-8-1-sources-jar/META-INF/maven/org.ehcache.modules/ehcache-core/pom.xml
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#

org.ehcache.jsr107.internal.Jsr107CacheConfigurationParser

Found in path(s):
* /ehcache-3-8-1-sources-jar/META-INF/services/org.ehcache.xml.CacheServiceConfigurationParser

1.419 activation 1.2.2

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1.420 py 1.8.0

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1.421 gzip 1.10-0ubuntu4.1

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1.423 spring-data-jpa 2.3.3.RELEASE

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1.425 urllib3 1.25.3

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Contributions to the urllib3 project

Creator & Maintainer

* Andrey Petrov <andrey.petrov@shazow.net>

Contributors

In chronological order:

* victor.vde <http://code.google.com/u/victor.vde/>
 * HTTPS patch (which inspired HTTPSConnectionPool)

* erikcederstrand <http://code.google.com/u/erikcederstrand/>
 * NTLM-authenticated HTTPSConnectionPool
 * Basic-authenticated HTTPSConnectionPool (merged into make_headers)

* niphlod <niphlod@gmail.com>
 * Client-verified SSL certificates for HTTPSConnectionPool
 * Response gzip and deflate encoding support
 * Better unicode support for filepost using StringIO buffers

* btoconnor <brian@btoconnor.net>
 * Non-multipart encoding for POST requests

* p.dobrogost <http://code.google.com/u/@WBRSRlBZDhBFXQB6/>
 * Code review, PEP8 compliance, benchmark fix

* kennethreitz <me@kennethreitz.com>
 * Bugfixes, suggestions, Requests integration

* georgemarshall <https://github.com/georgemarshall>
 * Bugfixes, Improvements and Test
 coverage

* Thomas Kluyver <thomas@kluyver.me.uk>
 * Python 3 support

* brandon-rhodes <http://rhodesmill.org/brandon>
 * Design review, bugfixes, test coverage.

* studer <theo.studer@gmail.com>
 * IPv6 url support and test coverage

* Shivaram Lingamneni <slingamn@cs.stanford.edu>
 * Support for explicitly closing pooled connections

* hartator <hartator@gmail.com>
 * Corrected multipart behavior for params

* Thomas Weischuh <thomas@t-8ch.de>
 * Support for TLS SNI
 * API unification of ssl_version/cert_reqs
 * SSL fingerprint and alternative hostname verification
 * Bugfixes in testsuite

* Sune Kirkeby <mig@ibofobi.dk>
 * Optional SNI-support for Python 2 via PyOpenSSL.

* Marc Schlaich <marc.schlaich@gmail.com>
 * Various bugfixes and test improvements.

* Bryce Boe <bbzbryce@gmail.com>
 * Correct six.moves conflict
 * Fixed pickle support of some exceptions

* Boris Figovsky <boris.figovsky@ravellosystems.com>
 * Allowed to skip SSL hostname verification

* Cory Benfield
 <https://lukasa.co.uk/about/>
 * Stream method for Response objects.
 * Return native strings in header values.
 * Generate 'Host' header when using proxies.

* Jason Robinson <jaywink@basshero.org>
 * Add missing WrappedSocket.fileno method in PyOpenSSL

* Audrius Butkevicius <audrius.butkevicius@elastichosts.com>
 * Fixed a race condition

* Stanislav Vitkovskiy <stas.vitkovsky@gmail.com>
 * Added HTTPS (CONNECT) proxy support

* Stephen Holsapple <sholsapp@gmail.com>
 * Added abstraction for granular control of request fields

* Martin von Gagern <Martin.vGagern@gmx.net>
 * Support for non-ASCII header parameters

* Kevin Burke <kev@inburke.com> and Pavel Kirichenko <juanych@yandex-team.ru>
 * Support for separate connect and request timeouts

* Peter Waller <p@pwaller.net>
 * HTTPResponse.tell() for determining amount received over the wire

* Nipunn Koorapati <nipunn1313@gmail.com>
 * Ignore default ports when comparing hosts for equality

* Danilo @dbrgn <https://dbrgn.ch/>
  * Disabled TLS compression by default on Python 3.2+
 * Disabled TLS compression in pyopenssl contrib module
 * Configurable cipher suites in pyopenssl contrib module

* Roman Bogorodskiy <roman.bogorodskiy@ericsson.com>
 * Account retries on proxy errors

* Nicolas Delaby <nicolas.delaby@ezeep.com>
 * Use the platform-specific CA certificate locations

* Josh Schneier <https://github.com/jschneier>
 * HTTPHeaderDict and associated tests and docs
 * Bugfixes, docs, test coverage

* Tahia Khan <http://tahia.tk/>
 * Added Timeout examples in docs

* Arthur Grunseid <https://grunseid.com>
 * source_address support and tests (with https://github.com/bui)

* Ian Cordasco <graffatcolmingov@gmail.com>
 * PEP8 Compliance and Linting
 * Add ability to pass socket options to an HTTP Connection

* Erik Tollerud <erik.tollerud@gmail.com>
 * Support for standard library io module.

* Krishna Prasad <kprasad.iitd@gmail.com>
 * Google App Engine documentation

* Aaron Meurer
 <asmeurer@gmail.com>
 * Added Url.url, which unparses a Url

* Evgeny Kapun <abacabadabacaba@gmail.com>
 * Bugfixes

* Benjamen Meyer <bm_witness@yahoo.com>
 * Security Warning Documentation update for proper capture

* Shivan Sornarajah <github@sornars.com>
 * Support for using ConnectionPool and PoolManager as context managers.

* Alex Gaynor <alex.gaynor@gmail.com>
 * Updates to the default SSL configuration

* Tomas Tomecek <ttomecek@redhat.com>
 * Implemented generator for getting chunks from chunked responses.

* tlynn <https://github.com/tlynn>
 * Respect the warning preferences at import.

* David D. Riddle <ddriddle@illinois.edu>
 * IPv6 bugfixes in testsuite

* Thea Flowers <magicalgirl@google.com>
 * App Engine environment tests.
 * Documentation re-write.

* John Krauss <https://github.com/talos>
 * Clues to debugging problems with `cryptography` dependency in docs

* Disassem <https://github.com/Disassem>
 * Fix pool-default headers not applying for url-encoded
 requests like GET.

* James Atherfold <jlatherfold@hotmail.com>
 * Bugfixes relating to cleanup of connections during errors.

* Christian Pedersen <https://github.com/chripede>
 * IPv6 HTTPS proxy bugfix

* Jordan Moldow <https://github.com/jmoldow>
 * Fix low-level exceptions leaking from ``HTTPResponse.stream()``.
 * Bugfix for ``ConnectionPool.urlopen(release_conn=False)``.
 * Creation of ``HTTPConnectionPool.ResponseCls``.

* Predrag Gruevski <https://github.com/obi1kenobi>
 * Made cert digest comparison use a constant-time algorithm.

* Adam Talsma <https://github.com/a-tal>
 * Bugfix to ca_cert file paths.

* Evan Meagher <https://evanmeagher.net>
 * Bugfix related to `memoryview` usage in PyOpenSSL adapter

* John Vandenberg <jayvdb@gmail.com>
 * Python 2.6 fixes; pyflakes and pep8 compliance

* Andy Caldwell <andy.m.caldwell@googlemail.com>
 * Bugfix related to reusing connections in indeterminate states.

* Ville Skytt <ville.skytta@iki.fi>
 * Logging efficiency
 improvements, spelling fixes, Travis config.

* Shige Takeda <smtakeda@gmail.com>
 * Started Recipes documentation and added a recipe about handling concatenated gzip data in HTTP response

* Jess Shapiro <jesse@jesseshapiro.net>

 * Various character-encoding fixes/tweaks
 * Disabling IPv6 DNS when IPv6 connections not supported

* David Foster <http://dafoster.net/>
 * Ensure order of request and response headers are preserved.

* Jeremy Cline <jeremy@jcline.org>
 * Added connection pool keys by scheme

* Aviv Palivoda <palaviv@gmail.com>
 * History list to Retry object.
 * HTTPResponse contains the last Retry object.

* Nate Prewitt <nate.prewitt@gmail.com>
 * Ensure timeouts are not booleans and greater than zero.
 * Fixed infinite loop in ``stream`` when amt=None.
 * Added length_remaining to determine remaining data to be read.
 * Added enforce_content_length to raise exception when incorrect content-length received.

* Seth Michael Larson <sethmichaellarson@protonmail.com>
  * Created selectors backport that supports PEP 475.

* Alexandre Dias <alex.dias@smarkets.com>
 * Don't retry on timeout if method not in whitelist

* Moinuddin Quadri <moin18@gmail.com>
 * Lazily load idna package

* Tom White <s6yg1ez3@mail2tor.com>
 * Made SOCKS handler differentiate socks5h from socks5 and socks4a from socks4.

* Tim Burke <tim.burke@gmail.com>
 * Stop buffering entire deflate-encoded responses.

* Tuukka Mustonen <tuukka.mustonen@gmail.com>
 * Add counter for status_forcelist retries.

* Erik Rose <erik@mozilla.com>
 * Bugfix to pyopenssl vendoring

* Wolfgang Richter <wolfgang.richter@gmail.com>
 * Bugfix related to loading full certificate chains with PyOpenSSL backend.

* Mike Miller <github@mikeage.net>
 * Logging improvements to include the HTTP(S) port when opening a new connection

* Ioannis Tziakos <mail@itziakos.gr>
 * Fix ``util.selectors._fileobj_to_fd`` to accept ``long``.

* Update appveyor tox setup to use the 64bit python.

* Akamai
(through Jess Shapiro) <jshapiro@akamai.com>
* Ongoing maintenance; 2017-2018

* Dominique Leuenberger <dimstar@opensuse.org>
* Minor fixes in the test suite

* Will Bond <will@wbond.net>
* Add Python 2.6 support to ``contrib.securetransport``

* Aleksei Alekseev <alekseev.yeskela@gmail.com>
* using auth info for socks proxy

* Chris Wilcox <git@crwilcox.com>
* Improve contribution guide
* Add ``HTTPResponse.geturl`` method to provide ``urllib2.urlopen().geturl()`` behavior

* Bruce Merry <https://www.brucemerry.org.za>
* Fix leaking exceptions when system calls are interrupted with zero timeout

* Hugo van Kemenade <https://github.com/hugovk>
* Drop support for EOL Python 2.6

* Tim Bell <https://github.com/timb07>
* Bugfix for responses with Content-Type: message/* logging warnings

* Justin Bramley <https://github.com/jbramleycl>
* Add ability to handle multiple Content-Encodings

* Katsuhiko YOSHIDA <https://github.com/kyoshidajp>
* Remove Authorization header
regardless of case when redirecting to cross-site

* [Your name or handle] <[email or website]>
* [Brief summary of your changes]

1.426 byte-buddy 1.10.14

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1.427 dom4j 2.1.3

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* /dom4j-2-1-3-sources-jar/org/dom4j/CDATA.java
* /dom4j-2-1-3-sources-jar/org/dom4j/Document.java
* /dom4j-2-1-3-sources-jar/org/dom4j/rule/Action.java
* /dom4j-2-1-3-sources-jar/org/dom4j/Comment.java
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* /dom4j-2-1-3-sources-jar/org/dom4j/tree/FlyweightCDATA.java
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* /dom4j-2-1-3-sources-jar/org/dom4j/tree/NamespaceCache.java
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* /dom4j-2-1-3-sources-jar/org/dom4j/tree/DefaultDocumentType.java
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* /dom4j-2-1-3-sources-jar/org/dom4j/io/XPPReader.java
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 /dom4j-2-1-3-sources-jar/org/dom4j/datatype/InvalidSchemaException.java
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1.430 logback-core 1.2.3

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1.431 flyway-test 6.4.0

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1.432 importlib-metadata 0.18

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